



**GENDER PATTERNS AMONG DSM-IV  
ATTENTION-DEFICIT/HYPERACTIVITY  
DISORDER SUBTYPES**

**VOLUME ONE**

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# VOLUME ONE

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## ABSTRACT

This study examined gender patterns among DSM-IV ADHD subtypes in a nationally representative sample of Australian children to address the following research questions:

1) What is the discriminant validity of ADHD subtypes in boys and girls?; and 2) Do the characteristics of boys and girls with ADHD differ?

ADHD subtypes in both the male and the female samples differed on most variables, however the pattern of differences was not always consistent across gender. Male and female subtypes showed a similar pattern of differences for prevalence, age, externalising problems and stimulant use. For example, children with inattentive type were more prevalent, older, had fewer externalising problems and lower stimulant use than those with combined and hyper-impulsive type. However, for internalising problems, impairment and service use, the pattern of subtype differences varied across gender. Among males, the combined type group had more internalising problems, impairment and service use than the other subtype groups, whereas among females, both the combined and inattentive type groups had higher rates for these variables than those with hyper-impulsive type.

With regard to gender differences, boys and girls with ADHD (all subtypes combined) did not differ on any of these variables, except that boys had poorer school functioning and greater stimulant use. However, significant gender by subtype interactions were found for impairment relating to social problems, school functioning and self-esteem. These interactions were consistent with boys being rated as more impaired than girls in the

combined and hyper-impulsive type groups, but equally or less impaired than girls in the inattentive type group, although the differences were not always statistically significant.

The findings of this study suggest that ADHD subtype patterns are influenced by gender and that there may be gender specific risks with regard to ADHD symptom expression. It is recommended that future studies carefully control for those conditions that mimic ADHD symptoms or are comorbid, in order to better assess the discriminant validity of ADHD subtypes and the gender-specific risks associated with high levels of inattentive and hyper-impulsive symptoms.

## **DECLARATION**

I certify that this thesis does not contain material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, that to the best of my knowledge and belief does not contain any material previously published or written by another person except where due reference is made in the text. I consent to the thesis being made available for photocopying and loan if accepted for the award of degree of Doctor of Philosophy.

Brian W Graetz

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# CHAPTER ONE

## INTRODUCTION

### STUDY RATIONALE AND AIMS

Attention Deficit Hyperactivity Disorder (ADHD) represents one of the most common reasons children are referred to mental health practitioners in Australia (Mellor, Storer, & Brown, 1996). Children with ADHD exhibit severe and pervasive impairments in multiple domains related to family, school and social functioning (Barkley, 1998a).

Unfortunately, most of the current knowledge of ADHD is limited to studies of clinic-referred boys. For example, the current DSM-IV guidelines identify three ADHD subtypes (inattentive, hyperactive-impulsive and combined subtypes) on the basis of the results of field trials conducted with 380 clinic-referred children of which 79% were male (Lahey et al., 1994). Although the results of these field trials indicate that these three subtypes are distinguishable in terms of age, gender and patterns of impairment, their discriminant validity with the wider population of children with ADHD has yet to be established for the following important reasons. First, only a minority of children with ADHD attend clinics (Schachar, 1991; Wolraich, Hannah, Pinnock, Baumgaertel, & Brown, 1996). Second, there is evidence to suggest that those who do attend may not be representative of children with ADHD in the general population (Gaub & Carlson, 1997b; Schachar, 1991). Finally, the under-representation of girls attending clinics means that it is unclear whether subtype discrimination will be found with girls with

ADHD and, if so, whether the pattern of differences is similar to that of boys with ADHD.

Generally little is known about girls with ADHD and how they compare to boys with the disorder. This is because researchers have found it difficult to recruit sufficient numbers of affected girls to conduct gender-based comparisons (Gaub & Carlson, 1997b). The fact that fewer girls with ADHD appear to attend clinics than boys, suggests that they may be a neglected subtype at risk for long-term emotional, social and academic problems (Berry, Shaywitz, & Shaywitz, 1985; Brown, Madan-Swain, & Baldwin, 1991; McGee & Feehan, 1991). Not surprisingly, over the past decade there have been calls for research examining the relative difficulties experienced by boys and girls with ADHD as a means to assess whether the current symptom thresholds should be lowered for girls (Arnold, 1996; Gaub & Carlson, 1997b; Silverthorn, Frick, Kuper, & Ott, 1996).

