

Sex Differences in ADHD: Conference Summary

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Clinical samples of attention deficit hyperactivity disorder (ADHD) have been dominated by males. Consequently, female manifestations and sex differences have been relatively neglected in the extensive ADHD research. Because ADHD is so common (3% to 5% of school children) and chronic (lifelong in many cases), even a small proportion of females multiplied by such a large base means hundreds of thousands of girls and women with ADHD, a significant public health problem. An NIMH conference concluded that research is needed not only on sex differences related to ADHD, but also on manifestations of ADHD in females as such. Areas of focus should include differences in life course (sex-differential age effects); effects of hormones; effects of ADHD parenting (in utero and postnatal) on the next generation; response to and implications for design of psychosocial treatment; effects of differential comorbidity; normative "background" sex differences that influence the manifestation of ADHD; differences in development of verbal fluency and

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social behavior; possible interactions of sex and ethnicity; a prospective study of both sex offspring of ADHD adults; and such methodological issues as appropriate instruments and diagnostic thresholds, power to prevent false negatives, valid impairment measures, validity and reliability of child self-reports, and more inclusive samples (all three subtypes: inattentive, hyperactive-impulsive, and combined).

Although attention deficit hyperactivity disorder (ADHD) is the best-studied of childhood mental disorders, investigations have been to a great extent confined to males (mostly boys, with a few studies of men) because of the great preponderance of males in clinically referred samples with ADHD, where the sex ratio ranges from 3:1 to 9:1 (e.g., American Psychiatric Association, 1994; Goodyear & Hynd, 1992; Lahey et al., 1994; Williams & Swanson, 1994). Females with ADHD and sex differences have been largely neglected in research until recent years. This neglect is of public health concern, because even a very small proportion of such a chronic and common disorder (3% to 5% lifetime incidence) translates to hundreds of thousands of affected females nationally. For example, if we assume a ratio of 5:1 and a combined prevalence of only 3%, the sex-specific prevalences would be 5% for males and 1% for females; 1% of 125 million U.S. females yields over a million girls and women with ADHD or its residua. And this estimate is conservative; for example, nonreferred population samples (e.g., Faraone et al., 1992; Gaub & Carlson, 1994; Lahey, 1994) suggest a sex ratio closer to 2:1 or 3:1 than to 5:1. Such a large pool of individuals who have not had reasonable benefit of research attention persuaded the National Institute of Mental Health (NIMH) to convene a conference of experts to review what is known, assess its significance, and delineate areas of needed research.

This article summarizes the conclusions of the November 16–17, 1994, Conference on Sex Differences in ADHD jointly sponsored by the NIMH Office for Special Populations and the Child & Adolescent Disorders Research Branch of the Division of Clinical & Treatment Research, NIMH. The 2 days of data sharing and discussion were focused on the following questions suggested ahead of time by the participants:

Is ADHD a valid diagnostic construct for females?

Are the same instruments and diagnostic criteria used for males also appropriate for females?

What, if any, are the normal sex differences in attention, impulse control, and activity level upon which ADHD symptoms are superimposed?

How do males and females with ADHD differ genetically, neurologically, psychologically, phenomenologically, and in treatment response?

Of the differences noted between males and females with ADHD, which result mainly from the normal sex differences on which symptoms are superimposed, and which result from sex-specific pathogenesis, sex-influenced genetics, or interactions with gender-specific socialization?

How does the life course of the disorder differ in males and females?

What is the best explanation of the observed diagnostic sex ratio?

What areas appear most productive scientifically and clinically for further research?

Are there any other methodological issues needing sex-specific attention?

As the following summation will show, the conceptual issues evolved into a somewhat different structure while answering or refining most of the original questions.

BACKGROUND OF NORMATIVE SEX DIFFERENCES ON WHICH ADHD IS SUPERIMPOSED

In any consideration of sex differences in ADHD, it is important to distinguish those that arise from normal sex differences and are therefore not attributable to differential manifestation of the disorder. In fact, the absence in ADHD of a sex difference that occurs in the normal population may be a phenomenon worth studying. Thus the disorder may interact with normative sex differences in relevant parameters. The following relevant sex differences have been noted in the normal, nonclinical population.

