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A Meta-Analytic Review of Gender Differences in ADHD

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The present study examined gender differences in ADHD through a meta-analysis. Effect size estimates for the primary symptoms and correlates of ADHD were calculated in an attempt to replicate and extend a previous meta-analysis on gender differences in the disorder. Relatively lenient inclusion criteria were used in order to maximize the number of studies included in the effect sizes.

The results indicated that in comparison to ADHD boys, ADHD girls had lower ratings on hyperactivity, inattention, impulsivity, and externalizing problems. In addition, ADHD girls had greater intellectual impairments and more internalizing problems than ADHD boys. Overall, the results of the current meta-analysis indicated general agreement with the previous meta-analysis. The clinical implications of these gender differences and future research considerations are discussed.

With prevalence estimates of ADHD usually ranging from 3% to 5% (American Psychiatric Association, 1994), ADHD clearly affects a large segment of the general population. The study of ADHD has generated considerable literature on almost every facet of the disorder, including possible causes, diagnosis, and treatment. Despite its reputation as one of the most comprehensively studied childhood mental disorders (Arnold, 1996; Barkley, 1998), much of the research on ADHD has tended to focus on an overly homogeneous sample of subjects: clinically-referred Caucasian males. The ability of ADHD researchers to generalize findings to females and the larger population is severely restricted by this limited subject pool. Furthermore, the lack of information on ADHD females has led to problems with the identification and treatment of these individuals.

The recruitment of ADHD females has proven to be a formidable task since far fewer females than males are evaluated at clinics for ADHD (Arnold, 1996). Epidemiological studies of ADHD have estimated that gender differences in the disorder range from 3:1 (Szatmari, Offord, & Boyle, 1989), whereas reports from clinically-referred samples have estimated a ratio closer to 9:1 (American Psychiatric Association, 1994). This discrepancy in prevalence suggests that clinical settings treat far fewer ADHD females than males (Gomez, Harvey, Quick, Scharer, & Harris, 1999). Based on studies of community samples, a large number of females and males should meet criteria for ADHD, yet females are rarely identified in clinical studies. This lack of information on ADHD females has potentially serious public health implications since long-term problems for the disorder include social, academic, and emotional difficulties (Arnold, 1996; McGee & Feehan, 1991).

ADHD females represent a "silent minority" as a result of their manifestation of the disorder (Berry, Shaywitz, & Shaywitz, 1985). Specifically, since ADHD females display less disruptive behavior than ADHD males (Achenbach, 1991) they are more likely to be ignored if they only display inattentive behaviors (Gaub & Carlson, 1997). ADHD clinics typically receive a higher number of referrals for ADHD males due to their greater likelihood of disruption in settings such as school. Thus, clinically referred females likely exhibit particularly disruptive behavior but may not represent most females with the disorder. An understanding of gender differences in ADHD is critical for disseminating the manifestation and identification of the disorder.

In an effort to summarize the existing literature and enhance the understanding of gender differences in ADHD, Gaub and Carlson (1997) conducted the first meta-analysis on gender differences in ADHD. They found that in comparison to ADHD boys, ADHD girls had greater intellectual impairments, lower ratings on hyperactivity, and lower ratings of externalizing and internalizing problems. Gaub and Carlson discovered, however, that some of these gender differences could be accounted for by moderator variables such as referral source (clinic vs. community samples) or the diagnostic system used by the researcher.

The meta-analysis by Gaub and Carlson (1997) provided the first quantitative summary on gender differences in ADHD. A number of methodological problems, however, may have affected their conclusions. First, the authors used stringent inclusion criteria that resulted in a total of only 18 possible studies for the analysis. Furthermore, within each of the dependent variables that they examined for sex differences, their analyses contained even fewer studies

(range from 1–12 studies). Second, Gaub and Carlson included only one unpublished study in their analyses. The exclusion of unpublished data may have resulted in a "file-drawer" problem (Rosenthal, 1991). Since negative findings are published less often than positive findings, inclusion of unpublished data might alter the magnitude and/or direction of the effect size. Finally, although the meta-analysis was published in 1997, all of the included studies were conducted prior to 1992. Since that time, the diagnostic criteria have changed with the publication of *DSM-IV*, and enhanced efforts have been made to include females in studies of ADHD (Arnold, 1996).