This study examines gender patterns among DSM-IV ADHD subtypes in a nationally representative sample of Australian male and female children aged 6 to 13 years to address the following research questions:

- 1) What is the discriminant validity of ADHD subtypes in boys and girls?
- 2) Do the characteristics of boys and girls with ADHD differ?

To address these questions, this study uses data collected from the Child and Adolescent Component of the National Survey of Mental Health and Well-Being. Conducted in 1998, this survey obtained detailed information from parents regarding children's



mental disorders, emotional and behavioural problems, social, family and school functioning as well as medication and service use.

## **THESIS STRUCTURE**

This thesis is divided into two volumes. Volume One contains the text of 11 chapters which represent the main body of the thesis, whilst Volume Two contains all tables, figures, references and appendices cited in the text. With regard to the contents of individual chapters, Chapter 2 critically reviews research findings relating to the discriminant validity of ADHD subtypes and ADHD gender differences. Chapter 3 describes the study participants, procedures and measures and Chapter 4 outlines the general statistical approaches used to address the two main research questions. The results of this study are presented in Chapters 5 through 9 according to the major domains that were assessed. These chapters address ADHD subtype and gender differences with regard to prevalence and symptom expression (Chapter 5), social-demographic characteristics (Chapter 6), comorbidity (Chapter 7), impairment (Chapter 8) and service and medication use (Chapter 9). Chapter 10 discusses the findings and their clinical relevance, and chapter 11 outlines the strengths and limitations of the study and highlights future research directions.

# **CHAPTER TWO**

## **LITERATURE REVIEW**

### **INTRODUCTION**

This chapter is divided into three parts. Part One provides an overview of how the disorder currently known as “ADHD” has evolved over the past 100 years. Particular attention is given to the various classifications outlined in the Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association) so as to provide the reader with pertinent information as to how the current DSM-IV ADHD subtypes were derived. Part Two examines research evidence pertaining to the discriminant validity of these DSM-IV ADHD subtypes in relation to those domains assessed in this study. Finally, Part Three examines research findings comparing boys and girls with ADHD.

## **PART I. THE EVOLUTION OF ADHD AS A DISORDER**

### **Early Perceptions and Descriptions**

Over the past 100 years the disorder currently known as ADHD has evolved through a series of re-conceptualisations. Views regarding the etiology and core features of the disorder have constantly changed which is reflected in the various terms given the condition. Early labels such as Brain-Damage Behaviour Syndrome and Minimal Brain Dysfunction reflected perceptions of an organic etiology whereas later terms such as Hyperactive Child Syndrome and Attention Deficit Disorder make no assumptions regarding etiology, but reflect different symptom pictures. The frustration of those attempting to define and operationalize the disorder is perhaps best summed up by one of the researchers who would eventually play a prominent role in the development of the current DSM-IV diagnostic guidelines for ADHD.

“...overall little has remained constant in our understanding of this disorder except for the belief that some children manifest such a disorder and we have never defined it adequately” (Lahey et al., 1988; p330).

The first comprehensive clinical descriptions of the disorder are generally credited to Sir George Frederick Still, the first Professor of Children’s Diseases at King’s College Hospital, in London (Barkley, 1996). In a series of lectures, Still (1902) described a group of 20 children attending his clinic who exhibited behaviours that today would likely attract a diagnosis of ADHD and possibly that of Oppositional Defiant Disorder or Conduct Disorder. He described these children as being “restless”, “fidgety”, “destructive”, “cruel and defiant” as well as having an “abnormal incapacity for sustained attention”. He suggested that they had “defects in moral control” in that they

were limited in their ability to regulate their behaviour based on the knowledge of what was right. Still believed that this moral deficit was essentially biological in nature, either due to the 'manifestation of some physical condition' such as a hereditary brain defect, or the result of pre- or post-natal central nervous system damage.