On rating scales and factors by teachers and parents, girls of all ages have fewer attention problems and less hyperactivity than same-age boys despite similar factor structure, and this seems consistent across cultures (e.g., Achenbach, 1991; Bauermeister, 1992; Bauermeister, Bird, Canino, Rubio-Stipec, & Alegria, 1995; Brito, Pinto, & Lins, 1995; Conners, 1994; Goyette, Conners, & Ulrich, 1978; Trites, Blouin, & Laprade, 1980). On rating scales and structured diagnostic interviews females have fewer symptoms not only of ADHD, but also of other externalizing problems, including conduct disorder, delinquency, and aggression (e.g., Achenbach, 1991; Bauermeister, 1992; Conners, 1994; Eme, 1992; Gaub & Carlson, in press; Lahey, 1994; Zoccolillo, 1993). Possibly related to the latter, normal girls experience less peer rejection and more social acceptance (e.g., Gaub & Carlson, 1994). In neuropsychological tests of attention, girls have shown in at least one study fewer Continuous Performance Test (CPT) errors, slower reaction times (trading speed for accuracy on the CPT), and faster (but not less accurate) digit cancellation (Pascualvaca, 1994). On one type of CPT with a high event rate, females showed superior signal detection

and less inattention with longer interstimulus intervals (Conners, 1994). However, not all studies show such neuropsychological differences, including the standardization samples for the Gordon Diagnostic System (Bauermeister, Berrfos, Jimenez, Acevedo, & Gordon, 1990; Gordon & Mettelman, 1988). On brain imaging, females have smaller brains but larger caudate nuclei (Giedd et al., 1996). Normal girls, in contrast to boys, show a puberty-related drop in cerebral glucose metabolism, with metabolism negatively correlated to Tanner stage (Ernst & Zametkin, 1994). Thus females normally differ from males on many measures commonly accepted by scientists and clinicians as relevant to ADHD pathology. Therefore, one conclusion of the conference was that more information is needed about such normative sex differences.

PREVALENCE RATIO, SEX-SPECIFIC CRITERIA, AND IMPAIRMENT

In nonclinical samples, the sex ratio of subjects meeting DSM (American Psychiatric Association, 1980) criteria for ADHD was about 2:1 to 3:1 (e.g., Gaub & Carlson, 1994; Lahey, 1994; Szatmari, Offord, & Boyle, 1989), considerably lower than in clinical samples. However, nonclinical studies do not always include teacher reports, which might increase the proportion of boys identified. The consensus was that part of the higher male-to-female ratio in clinical samples results from boys being more likely to be referred for their comorbid conduct or oppositional disorder and aggression (Biederman, 1994; Gaub & Carlson, in press; Lahey, 1994). Even after correction for comorbidity, however, there remained some referral bias favoring referral of boys (Lahey, 1994). It is not clear whether girls are preferentially treated in "nonclinical" ways by the school, home, or community; whether their needs are simply overlooked; whether they have less need; or whether it is some combination of these. The later age of onset reported for girls in some samples (Lahey, 1994) could reflect either insensitivity to early signs of the disorder in girls or an actual difference in life course of the disorder in boys and girls.

There was disagreement as to whether the clinical ascertainment bias favoring boys is counterintuitive to or congruent with expectations from social gender role theory. There was general agreement that (a) the "true" sex ratio is lower than in clinically referred samples and (b) even after all corrections the derived ratio will probably never approach 1:1 (as long as the same diagnostic criteria are used for both sexes).

A meta-analysis (Gaub & Carlson, in press) suggested that clinic-referred girls with ADHD had more severe attentional and intellectual im-

pairment across all IQ scales than clinically referred boys with ADHD, but less hyperactivity and conduct disorder, and a similar degree of impairment in most other domains of function. For example, Berry, Shaywitz, and Shaywitz (1985) and James and Taylor (1990) reported that girls with ADHD have more serious cognitive or language disturbance than boys with ADHD. Recruitment source was important; nonreferred boys had more inattention and internalizing disorders than nonreferred girls, in contrast to the situation with referred samples (Gaub & Carlson, in press). However, other conference participants cited data showing similar impairment in all domains for clinically referred boys and girls (e.g., Breen, 1989; Faraone, Biederman, Keenan, & Tsuang, 1991; Horn, Wagner, & Ialongo, 1989), and Biederman, Faraone, Spencer, Wilens, and Mick (1994) reported similarities in men and women with ADHD. There was some (but not universal) evidence for greater peer rejection of girls with ADHD (Berry et al., 1985), at least in the inattentive subtype (Gaub & Carlson, 1994). In particular, even though the inattentive subtype favored by girls tends to elicit more peer neglect than rejection (Wheeler & Carlson, 1994), within this subtype girls are more rejected than boys (Gaub & Carlson, 1994). Nevertheless, one small study showed that girls are more relationship-oriented and less hostile in conflict situations (Thomeer, 1994).