The current analysis was thus undertaken for two primary reasons. First, while relatively little data exist on gender differences in ADHD, an updated quantitative summary would aid ADHD researchers and clinicians in their efforts to understand, diagnose, and treat affected individuals. A secondary rationale for the current analysis was to compare the results to the previous meta-analysis on gender differences in ADHD. In particular, the current meta-analysis would assess methodological changes, such as modifications in inclusion criteria. Also, the addition of more recent studies on gender differences in ADHD might have implications regarding the findings and conclusions of the Gaub and Carlson (1997) study. A number of potential moderators were selected for examination in order to determine if these variables affected the magnitude and/or direction of the effect sizes for gender differences in ADHD (Baron & Kenny, 1986). These moderator variables include sex of the first author, publication status, referral source, rater, whether IQ was assessed, age of subjects, diagnostic system used, and inclusion in the previous meta-analysis. These moderator variables are discussed in more detail below.

Method

Search Strategy

The author used several means to identify relevant reports that examined ADHD and gender differences. First, computerized databases such as PsychINFO, Medline, and Dissertation Abstracts International were searched using the keywords *ADHD*, *ADD*, and *Hyperkinesis* crossed with the keywords *Sex Differences* and *Gender Differences*. Second, the author obtained and examined all articles used in the Gaub and Carlson (1997) meta-analysis. In order to find potentially relevant research omitted from the computer search, the author also examined all reference sections from the obtained studies. Finally, the author contacted major ADHD researchers by e-mail to locate additional unpublished material.

Inclusion Criteria

Studies in the current analysis had to meet all of the following inclusion criteria:

1. Subjects had to receive a diagnosis of ADHD with an explanation of how the diagnosis was made.

2. The study had to directly compare ADHD males and females on relevant variables.

3. Sufficient data were provided in the text or by the author(s) to calculate an effect size.

In order to determine if inclusion criteria influenced the previous results, the current analysis contained specifically less stringent criteria than those in the Gaub and Carlson (1997) paper. The inclusion criteria from the previous meta-analysis not used in this study consisted of a minimum sample size of 10 subjects per group, subjects aged 13 and younger, and a measured IQ greater than 80. The current analysis treated the Gaub and Carlson inclusion criteria in two manners. First, the current analysis corrected all effect sizes by a weighting factor for sample size. Second, whether or not IQ was assessed and the age of subjects were analyzed as potential moderator variables.

The search strategy yielded a total of 120 potential articles for the analyses. Thirty-eight articles provided sufficient data for inclusion in the analyses. From these articles, 13 were included in the previous review (Barkley, 1989; Befera & Barkley, 1985; Berry et al., 1985; Breen, 1989; Breen & Altepeter, 1990; Breen & Barkley, 1988; Brown, Madan-Swain, & Baldwin, 1991; deHaas, 1986; Horn, Wagner, & Ialongo, 1989; Kashani, Chapel, Ellis, & Shekim, 1979; Pelham & Bender, 1982; Pelham, Walker, Sturges, & Hoza, 1989; Thomeer, 1996), and 25 were additional studies (Ackerman, Dykman, & Oglesby, 1983; Arcia & Conners, 1998; Biederman et al., 1994; Carlson, Tamm, & Gaub, 1997; Dunn & Shapiro, 1999; Gabel, Schmitz, & Fulker, 1996; Hawn, 1979; James & Taylor, 1990; Katz, Goldstein, & Geckle, 1998; Mannuzza & Gittelman, 1984; McGee, Williams, & Silva, 1987; Miller, Palkes, & Stewart, 1973; Nada-Raja et al., 1997; Pascualvaca, 1989; Ramirez & Shapiro, 1998; Schaughency, McGee, Raja, Feehan, & Silva, 1994; Schireson, 1989; Schuerholz, Singer, & Denckla, 1998; Sharp et al., 1999; Shenberger, 1995; Silverthorn, Frick, Kuper, & Ott, 1996; Wiedenhoff, 1993).

In addition, two research reports conducted multiple studies under the rubric of a larger study. Specifically, Pascualvaca (1989) and Ramirez and Shapiro (1998) examined gender differences in ADHD with several independent samples within a larger study. Therefore, the current analysis treated these data as separate studies, as deemed appropriate by Hedges and Becker (1986). All other studies contributed only one effect size to each dependent variable. Further study characteristics are available upon request.