The view that hyperactivity was linked to brain damage was supported by a number of studies over the early part of the twentieth century. In the 1920s there were case reports of children having contracted and survived encephalitis subsequently exhibiting a total change in personality characterised by hyperactivity and distractibility as well as other behaviour problems such as emotional lability and 'general incorrigibility' (Ebaugh, 1923). Similar behaviours were also reported in studies looking at children who had experienced birth trauma (Doll, Phelps, & Melcher, 1932), head injury (Strecker & Ebaugh, 1924) and lead poisoning (Byers & Lord, 1943). The chance discovery by Bradley (1937) that amphetamines were effective in the treatment of hyperkinesis further supported the biological basis for hyperactivity.

In the 1940s Strauss and colleagues used the term "Brain Injured Child" to describe children exhibiting hyperactive behaviours (Strauss & Lehtinen, 1947). Their work is notable as it adopted the view that brain damage could be presumed to be present, even when it could not be demonstrated. This group devoted themselves to studying and educating children with borderline intelligence. They noted that children whose borderline intelligence was due to exogenous factors (i.e., brain damage) tended to be more talkative, inattentive, restless, disinhibited, and defiant compared to those whose borderline intelligence was due to endogenous factors (i.e., family history of mental deficiency) (Strauss & Lehtinen, 1947). They reasoned that if hyperactivity, inattention,

impulsiveness, and distractibility were the sequelae of brain damage in children, then children exhibiting such behaviours were brain-damaged (Strauss & Kephart, 1955). Although, they listed a number of criteria to identify a brain damaged child including history of perinatal brain injury, neurological indications, and evidence of “normal family stock”, they indicated that the diagnosis could be given to children on the basis of their behaviour alone (Strauss & Kephart, 1955).

Understandably, the reasoning that if brain damage causes behavioural problems then all children with behavioural problems must be brain damaged was heavily criticized for its circularity (Birch, 1964; Herbert, 1964). Many were also sceptical of the unitary concept of the brain-damaged child being proffered by Strauss and colleagues as many children with independently verified brain damage did not exhibit patterns of behaviour supposedly characteristic of brain-damaged children (Birch, 1964). By the end of the 1950s the belief that brain damage was the sole causative factor responsible for hyperactive behaviour was being strongly challenged (Sandberg & Barton, 1996).

In 1962, both the Oxford International Study Group on Child Neurology and a National Institute of Health Task Force in the United States recommended that the term minimal brain damage be replaced by minimal brain dysfunction (MBD) (Weiss, 1996). This subtle change from ‘damage’ to ‘dysfunction’ made it possible to broaden the scope of possible etiological factors to include genetic transmission and even early deprivation (Rie, 1980). Although MBD was viewed by some as representing a more balanced view of the multi-factorial origins of the disorder (Clements & Peters, 1962), the term was criticised for its lack of specificity in that it remained a catch-all diagnostic label given to children exhibiting a wide range of behavioural and learning problems (Kessler,

1980; Shaywitz & Shaywitz, 1988). Others viewed the introduction of MBD far more cynically suggesting that while the term still implied a relationship to brain-damage, professionals were no longer obligated to document the evidence (Kenny, 1980; Shaywitz & Shaywitz, 1988).

The late 1950s and 1960s saw a gradual shift away from diagnostic labels that promoted an etiological viewpoint to more descriptive views of the disorder (Weiss & Hechtman, 1993). Terms such as Hyperkinetic Behaviour Syndrome (Laufer, Denhoff, & Riverside, 1957) and Hyperkinetic Impulse Disorder (Laufer, Denhoff, & Solomons, 1957) were introduced based on the core symptoms of restlessness and impulsivity. Later, the term Hyperactive Child Syndrome was introduced, emphasising the importance of excessive motor activity as the defining feature of the disorder, with aggression and impulsivity viewed as associated characteristics (Chess, 1960).