A great deal of discussion centered on appropriate diagnostic criteria for girls. Part of the reason fewer girls are diagnosed (even after controlling for referral bias) is that since girls as a group have a base level of inattention and hyperactivity lower than boys by rating scales and some lab tests (e.g., Achenbach, 1991; Conners, 1994; Goyette et al., 1978; Pascualvaca, 1994; Trites et al., 1980), they have to deviate farther from sex peers than do boys to attain a "diagnostic" level of problems. This could be "corrected" by using sex-specific thresholds related to degree of deviance from sex norms, analogous to the established practice of comparing to age-appropriate behavior (McGee & Feehan, 1991). Conceivably, the "right" thresholds could even equalize the sex ratio (at least if the impairment criterion were ignored). However, this would probably identify and label as disordered some girls who were not impaired in the usual sense (Gaub & Carlson, 1994). On the other hand, some participants argued that we wouldn't know whether such girls were impaired unless we studied them. Thus a tension was identified between the concern about inappropriately labeling girls who are functioning reasonably and the opposing concern that girls who have real needs might be missed. The consensus was that girls who fall below the generic diagnostic threshold but above a sex-specific threshold should be studied to find out to what extent they might be impaired, but should not be diagnosed until this issue is resolved.

There was considerable support for the primacy of an impairment criterion. Some participants said that case identification should first be made by impairment, and only then consider diagnosis. The question remained whether impairment should be relative to a generic child of the given age or relative to one's own sex as well as age. Most felt that impairment should be judged relative to the tasks (academic, behavioral, social) that a child of the given age and sex is expected to perform, for which sex distinctions have tended to blur of late. This majority sentiment was supported by the MECA (Methods for Epidemiology of Child and Adolescent Mental Disorders) data showing no sex difference in the relationship of impairment ratings to symptom counts (Lahey, 1994). Many felt comfortable with something like the Global Assessment of Function (GAF) as currently used and defined. Others suggested the Vineland Scales of Adaptive Behavior as an impairment index because both males and females with ADHD show significant discrepancies from IQ on adaptive behavior thus measured (Roizen, Blondis, Irwin, & Stein, 1994).

The final consensus about these issues was that thresholds on symptom lists and instruments should be sex-specific, but the same impairment criterion should be used, which should include social, academic, and behavioral domains. The loss of normative differences in diagnosed samples should be studied. Whether sex-corrected or uniform criteria are used for study entry should be determined by the purpose of the study.

POSSIBLE DIFFERENCES IN ETIOLOGY

One group (Biederman, 1994) reported that girls with ADHD have a higher rate of first-degree relatives with ADHD than do boys with ADHD. If upheld by subsequent studies, this could reflect, among other things (such as polygenic inheritance), a lower rate of "sporadic" insult-induced ADHD among girls. This could account for some of the observed unbalanced sex ratio. However, it is at variance with previously reported results in a smaller sample (Mannuzza & Gittelman, 1984).

DIFFERENCES IN COMORBIDITY

The few studies that have examined sex-differential comorbidity have been inconsistent, but with a suggestion of less externalizing pathology (oppositional, antisocial, aggressive) in females (e.g., Berry et al., 1985; Eme, 1992; Gaub & Carlson, in press); this trend was not significant on the MECA and DSM-IV (APA, 1994) field trial data (Lahey, 1994). There is a suggestion of more internalizing comorbidity in females in some studies

(e.g., Conners, 1994), at least in the inattentive type (Gaub & Carlson, 1994), which may be accentuated at later ages when depression activates. However, one study of adult follow-up showed no trend at all for more comorbidity of any type in females (Klein, 1994). This is an area needing more study.

AGE × SEX EFFECTS (LIFE COURSE SEX EFFECTS)

There may be some sex differences in life course. For example, one study suggested a better prognosis in adulthood for females, at least in regard to antisocial personality and substance abuse (Klein, 1994). A later age of onset was reported for girls in some studies (Lahey, 1994) and an earlier age of waning in another (Klein, 1994). Some adult clinical samples (but not all) have suggested a more even sex ratio than in children, possibly because of more female self-referral (Beiderman, 1994; Beiderman et al., 1994; Stein, 1994). According to the Scott-Levin physician diagnosis and drug audit data, a higher proportion of ADHD office visits after age 17 are by females, even though the referral rate falls for both sexes after 17 (Williams & Swanson, 1994). This may be associated with a postulated relatively greater willingness of females to admit ADHD symptoms to themselves and others, as suggested by a few data (Hechtman, 1994; Klein, 1994); when the age of self-referral is reached, males may neglect treatment more than females do.