Statistical Analyses

Calculation of Effect Sizes

In this study, the effect sizes examined the magnitude and direction of the differences between ADHD males and females. For these analyses, the unbiased estimator *d* (Hedges & Olkin, 1985) was chosen for the calculation of effect sizes in the current analysis since it corrects for a discrepancy between the sample and population effect sizes. For the present analyses, positive effect sizes represented *higher* mean scores for males. Thus, positive effect sizes on primary symptoms represented greater impairment for males, whereas positive effect sizes on variables such as Full Scale IQ represented stronger performance for ADHD males.

Effect sizes were calculated using a number of software programs and by hand, according to formulas provided by Hedges and Olkin (1985), Hedges and Becker (1986), and Rosenthal (1991). If means and standard deviations were not provided in the text or by the author(s), effect sizes were estimated from t-values, χ^2-values, or F-values according to formulas provided by Rosenthal (1991, 1994). In order to determine the significance of the unbiased effect sizes, a 95% confidence interval was calculated. If a confidence interval did not contain zero, then the effect size was considered significant.

Combining Effect Sizes: The current analysis calculated unweighted and weighted grand effect sizes for each dependent variable of interest, which included primary ADHD symptoms, internalizing/externalizing problems, intelligence, academic achievement, neuropsychological functioning, and social functioning. The weighted effect sizes provided greater value to studies that used larger sample sizes, which tends to decrease the variance of the effect size estimator (Hedges & Olkin, 1985) and provides more reliable and valid results. As a result, only the weighted effect sizes estimates are reported.

Tests for Homogeneity of Effect Sizes: The assumption of homogeneity underlying the effect size estimate suggests that all individual effect sizes derive from a single population. This assumption was tested for all significant effect sizes with the *Q* statistic. If this value exceeded the a priori critical value (α = .05), then the effect size was considered homogeneous and the samples were examined for possible moderator variables. The potential moderator variables examined included sex of the first author, publication status, referral source, rater, whether IQ was assessed, age of subjects, diagnostic system used, and inclusion in the previous meta-analysis. These moderator variables were chosen because they reflect methodological differences between the two meta-analyses. Unfortunately, other potential moderator variables such as comorbid diagnoses or racial characteristics of subjects could not be analyzed because such information was rarely available in the existing literature. The effect sizes were regressed onto each contrast using weighted least squares regression analyses (Hedges & Olkin, 1985), and the equations were weighted by sample size. The moderator variables are described in more detail below.

Sex of First Author

The purpose of examining sex of first author as a moderator variable was to rule out any potential gender biases of the researchers. Eagley (1986) has noted that gender differences research is vulnerable to a number of potential biases, including author biases.

Publication Status

The meta-analysis included combinations of published and unpublished studies. All of the unpublished data in the analyses were either dissertations or theses not published for unknown reasons. Smith (1980) has reported that published studies tend to have higher effect sizes than unpublished studies. Therefore, exclusion of unpublished data can lead to a potential bias in effect sizes.

Referral Source

Gaub and Carlson (1997) found that some of the significant gender differences in their study could be accounted for by referral source (i.e., clinic or community samples). In general, children who were assessed from clinical samples tended to have much more impairment than community samples. Referral source allowed for the examination of gender differences based on ascertainment site of the subjects.

Rater

In many of the studies on ADHD, both parents and teachers rated subjects on symptoms of ADHD. Since differences were expected in these ratings, the rater (parent or teacher) was examined as a potential moderator variable.

IQ Assessed

The previous meta-analysis (Gaub & Carlson, 1997) used an IQ of greater than 80 as an inclusion criterion. Since cut-off scores were specifically removed for the current analysis, it was important to determine if differences existed between those studies that assessed for and those that did not assess for IQ.

Age

The previous analysis (Gaub & Carlson, 1997) only examined children. For the current analysis, no age restrictions were placed on the studies. This moderator variable compared children to adolescents and adults.

Diagnostic System

In order to determine if the diagnostic criterion moderated the findings, the data were analyzed for diagnostic system as a potential moderator. Specifically, the data were coded for *DSM-III, DSM-III-R,* or *DSM-IV* systems, if reported. None of the studies from the previous meta-analysis (Gaub & Carlson, 1997) were based on *DSM-IV* criteria.