With the 1970s came a sharp rise in the number of investigations into childhood hyperactivity (Sandberg & Barton, 1996). This coincided with the beginning of the development of parent and teacher rating scales to assess children's hyperactivity symptoms (Conners, 1969). The most influential research to be conducted during this period came from Virginia Douglas and her students in Canada. They conducted a series of investigations aimed at defining the specific disabilities that characterised hyperactive children. The results of their work suggested that it was children's inability to sustain attention and to inhibit impulsive responding that accounted for most of the deficits found in hyperactive children. For example, under conditions of continuous reinforcement, hyperactive children performed just as well as normal children on learning tasks, however with partial reinforcement schedules and on vigilance tasks

hyperactive children performed considerably worse than normal children (Douglas, 1972). Furthermore, as their performance on these vigilance tasks deteriorated, hyperactive children exhibited greater restlessness. Douglas hypothesised that, because hyperactive children have short attention spans, they tend to “flit” from one goal to another. This made their behaviour look disorganized and gave the impression of excessive activity.

### **Classifications of ADHD in the Diagnostic and Statistical Manuals of Mental Disorders (Versions I to IV)**

The Diagnostic and Statistical Manual of Mental Disorders (DSM) is the American Psychiatric Association’s official nomenclature of psychiatric disorders and is one of the two main diagnostic classifications systems used to describe psychiatric disorders. Although the first edition of the DSM (American Psychiatric Association, 1952) did not recognise the disorder known today as ADHD, reference was made in DSM-II (American Psychiatric Association, 1968) to a unitary disorder called Hyperkinetic Reaction of Childhood (or Adolescence) the main feature of which was motor overactivity.

Since the introduction of DSM-II, successive editions of the DSM have revised both the diagnostic criteria and subtyping associated with ADHD, reflecting continuing uncertainty as to the disorder’s core deficits and number of underlying dimensions. DSM-III (American Psychiatric Association, 1980) replaced the term Hyperkinetic Reaction with Attention Deficit Disorder (ADD) signifying a shift in emphasis from a disturbance of activity to a disturbance of attention. This shift was predominantly influenced by the work of Virginia Douglas and her associates which suggested

attention problems were the predominant feature of the disorder (Douglas & Peters, 1979). DSM-III revolutionised clinical diagnostic procedures by providing specific symptom criteria for the assessment of disorders. In the case of ADD, 14 symptoms were grouped into 3 symptom dimensions reflecting the central features of the disorder. These were inattention (5 symptoms), impulsivity (5 symptoms) and hyperactivity (4 symptoms) from which two ADD subtypes were identified; a) Attention Deficit Disorder with Hyperactivity (ADD/H) and b) Attention Deficit Disorder without Hyperactivity (ADD/wo). To meet the symptom criteria for ADD/H the child had to have at least 3 symptoms of inattention, 3 symptoms of impulsivity and 2 symptoms of hyperactivity. In the case of ADD/wo a child had to present with 3 or more symptoms from both the inattention and impulsivity groups, but not more than 1 symptom from the hyperactivity group. DSM-III also introduced age of onset (before the age of seven years) and symptom duration (at least 6 months) criteria for case identification.

The DSM-III ADD classification attracted considerable criticism. Concerns were raised regarding the complexity as well as the empirical basis of requiring specific numbers of symptoms from the different symptom dimensions (McBurnett, Lahey, & Pfiffner, 1993). Some suggested that the constructs of inattention, hyperactivity and impulsivity could not be reliably distinguished (Newcorn et al., 1989). For example, the symptom “has difficulty sticking to a play activity” was considered a measure of inattention, while a similar symptom “shifts excessively from one activity to another” was used to define impulsivity. Most concern centred upon the validity of the subtype “ADD without hyperactivity” for which there was little empirical support (Goodyear & Hynd, 1992). When DSM-III-R (American Psychiatric Association, 1987) was released the ADD/wo subtype was substantially downgraded as a diagnostic entity, referred to as



Undifferentiated Attention Deficit Disorder (UADD). This category was placed at the back of the child disorders section with no specific criteria given as to how it could be assessed and it generated very little research interest (McBurnett et al., 1993).