Another explanation for any evening of the sex ratio with age could be age-correlated female depression, which could mimic or exacerbate ADHD symptoms. Alternatively, some conference participants wondered whether depression could be a female expression of ADHD, a suspicion indirectly supported by factor analyses separately for fathers and mothers of diagnosed children with ADHD: Though the father's factors were similar to the diagnosed children's, the first factor for the mothers was a "moody-irritable" factor (Stein et al., 1995).

Relative to normal controls, one study found ADHD associated with earlier sexual activity in girls and later sexual activity in boys (Conners, 1994).

There is a possibility that changing hormone levels could influence expression of the disorder. On one neuropsychological test, females showed a slower reaction time than males at all ages except 13 to 16 (Conners, 1994), the same age when normal girls show decreased brain glucose metabolism as a function of sexual maturation (Ernst & Zametkin, 1994; Ernst et al., 1994). In women with ADHD, but not men (with or without ADHD) or normal women, there was a significant decrease in brain metabolism

with age. Women and sexually mature girls (but not sexually immature girls) with ADHD showed more decrease of brain metabolism relative to controls than did men and boys (Ernst & Zametkin, 1994; Zametkin et al., 1990). A caution is that the brain metabolism data were based on very small samples and are still evolving. One conclusion of the conference was that age effects deserve research attention both in their own right and in regard to sex differences.

MOTHERS WITH ADHD

A relatively uninvestigated area is the effect on offspring of mothers with ADHD. Women with ADHD tend to have higher rates of adolescent pregnancy and substance abuse than other women (e.g., Barkley, 1994; Biederman, 1994; Loney, 1994), and are more likely than other mothers to provide inattentive, inconsistent, or impulsive caregiving. They are thus likely to stress both physiologically and psychosocially fetuses and infants who are already genetically vulnerable. They may create a toxic or stressful environment for their vulnerable offspring. Much is already known about the effects of alcohol, nicotine, and other substances on fetal development (King, 1994) and about the effects of partial maternal deprivation and inconsistent discipline. This knowledge base, from both animal and human literature, should be incorporated into the study of the prenatal and parenting behavior of women with ADHD.

TREATMENT RESPONSE

No differential sex effect has been noted for the drugs commonly used to treat ADHD (e.g., Barkley, 1989; Pelham, Walker, Sturges, & Hoza, 1989). There are no data available to support a statement about a differential sex effect of psychosocial treatments because studies of these have generally excluded girls. However, there is some reason to suspect a differential effect. For example, mothers have been found to be more critical of ADHD daughters than of ADHD sons (Barkley, 1994). This may have implications for parent training; e.g., techniques like positive attending and "catching them being good" may need more emphasis, or perhaps paradoxically fathers may need to be more involved with treatment of girls. Further, since much of current parent training targets oppositional and aggressive comorbidity, more prevalent in boys, target behaviors might need redefinition. For example, prosocial assertion, self-organization, or internalizing symptoms may be more appropriate targets.

If diagnosed girls are more deviant from same-sex peers than are diagnosed boys, not only do the social implications need more attention in treatment, but also the efficacy and importance of such interventions as a “buddy system” could be affected. [The buddy system (Betsy Hoza, personal communication) involves systematically structured socialization of two matched children with ADHD, guided through parent training; it is based on the finding that whether one has a good friend or not is highly predictive of later adjustment.]

Culture strongly affects psychosocial treatment palatability, compliance, and feasibility, as well as gender role expectations and gender-specific parent–child interactions that might be the focus of treatment. Since these differ in various subcultures, there may be Sex \times Ethnicity Interactions. For example, a macho culture might have different expectations about a boy’s obedience to his mother than a girl’s, or about appropriate behavior for girls. Obviously, psychosocial treatments have a potential for differential sex effects and differential treatment design requirements that need investigation.