Previous Meta-Analysis

Another important methodological question is whether the studies included in the current analysis were somehow different from those included in the previous meta-analysis (Gaub & Carlson, 1997).

Estimation of the "Fail-Safe N"

An extensive search was conducted to obtain published and unpublished studies for inclusion in the current analysis. Despite this effort, it is possible that additional data, particularly unpublished, exist in the field, and, therefore, included studies may not represent the entire population of studies conducted (Rosenthal, 1991). Thus, the "Fail-Safe N" statistic (Orwin, 1983) was calculated to represent the number of studies that would be necessary to make a significant estimation of effect size insignificant.

Results

The results of the current meta-analysis are shown in Table 1. Significant gender differences emerged for all primary symptoms of ADHD. ADHD females were rated as significantly less impaired than ADHD males on hyperactivity (d_+= .29, p < .05), inattention (d_+= .23, p<.05), and impulsivity (d_+= .22, p<.05). Significant gender differences in ADHD also emerged for measures of comorbid conditions. Specifically, ADHD females manifested significantly less externalizing problems (d_+= .21, p < .05) and significantly more internalizing problems (d_+= -.12, p<.05) than ADHD males.

Significant gender differences in ADHD also emerged for measures of intellectual functioning. ADHD females performed worse than ADHD males on Full Scale IQ (d_+= .27, p<.05) and Verbal IQ (d_+= .37, p<.05). No gender difference was found for Performance IQ. In addition, no significant gender differences emerged on measures of academic achievement, neuropsychological or social functioning.

Ratings of ADHD primary symptoms and comorbid conditions were analyzed separately by parent and teachers (see Table 2). ADHD females were rated as less hyperactive than ADHD males based on the weighted mean effect size by parents (d_+= .16, p < .05) and by teachers (d_+= .36, p < .05). On ratings of inattention, only teacher ratings showed a significant gender difference, rating ADHD females as less inattentive than ADHD males (d_+= .18, p<.05). Teachers also rated ADHD females as manifesting fewer externalizing problems than ADHD males (d_+= .19, p<.05).

Tests of Homogeneity and Analyses of Moderator Variables

Referral Source: The results of the moderator analyses for referral source are shown in Table 3. The findings indicated that referral source moderated hyperactivity (b = -.30, CI = .03, p < .05), reading achievement (b = .25, CI = .23, p<.05), parent ratings of hyperactivity (b = -.33, CI = .07, p<.05), teacher ratings of hyperactivity (b = -15, CI = .03, p<.05), parent ratings of inattentiveness (b = -.38, CI = .25, p < .05), and teacher ratings of inattentiveness (b = -.36, CI = .03, p<.05). Effect sizes were separated by clinic and community sample. Using community samples only, ADHD females were rated as significantly less impaired than ADHD males on all of the dependent measures above. On parent ratings of inattentiveness, however, clinic samples showed significantly more impairment for ADHD females than ADHD males.

Previous Meta-Analysis: The results of the moderator analyses for whether studies were included in the previous meta-analysis are shown in Table 4. Previous meta-analysis moderated hyperactivity (b = .22, CI = .08, p<.05), reading achievement (b = .23, CI = .15, p < .05), parent ratings of hyperactivity (b = .24, CI = .12, p < .05), parent ratings of

Table 1. Effect Sizes of Primary Symptoms and Correlates of Gender Differences in ADHD