DSM-III-R reverted back to a single uni-dimensional definition of the disorder, which it termed Attention Deficit-Hyperactivity Disorder (ADHD). With DSM-III-R the three symptom groups (reflecting problems of inattention, impulsivity and hyperactivity) identified in DSM-III were revised and collapsed into a single list of 14 symptoms from which any 8 were sufficient to meet the symptom count criterion. This meant that children could meet symptom criteria for the disorder with any combination of inattention and/or impulsiveness and/or hyperactivity symptoms. This polythetic definition of ADHD was criticised on the grounds that it would exacerbate the heterogeneity problem (Lahey et al., 1988; Newcorn et al., 1989). For example, by allowing any 8 symptoms from a list of 14 to define the presence of the disorder, individual children with ADHD could have 8 symptoms each but have only 2 symptoms in common. It was also possible to meet symptom criteria without having any symptoms of inattention.

The decision by the DSM-III-R advisory committee to revert back to a uni-dimensional definition of ADHD was considered to be somewhat premature given that research evidence regarding the validity of ADHD symptom dimensions and subtypes was beginning to emerge (Lahey & Carlson, 1991). Following the release of DSM-III-R studies were conducted that investigated the number of dimensions of maladaptive behaviour that underlie ADHD (Lahey et al., 1994). The results of these studies, involving both community and clinic samples, suggested that the symptoms of ADHD

clustered into two dimensions - one composed of symptoms describing inattention, disorganization and difficulty completing tasks, and a second dimension composed of excessive motor activity and impulsive symptoms (Lahey & Carlson, 1991; McBurnett, 1997; Pelham, Gnagy, Greenslade, & Milich, 1992). During this time research evidence was also accumulating which suggested that the ADD/wo and ADD/H subtypes identified in DSM-III could be distinguished in clinically meaningful ways. For example, children with the ADD/wo subtypes had fewer serious conduct problems, but greater anxiety and learning disorders than ADD/H subtypes (Goodyear & Hynd, 1992; Lahey, Carlson, & Frick, 1997).

These emerging research findings were pivotal to the diagnostic guidelines developed in DSM-IV (American Psychiatric Association, 1994) for ADHD (McBurnett et al., 1993), and were supported by the results of the DSM-IV field trials. The DSM-IV field trials were conducted with 380 children aged 4 to 17 years across 10 different sites in North America with the view to providing an empirical basis for determining symptom lists and symptom cut-offs for DSM-IV ADHD (Lahey et al., 1994).

The first stage of the field trials involved testing the predictive utility of 21 ADHD symptoms (11 inattentive and 10 hyperactive-impulsive symptoms) from which 18 were eventually selected (9 inattentive and 9 hyperactive-impulsive symptoms) (Frick et al., 1994). This was followed by an examination of the associations between inattentive and hyperactive-impulsive symptom groups with global impairment (parent and clinician ratings on the Children's Global Assessment Scale; C-GAS) (Shaffer et al., 1983) and academic impairment (parent and teacher ratings). Consistent with factor analytic studies suggesting the independence of the two symptom dimensions they

found hyperactive-impulsive symptoms to be associated with global impairment whereas inattentive symptoms were associated with academic impairment (Lahey et al., 1994).

Lahey et al. (1994) then conducted a series of data analyses aimed at identifying optimal diagnostic thresholds for the two symptom dimension. First, the number of symptoms was plotted against the relevant impairment indices to determine the number of symptoms associated with a specific level of dysfunction. Hyperactive-impulsive symptoms were plotted against the median C-GAS scores to find the point at which the number of hyper-impulsive symptoms identified resulted in a median C-GAS score of 60. This point was found to be five hyperactive-impulsive symptoms for both informants (parent and interviewer C-GAS). Inattentive symptoms were plotted against parent and teacher academic performance measures (impairment was defined as 1.5 SD above the mean of a community 'normal' sample). This score was intercepted by an inattentive symptom count of six to seven. Second, they examined the optimum number of symptoms for predicting diagnoses made by clinicians. For clinician diagnosed ADHD, the cut off score for hyperactive-impulsive symptoms was four to five, regardless of the number of inattentive symptoms. For clinician-diagnosed ADD, the cut-off score for inattentive symptoms was six to seven. Based on these analyses, DSM-IV was originally going to set the symptom cut-points at six for inattentive symptoms and five for hyperactive-impulsive symptoms, however the cutpoint for hyperactive-impulsive symptoms was eventually increased to six so as to provide a more conservative threshold for the diagnosis of ADHD (McBurnett et al., 1993).