TYPE II ERROR AND POWER

Because of the small proportion of females in most clinical ADHD samples, there is a great danger of false negatives in sex comparisons—true sex differences can be missed when a small number on one side of the comparison provides insufficient power. (The same problem also pertains to study of other disorders where it may be difficult to obtain sufficient sample proportions of one sex—for example, males with eating disorders.) This is not an easily solved problem, because some centers do not have enough female referrals for samples affording the appropriate level of statistical power. Recruiting extra females outside the usual referral channels could confound sex comparisons with recruitment or referral bias. A related problem is deciding just what is the desired power: What size effect are we willing to miss as not clinically meaningful?

The conference participants did not attempt to answer the latter question, but suggested the following solutions for the low proportion of females: (1) In centers with a large enough referral base, researchers should oversample females—e.g., take all consecutive females but only every third male (nonselectively). (2) Researchers should concentrate on large effects, at least in the early stages of investigating sex effects. (3) Researchers should include a “reverse power analysis” in reports of negative results, stating what size effect could have been missed with the number of females in the sample. (4) Researchers should consider one-tailed tests where the direction of dif-

ference is reasonably predictable. (5) Rather than merely reporting a difference as significant or not, investigators should create a third, intermediate category between the usual chosen significance level (e.g., alpha .05) and the alpha (e.g., .15) that would have allowed reasonable power (e.g., $1 - \beta = .8$) for an effect size that we would not want to miss in the given study. This category could be called "neither significant nor nonsignificant" or "nondefinitive" or "borderline." It could alert the field that the results should not be cited as a failure to reject the null hypothesis, but rather as an indication for further investigation with a larger number of females.

OTHER METHODOLOGICAL ISSUES

Since ADHD girls seem to cluster more in the inattentive subtype than do boys (Gaub & Carlson, in press; Goodyear & Hynd, 1992; Hinshaw, 1994; Lahey & Carlson, 1991; Lahey et al., 1994); inclusion of this subtype in samples would help increase the numbers of girls available for study. However, the higher rate of inattentive subtype in females raises questions about the relationship of the subtypes. One solution could be to explore the "groups" dimensionally. Another reason for including the inattentive subtype is that it is important not to control out the variables of interest. Since this subtype may be a favored expression of the disorder for females, excluding it may inadvertently exclude variance relevant to female expression. In other words, more diagnostically inclusive samples may provide the variance needed to detect sex differences.

The fact that clinical samples suffer referral or ascertainment bias is well known, but an additional complication highlighted by the conference is a probable sex difference in ascertainment bias, with only more severely affected girls being referred. Any study of sex differences will need to consider this phenomenon, which can make simple comparisons of clinically referred boys to clinically referred girls misleading. A further complication is that we do not know whether this suspected ascertainment sex difference extends to adulthood, and if it does not, at what age it washes out (or possibly reverses!).

An epistemological issue is the need to understand the child's self-report and find ways to increase its reliability and validity. This need, of course, is not unique to ADHD; it arises in most attempts to use the child as an informant, and may be even more important in internalizing disorders where caretakers may be unaware of symptoms. The possibility of a valid and reliable method of self-disclosure seems especially intriguing because, on self-report Diagnostic Interview Schedule for Children (DISC), equal proportions of boys and girls in a population sample identified themselves as having ADHD, albeit with low reliability (Jensen, 1994; Lahey, 1994).

A hope for refinement in this area comes from techniques gleaned from ethnographic research: Observation of children in their everyday settings and use of interviews that encourage open-end responses might yield data on the experience of ADHD (Arcia, 1994; King, 1994).

Articulation of various studies with each other is of utmost importance. They should be designed and reported to support meta-analysis (e.g., reporting effect sizes, measuring multiple domains of function, and using some identical instruments). Soon they should also interface with the Utilization, Needs, and Outcomes in Child and Adolescent Populations (UNOCAP) studies, the NIMH multisite cooperative agreement studies of developmental epidemiology and services utilization.

The normative sex differences on most of the scales used to screen for ADHD raises a question about the best instrument for females. There should be exploration of appropriate instruments. However, basically the same instruments should be used for both sexes, possibly with the addition of questions more sensitive to ADHD manifestations in females. Instruments should aim to capture the whole ADHD experience regardless of sex, and to tap functional abilities (Stein, Szumowski, Blondis, & Roizen, 1995). More normal control data should be gleaned from literature and further study. Better ways to measure the quality of life are needed; this will also speak to the problem of measuring impairment in a gender-fair manner.