Variable	d_+ (95% CI)	*k*	*Q*	*df*	Fail-Safe N
Primary Symptoms					
Hyperactivity	.29 (±.11)*	20	71.43*	19	3837
Inattention	.23 (±.15)*	20	14.18	19	1401
Impulsivity	.22 (±.15)*	8	10.87	7	193
Comorbid Conditions					
Externalizing	.21 (±.11)*	21	43.32*	20	2213
Internalizing	-.12 (±.12)*	17	13.08	16	414
Intellectual Functioning					
Full Scale IQ	.27 (±.12)*	21	18.39	20	2871
Performance IQ	.17 (±.17)	11	4.92	10	
Verbal IQ	.37 (±.17)*	11	7.25	10	793
Academic Achievement					
Math	.03 (±.21)	8	17.47*	7	
Reading	.10 (±.21)	8	16.88*	7	
Spelling	.22 (±.49)	2	5.45*	1	
Neuropsychological Functioning					
CPT Omission Errors	-.26 (±.39)	4	5.02	3	
CPT Commission Errors	.10 (±.20)	6	4.38	5	
Stroop Words	.07 (±.41)	2	.12	1	
Stroop Colors	-.12 (±.41)	2	.07	1	
Stroop Interference	-.19 (±.41)	2	.16	1	
MFFT Errors	-.15 (±.27)	5	9.24	4	
MFFT Latency	-.15 (±.27)	5	5.74	4	
Social Functioning					
Social Skills	-.23 (±.39)	3	0.21	2	
Peer Popularity	.03 (±.20)	7	7.61	6	
Social Problems	.08 (±.17)	8	5.41	7	

Note: d_+ = weighted mean effect size; *CI* = confidence interval; *k* = number of studies; *Q* = test of homogeneity; *df* = degrees of freedom.
*$p < .05$.

Table 2. Effect Sizes of Primary Symptoms and Correlates of Gender Differences in ADHD for Parent and Teacher Ratings

Variable	d_+ (95% CI)	*k*	*Q*	*df*	Fail-Safe N
Primary Symptoms					
Hyperactivity–Parent Ratings	.16 (±.12)*	12	61.28*	11	329
Hyperactivity–Teacher Ratings	.36 (±.12)*	15	48.59*	14	2664
Inattention–Parent Ratings	.09 (±.13)	10	30.95*	9	
Inattention–Teacher Ratings	.18 (±.12)*	16	39.62*	15	818
Comorbid Conditions					
Externalizing–Parent Ratings	.10 (±.13)	14	26.99*	13	
Externalizing–Teacher Ratings	.19 (±.13)*	17	29.09*	16	837
Internalizing–Parent Ratings	-.12 (.13)	14	11.43	13	
Internalizing–Teacher Ratings	-.05 (.19)	5	3.62	4	

Note: d_+ = weighted mean effect size; *CI* = confidence interval; *k* = number of studies; *Q* = test of homogeneity; *df* = degrees of freedom.
*$p < .05$.

Table 3. Investigation of Referral Source as a Moderator

Variable and Class	N	*b* (95% CI)	Mean d_+ (95% CI)	*Q*
Hyperactivity		-.30 (±.03)*		
Clinic	11		.07 (±.30)	0.19
Community	9		.86 (±.39)*	52.57*
Externalizing		-.17 (±1.85)		
Clinic	15		.12 (±.16)	2.96
Community	6		.44 (±.31)*	19.56*
Math Achievement		.20 (±.23)		
Clinic	5		.08 (±.46)	0.15
Community	3		.09 (±.88)	0.15
Reading Achievement		.25 (±.23)*		
Clinic	5		.08 (±.52)	0.28
Community	3		.19 (±.72)	0.26
Hyperactivity–Parent Ratings		-.33 (±.07)*		
Clinic	8		-.15 (±.47)	3.66
Community	4		.69 (±.35)*	35.73
Hyperactivity–Teacher Ratings		-.15 (±.03)*		
Clinic	8		.19 (±.29)	2.04
Community	7		.89 (±.47)*	43.78*
Inattentiveness–Parent Ratings		-.38 (±.25)*		
Clinic	8		-.19 (±.14)*	4.66*
Community	2		.51 (±.11)*	24.15*
Inattentiveness–Teacher Ratings		-.36 (±.03)*		
Clinic	9		.01 (±.21)	2.21
Community	7		.44 (±.16)*	33.19*
Externalizing–Parent Ratings		-.11 (±.18)		
Clinic	12		.11 (±.20)	2.12
Community	2		.01 (±.52)	0.07
Externalizing–Teacher Ratings		-.18 (±1.21)		
Clinic	11		.05 (±.15)	0.07
Community	6		.48 (±.29)*	20.85*

Note: N = number of studies; *b* = regression coefficient; d_+ = weighted mean effect size; *CI* = confidence interval; *Q* = test of homogeneity; *$p < .05$.

externalizing ($b = .34$, $CI = .08$, $p < .05$), and teacher ratings of inattentiveness ($b = .15$, $CI = .11$, $p < .05$). Effect sizes were separated by whether studies were included in the previous meta-analysis. Based on studies not included in the previous meta-analysis, ADHD females were rated as significantly less impaired than ADHD males on hyperactivity, parent ratings of hyperactivity, and parent ratings of inattentiveness.

Sex of First Author: The findings indicated that sex of first author significantly moderated parent ratings of hyperactivity ($b = .26$, $CI = .09$, $p < .05$), teacher ratings of hyperactivity ($b = -.19$, $CI = .13$, $p < .05$), and parent ratings of externalizing problems ($b = .46$, $CI = .08$, $p < .05$). Effect sizes were calculated separately for male and female authors. When the first author was female, teachers' ratings on hyperactivity were significantly lower for ADHD females than males.

Publication Status: The findings indicated that publication status moderated hyperactivity ($b = .17$, $CI = .03$, $p < .05$), math achievement ($b = -.30$, $CI = .20$, $p < .05$), reading achievement ($b = -.22$, $CI = .21$, $p < .05$), teacher ratings of hyperactivity ($b = .19$, $CI = .05$, $p < .05$), and teacher ratings of externalizing problems ($b = .09$, $CI = .07$, $p < .05$). Effect sizes were separated by publication status. Based on the unpublished studies, ADHD females demonstrated significantly less impairment than ADHD males on hyperactivity and teacher ratings of hyperactivity.

IQ Assessed: Whether or not IQ was assessed moderated hyperactivity ($b = -.24$, $CI = .03$, $p < .05$), parent ratings of hyperactivity ($b = -.27$, $CI = .07$, $p < .05$), teacher ratings of hyperactivity ($b = -.33$, $CI = .03$, $p < .05$), and teacher ratings of inattentiveness ($b = -.15$, $CI = .03$, $p < .05$). Effect sizes were separated by whether or not IQ was assessed. When IQ was assessed, ADHD females were rated as significantly less impaired than ADHD males on hyperactivity, teacher ratings of hyperactivity, and teacher ratings of inattentiveness.

Diagnostic System: The diagnostic system moderated math achievement ($b = -.27$, $CI = .18$, $p < .05$), teacher ratings of inattention ($b = -.09$, $CI = .07$, $p < .05$), and teacher ratings of externalizing ($b = .12$, $CI = .05$, $p < .05$). Effect sizes were separated by the diagnostic system used. Based on the *DSM-IV*, ADHD females were rated as significantly less impaired than ADHD males on teacher ratings of inattentiveness.

Table 4. Investigation of Inclusion in Previous Meta-Analysis as a Moderator

Variable and Class	N	*b*	(95% CI)	Mean d_+	(95% CI)	*Q*
Hyperactivity		.22	(±.08)*			
Yes	5			.01	(±.55)	0.21
No	15			.57	(±.32)*	30.43*
Externalizing		-.29	(±2.66)			
Yes	8			.22	(±.23)	2.50
No	13			.21	(±.21)	11.07
Math Achievement		-.08	(±.15)			
Yes	2			-.13	(±.84)	0.16
No	6			.16	(±.48)	0.11
Reading Achievement		.23	(±.15)*			
Yes	2			-.36	(±.62)	0.94
No	6			.28	(±.42)	2.13
Hyperactivity–Parent Ratings		.24	(±.12)*			
Yes	4			-.41	(±.65)	2.61
No	8			.40	(±.40)	11.38
Hyperactivity–Teacher Ratings		.03	(±.12)			
Yes	3			.40	(±.55)	2.63
No	12			.55	(±.38)*	28.78*
Inattentiveness–Parent Ratings		-.30	(±.31)			
Yes	4			-.18	(±.23)	0.51
No	6			.04	(±.32)	3.96
Inattentiveness–Teacher Ratings		.15	(±.11)*			
Yes	4			.01	(±.29)	0.01
No	12			.26	(±.20)*	10.38
Externalizing–Parent Ratings		.34	(±.08)*			
Yes	5			.07	(±.15)	0.36
No	9			.11	(±.28)	1.64
Externalizing–Teacher Ratings		-.28	(±1.70)			
Yes	6			.28	(±.33)	4.12
No	11			.16	(±.19)	4.26

Note: N = number of studies; *b* = regression coefficient; d_+ = weighted mean effect size; *CI* = confidence interval; *Q* = test of homogeneity; *$p<.05$.