An interesting arena for methodological measurement differences is in peer relations and activities. Meyer-Bahlburg, Sandberg, Dolezal, and Yager (1994) reported data showing more versatility in play preferences of girls. Johnston, Pelham, and Murphy (1985) found that peer ratings discriminated between boys with ADHD and normal boys, but did not usefully discriminate between normal girls and those with ADHD despite the fact that other authors (e.g., Berry et al., 1985) reported more peer disapproval for girls than boys with ADHD. It is not clear how such differences might influence observations of peer play or sociometric measurements.

Given the potential for caregiver bias in rating the behavior and function of boys and girls, it becomes especially important in sex-difference research to emphasize direct observations rather than to depend on rating scales. It is also important to understand the models, premises, assumptions, and values about gender that underlie teachers' and parents' reports.

FUTURE RESEARCH TARGETS

The effects of different comorbidity profiles constitute a prime area for useful investigation. For example, comorbidity might be expected to affect both referrals and treatment response.

The effect of hormones over the life course on the manifestation and impairment of the disorder seems another prime area in which to suspect important sex differences. The unique changes in pubertal girls in cerebral glucose metabolism (Ernst & Zametkin, 1994) and in some neuropsychological tests of attention (Conners, 1994) are undoubtedly related to hormones (since the brain metabolic changes seem associated more closely with Tanner stage than with chronological age), although this remains to be demonstrated. It therefore would not be surprising to find hormone effects in other functions related to the deficits of ADHD.

The expression, course, prognosis, and psychosocial treatment response in females as such deserves investigation in its own right, not just in terms of differences from males. For example, the higher adolescent pregnancy rate in girls with ADHD compared to normal girls is extremely important even though it would obviously not be targeted in a study of sex differences. The related issue of ADHD mothers' effect on offspring has already been mentioned.

The prospective study of both-sex offspring (diagnosed or not) of adults with ADHD promises to instruct not only about sex differences but also about the essence of the disorder and the interactions of genetic vulnerability with socialization. Such research could lead to a better understanding of the disorder in both sexes.

A better understanding of the development of verbal fluency, working memory, and social-behavior output in both sexes could support elucidation of the effects of ADHD on these important functions (Barkley, 1994; Hechtman, 1994; Lorch, 1994). This research in turn, given subtle normative sex differences in these areas, might shed much light on the sex-different manifestations of the disorder.

The possibility of sex and ethnicity interactions in the expression and treatment response of ADHD is intriguing. Even at a basic level of clinical sample composition, if cultural gender role models affect parental referral decisions, those effects are probably modified across ethnic groups because various ethnic cultural models differ from each other as well as those of from the mainstream culture.

MUTUAL ENLIGHTENMENT

One interesting insight that evolved from the conference is that focusing on female manifestations of ADHD and sex differences will not only contribute knowledge useful to females, but also will facilitate more exact thinking about the disorder in males and about the field in general. Thinking about research directions for female ADHD brought up the following

areas needing attention in general: (1) a better understanding of the effects of ADHD on verbal fluency and response, working memory, and the organization of social-behavior output; (2) more inclusive samples, including single-factor subtypes; (3) standardized actual observations of behavior (rather than just rating scales); (4) the relation of positron emission tomography (PET) scanning and other metabolic brain imaging to performance tests; (5) progression of public speech to internal reflection and self-guidance; (6) effect of ADHD adult behavior on the next generation; (7) the power of paradigms; (8) development of time sense; (9) age effects; and (10) hormone effects.