Age of Subjects: Age of subjects moderated hyperactivity ($b = .08$, $CI = .04$, $p < .05$), math achievement ($b = .22$, $CI = .18$, $p < .05$), reading achievement ($b = .28$, $CI = .11$, $p < .05$), parent ratings of hyperactivity ($b = -.22$, $CI = .05$, $p < .05$), teacher ratings of hyperactivity ($b = .29$, $CI = .05$, $p < .05$), and parent ratings of externalizing problems ($b = -.20$, $CI = .05$, $p < .05$). Effect sizes were separated by the age of subjects (child vs. adolescent/adult). For child subjects, ADHD females were rated as significantly less impaired than ADHD males on hyperactivity and teacher ratings of hyperactivity. In addition, when the subjects were adolescents or adults, ADHD females were also rated as significantly less impaired than ADHD males on parent ratings of hyperactivity.

Rater: Rater moderated only hyperactivity ($b = .11$, $CI = .07$, $p < .05$). Effect sizes were separated by parent or teacher ratings. Based on teacher ratings, ADHD females were rated as significantly less impaired than ADHD males on hyperactivity.

Discussion

The results of the current analysis indicated general agreement with the Gaub and Carlson (1997) meta-analysis and demonstrated that the effect sizes were not influenced by methodological changes in the inclusion criteria. The results suggested that ADHD females manifested fewer primary symptoms and externalizing problems than males. In contrast, on related problems, such as intellectual functioning, ADHD females fared worse than their male counterparts. Of particular interest, and the primary difference between the current analysis and the Gaub and Carlson study, was the finding that ADHD females were rated as higher on internalizing problems than males, suggesting that comorbid conditions such as depression and anxiety may be more problematic for ADHD females.

When effect sizes were separated by teacher and parent ratings, a number of other gender differences emerged. ADHD females were rated as less hyperactive according to parent and teacher reports. In contrast, ADHD females were rated as less inattentive and displayed fewer externalizing problems according to teachers only. The results suggest that parent and teacher ratings generally

disagree on some of the primary symptoms and comorbid conditions, and teachers rate ADHD males as significantly more impaired than ADHD females in comparison to parent reports. Such differences in ratings may indicate a "halo effect" whereby teachers overly attend to disruptive behaviors and ignore inattentive behaviors (Abikoff, Courtney, Pelham, & Koplewicz, 1993). This potential bias might contribute to the underidentification of affected females, particularly in the classroom.

Alternatively, the data could also suggest that teachers over-recognize ADHD males and correctly identify their female counterparts. This interpretation would suggest that there is bias by parents and not teachers. Based on the available data, it is not clear which interpretation is more justified. Since a number of variables significantly moderated all of these significant gender differences, indicating that these dependent measures are complex and influenced by numerous factors, these results must be interpreted with caution.

Since potential ratings biases exist in the disorder, and the symptoms of ADHD in females tend to be subtler than in males, it is likely that many ADHD females are unrecognized. Since the classroom is often the first place in which these symptoms become problematic, it might be helpful to provide elementary school teachers and parents with training on recognizing ADHD symptoms in both males and females and the differential manifestation of the disorder by gender. Particularly, teachers and parents need to be aware that difficulty in the ability/IQ domain may be indicative of other problems besides intellectual impairment. In addition, although the data from this review cannot disseminate subtypes, ADHD boys and girls who meet criteria for the inattentive subtype are probably more difficult to recognize. Therefore, an enhanced understanding of this subtype needs to be communicated to both parents and teachers.

The findings also indicated that ADHD females performed worse than males on measures of intellectual functioning. Nadeau, Littma, and Quinn (1999) suggested that ADHD females often receive referrals for school-related difficulties or potential learning disabilities (LD) and that gender differences in intellectual functioning might reflect a referral bias. Previous research has indicated that ADHD subjects in general are likely to have both intellectual and academic difficulties in comparison to non-ADHD counterparts (Faraone et al., 1993). Barkley (1998) has suggested that these differences may not indicate true intellectual differences but rather manifestations of a poor test-taking style characterized by inattention and impulsivity. Unfortunately, the existing data did not permit the examination of reason for referral or comorbid conditions such as LD.

The moderator analyses indicated that a number of variables might account for significant gender differences for some of the dependent variables. As expected, referral source moderated a number of variables, which suggests that clinically referred samples tended to manifest more severe symptomatology than community samples. Many of the variables examined significantly moderated hyperactivity, parent or teacher ratings of hyperactivity, or parent and teacher ratings of externalizing problems. These ratings were primarily conducted by rating scales and may indicate a gender bias for disruptive behaviors on these measures.

An unexpected finding emerged from the moderator analyses. Sex of first author significantly moderated parent and teacher ratings of hyperactivity and parent ratings of externalizing problems. This finding may actually reflect clinic versus community samples as opposed to a bias in the sex of the first author. Upon examining the studies used to calculate moderator variables, most of the female authors utilized community or school samples, whereas male authors tended to use clinical samples. As a result, the ratings of ADHD girls from community samples might reflect lower ratings on hyperactivity than clinical samples.

Limitations

The current analysis suffers from some of the same methodological shortcomings as the Gaub and Carlson (1997) study. Although the current analysis enlarged the sample size for a number of important variables, other dependent variables such as neuropsychological and social functioning remained limited by a small number of studies. Due to this lack of statistical power, it is unclear if gender differences did not exist on these variables or if null findings resulted from insufficient data. The lack of data on many of the correlates of ADHD indicates a need for a more universal protocol in the assessment of ADHD since a lack of consistency significantly limits the ability to summarize the findings quantitatively.

Another limitation of the gender differences literature on ADHD and this data set is the lack of data on comorbid disorders. Comorbid conditions potentially play a major role in the manifestation, severity, and treatment of the disorder, as indicated by high levels of externalizing problems for ADHD males and high levels of internalizing problems for ADHD females. In fact, the current analysis might actually be comparing ADHD males with comorbid

conduct disorder (CD) or oppositional defiant disorder (ODD) to ADHD females with anxiety or mood disorders. Since numerous ADHD researchers have reported high rates of comorbidity (Biederman, Newcorn, & Sprich, 1991; Carlson et al., 1997; Pliszka, Carlson, & Swanson, 1999), the lack of information on comorbidity in this data set is particularly troubling. These high rates of comorbidity make it unlikely that the current analysis provides information that characterizes a "pure" form of the disorder. Future research must assess comorbid conditions, including, at a minimum, CD, ODD, depressive disorders, anxiety disorders, and LD.

The examination of gender differences in the subtypes of ADHD was also limited by the fact that little data exist on this topic. Unfortunately, the current data set could not provide additional insight into gender differences in subtypes of the disorder. Instead, the current analysis relied on a unidimensional construct of ADHD that has changed in terminology and diagnostic criteria over the years. In order to assess this question, the diagnostic system used was examined as a potential moderator variable. In fact, the diagnostic system was found to moderate only several dependent measures. Therefore, although the current analysis used different diagnostic systems, these systems did not appear to play a major role in how the symptoms and correlates of ADHD varied by gender. Future conceptualizations of the disorder would benefit from the examination of gender differences in subtypes, particularly since gender differences in prevalence among clinical samples have emerged in previous research.

Conclusions

The current and the Gaub and Carlson (1997) meta-analyses indicated that a number of changes are necessary in the study of gender differences in ADHD. First, more females are needed in ADHD research studies, and these investigations should include sections on gender differences. Second, ADHD studies need to move away from the clinic and address a wider community-based population. While recruitment of females for studies remains challenging, epidemiological evidence suggests that many affected females should be present in these samples. Third, future research efforts should include comparisons of the subtypes of the *DSM-IV* in the examination of gender differences. Assessment of these subtypes is imperative since the current diagnostic system does not view ADHD as a unidimensional construct and since gender differences have been reported in the subtypes of ADHD. Fourth, the diagnostic heterogeneity of ADHD needs further consideration. Since gender differences emerged on internalizing and externalizing problems, differences in comorbid conditions would also be expected. Thus, assessment of comorbid conditions is essential. Finally, the developmental course of the disorder and gender differences within this trajectory are poorly understood. Additional longitudinal studies of adult and adolescent males and females with ADHD would be especially beneficial.

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