REFERENCES

- Achenbach, T. M. (1991). *Manual for Child Behavior Checklist and Revised Child Behavior Profile*. Burlington, VT: University Associates in Psychiatry.
- American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, DC: Author.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Arcia, E. (1994). Personal communication at NIMH Sex Differences Conference.
- Barkley, R. A. (1989). Hyperactive girls and boys: Stimulant drug effects on mother-child interactions. *Journal of Child Psychology and Psychiatry*, *30*, 379-390.
- Barkley, R. A. (1994). Personal communication at NIMH Sex Differences Conference.
- Bauermeister, J. (1992). Factor analyses of teacher ratings of attention-deficit hyperactivity and oppositional defiant symptoms in children aged four through thirteen years. *Journal of Clinical Child Psychology*, *21*, 27-34.
- Bauermeister, J. J., Berrfos, B., Jimenez, A. L., Acevedo, L., & Gordon, M. (1990). Some issues and instruments for the assessment of attention deficit disorder with hyperactivity (ADDH) in Puerto Rican children. *Journal of Clinical Child Psychology*, *19*, 9-16.
- Bauermeister, J. J., Bird, H. R., Canino, G., Rubio-Stipec, M., & Alegria, M. (1995). *The dimensions of ADHD: Finding from teachers' and parents' reports in a community sample*. Manuscript submitted for publication.
- Berry, C. A., Shaywitz, S. E., & Shaywitz, B. A. (1985). Girls with attention deficit disorder: A silent majority? A report on behavioral and cognitive characteristics. *Pediatrics*, *76*, 801-809.
- Biederman, J. (1994). Personal communication of preliminary findings at NIMH Sex Differences Conference.
- Biederman, J., Faraone, S. V., Spencer, T., Wilens, T., & Mick, E. (1994). Gender differences in adults with attention deficit hyperactivity disorder. *Psychopharmacology Bulletin*, *30*, 653.
- Breen, M. J. (1989). Cognitive and behavioral differences in ADDH in boys and girls. *Journal of Child Psychology and Psychiatry*, *30*, 711-716.
- Brito, G. N. O., Pinto, R. C. A., & Lins, M. F. C. (1995). A behavioral assessment scale for attention deficit disorder in Brazilian children based on DSM-III-R criteria. *Journal of Abnormal Child Psychology*, *23*, 509-520.
- Conners, C. K. (1994). Personal communication at NIMH Sex Differences Conference.
- Eme, R. F. (1992). Selective female affliction in development of disorders of childhood: A literature review. *Journal of Clinical Child Psychology*, *21*, 354-364.
- Ernst, M., Liebenauer, L. L., Jons, P. H., King, A. C., Cohen, M. D., & Zametkin, A. J. (1994, October). *Sexual maturation and brain metabolism in ADHD and normal girls*.

- Presentation at 41st Annual Meeting American Academy of Child & Adolescent Psychiatry, New York.
- Ernst, M., & Zametkin, A. (1994). Personal communication at NIMH Sex Differences Conference.
- Faraone, S. V., Biederman, J., Chen, W. J., Krifcher, B., Keenan, K., Moore, C., Sprich, S., & Tsuang, M. T. (1992). Segregation analysis of attention deficit disorder. *Proceedings 145th Annual Meeting American Psychiatric Association*, p. 128.
- Farone, S. V., Biederman, J., Keenan, K., & Tsuang, M. T. (1991). A family genetic study of girls with DSM-III attention-deficit disorder. *American Journal of Psychiatry*, *148*, 112-117.
- Gaub, M., & Carlson, C. L. (1994). Personal communication at NIMH Sex Differences Conference.
- Gaub, M., & Carlson, C. L. (in press). Gender differences in ADHD: A meta-analysis and critical review. *Journal of the American Academy of Child and Adolescent Psychiatry*.
- Giedd, J. N., Snell, J. W., Lange, N. Rajapakse, J. C., Kaysen, D., Vaituzis, A. C., Vauss, Y. C., Hamburger, S. D., Kozuch, P. L., & Rapoport, J. L. (1996). Quantitative magnetic resonance imaging of human brain development: Ages 4-18. *Cerebral Cortex*, *6*, 551-560.
- Goodyear, P., & Hynd, G. W. (1992). Attention-deficit disorder with (ADD/H) and without (ADD/WO) hyperactivity: Behavioral and neuropsychological differentiation. *Journal of Clinical Child Psychology*, *21*, 273-305.
- Gordon, M., & Mettelman, B. B. (1988). The assessment of attention: I. Standardization and reliability of a behavior-based measure. *Journal of Clinical Psychology*, *44*, 682-690
- Goyette, C. H., Conners, C. K., & Ulrich, R. F. (1978). Normative data on revised Conners Parent and Teacher Rating Scales. *Journal of Abnormal Child Psychology*, *6*, 221-236.
- Hechtman, L. (1994). Personal communication at NIMH Sex Differences Conference.
- Hinshaw, S. P. (1994). *Attention deficits and hyperactivity in children* (Table 4.1). Thousand Oaks, CA: Sage.
- Horn, W. F., Wagner, A. E., & Ialongo, N. (1989). Sex differences in school-aged children with pervasive attention deficit hyperactivity disorder. *Journal of Abnormal Child Psychology*, *17*, 109-125.
- James, A., & Taylor, E. (1990). Sex differences in the hyperkinetics syndrome of childhood. *Journal of Child Psychology and Psychiatry*, *30*, 383-387.
- Jensen, P. S. (1994). Personal communication at NIMH Sex Differences Conference.
- Johnston, C., Pelham, W. E., & Murphy, H. A. (1985). Peer relationships in ADHD and normal children: A developmental analysis of peer and teacher ratings. *Journal of Abnormal Child Psychology*, *13*, 89-100.
- King, J. (1994). Personal communication at NIMH Sex Differences Conference.
- Klein, R. (1994). Personal communication at NIMH Sex Differences Conference.
- Lahey, B. B. (1994). Personal communication at NIMH Sex Differences Conference.
- Lahey, B. B., Applegate, A., McBurnett, K., Biederman, J., Greenhill, L. L., Hynd, G. W., Barkley, R. A., Newcorn, J., Jensen, P., Richters, J. E., Garfinkel, B., Kerdyk, L., Frick, P. J., Ollendick, T., Perez, D., Hart, E. L., Waldman, I., & Shaffer, D. (1994). DSM-IV field trials for attention-deficit hyperactivity disorder in children and adolescents. *American Journal of Psychiatry*, *151*, 1673-1685.
- Lahey, B. B., & Carlson, C. L. (1991). Validity of the diagnostic category of attention deficit disorder without hyperactivity: A review of the literature. *Journal of Learning Disabilities*, *24*, 110-120.
- Loney, J. (1994). Personal communication at NIMH Sex Differences Conference.
- Lorch, E. (1994). Personal communication at NIMH Sex Differences Conference.
- Mannuzza, S., & Gittelman, R. (1984). The adolescent outcome of hyperactive girls. *Psychiatry Research*, *13*, 19-29.
- McGee, R., & Feehan, M. (1991). Are girls with problems of attention underrecognized? *Journal of Psychopathology and Behavioral Assessment*, *13*, 187-198.
- Meyer-Bahlburg, H. F. L., Sandberg, D. E., Dolezal, C. L., & Yager, T. J. (1994). Gender-related assessment of childhood play. *Journal of Abnormal Child Psychology*, *22*, 643-660.
- Pascualvaca, D. (1994). Personal communication at the NIMH Sex Differences Conference.

- Pelham, W. E., Walker, J. L., Sturges, J., & Hoza, J. (1989). Comparative effects of methylphenidate on ADD girls and ADD boys. *Journal of the Academy of Child and Adolescent Psychiatry, 28*, 773-776.
- Roizen, N., Blondis, T., & Stein, M. A. (1994). Adaptive functioning in children with ADHS. *Archives of Pediatrics and Adolescent Medicine, 148*, 1137-1141.
- Stein, M. A. (1994). Personal communication at the NIMH Sex Differences Conference.
- Stein, M. A., Sandoval, R., Szumowski, E., Roizen, N., Reinecke, M., Blondis, T., & Klein, Z. (1995). Psychometric characteristics of the Wender Utah Rating Scale (WURS): Reliability and factor structure for men and women. *Psychopharmacology Bulletin, 31*, 423-431.
- Stein, M. A., Szumowski, E., Blondis, T., & Roizen, N. (1995). Adaptive skills dysfunction in ADD and ADHD Children. *Journal of Child Psychology and Psychiatry, 36*, 663-670.
- Szatmari, P., Offord, D. R., & Boyle, M. H. (1989). Ontario Child Health Study: Prevalence of ADDH. *Journal of Child Psychology and Psychiatry, 30*, 219-230.
- Thomeer, M. (1994). Personal communication at NIMH Sex Differences Conference.
- Trites, R. L., Blouin, A. G., & LaPrade, K. (1980). Factor analysis of the Conners Teacher Rating Scale based on a large normative sample. *Journal of Consulting and Clinical Psychology, 48*, 615-621.
- Wheeler, J., & Carlson, C. L. (1994). The social functioning of children with ADD with and without hyperactivity: A comparison of their peer relations and social deficits. *Journal of Emotional and Behavioral Disorders, 2*, 2-12.
- Williams, L., & Swanson, J. (1994). Personal communication at NIMH Sex Differences Conference.
- Zametkin, A. J., Nordahl, T. E., Gross, M., King, A. C., Semple, W. E., Rumsey, J., Hamburger, S., & Cohen, R. M. (1990). Cerebral glucose metabolism in adults with hyperactivity of childhood onset. *New England Journal of Medicine, 323*, 1361-1366.
- Zoccolillo, M. (1993). Gender and the development of conduct disorder. *Development and Psychopathology, 5*, 65-78.