Although DSM-IV retained the diagnostic term ADHD, the disorder was subdivided into three subtypes according to the symptom profiles obtained from the list of 18 symptoms (9 hyperactivity/impulsivity symptoms and 9 inattention symptoms). These subtypes were: (a) predominantly inattentive type (children exhibiting at least six inattention symptoms but fewer than six hyperactive-impulsive symptoms, (b) predominantly hyperactive-impulsive type (children exhibiting at least six hyperactive-impulsive symptoms but fewer than six inattention symptoms), and (c) combined type (children exhibiting at least six inattention symptoms and at least six hyperactive-impulsive symptoms). DSM-IV also introduced two new criteria for case identification: namely, impairment from symptoms must be both pervasive (i.e., occur in two or more settings) and clinically significant (i.e., should affect social, academic or occupational functioning). The age of onset criteria and symptom duration criteria remained unchanged.

The combined and inattentive types are viewed as being similar to DSM-III's ADD/H and the ADD/wo respectively (Carlson, Shin, & Booth, 1999; Willcutt, Pennington, Chhabildas, Friedman, & Alexander, 1999), however there are important differences with regard to the numbers and clusters of symptoms. For example, the DSM-IV inattentive type does not include the impulsive behaviours prescribed for the DSM-III ADD/wo subtype. The hyperactive-impulsive type (hereby referred to as hyper-impulsive type for the sake of brevity) has no previous diagnostic counterpart. Justification for its introduction was based on the clinical observation that the vast majority of children meeting the criteria for hyper-impulsive type (87%) exhibited clinically significant impairment (Lahey et al., 1994). However, the fact that the majority of those children in the hyper-impulsive type group were in pre-school (65%)

has raised doubts as to the validity of this subtype. There has been speculation that this group of children may eventually develop inattention symptoms (thus representing a precursor to the combined ADHD type), or conversely show a reduction of symptoms over time (thus representing a misdiagnosed group of active but normal children) (Carlson et al., 1999).

## **PART II. THE DISCRIMINANT VALIDITY OF DSM-IV ADHD SUBTYPES**

### **Overview of the Limitations of Existing Research**

By identifying three subtypes of ADHD, the task force on DSM-IV aimed to reduce the level of heterogeneity previously associated with the disorder (Lahey et al., 1994).

However, for the new subtypes to be considered valid it is important to demonstrate that they are distinguishable by criteria other than the symptoms that define them, and that, moreover, these distinctions have clinical meaning and utility (Cantwell & Rutter, 1994). Thus children with different ADHD subtypes should differ in such areas as prevalence, age, gender ratios, comorbidity, functional impairment, etiology, clinical course or response to treatment. In the DSM-IV field trials ADHD subtypes were found to differ on several relevant characteristics including prevalence, age, gender and patterns of impairment (Lahey et al., 1994).

Since the introduction of DSM-IV the published research on the three DSM-IV ADHD subtypes has steadily grown, however there remains important gaps in the research evidence supporting the discriminant validity of DSM-IV ADHD subtypes (Carlson & Mann, 2000; Carlson et al., 1999; McBurnett, Pfiffner, & Ottolini, 2000).

First, the current DSM-IV subtypes were identified on the basis of findings from a clinic sample (Lahey et al., 1994). Research indicates that only a minority of children with ADHD attend clinics and there is a likely referral bias for those who do (Gaub & Carlson, 1997b; Schachar, 1991). It is important to assess the extent to which the subtypes can be distinguished within the total population of children with ADHD.

Although previous studies have investigated DSM-IV ADHD subtypes with

community samples, these studies have generally been restricted to comparisons of prevalence, gender ratios and comorbid emotional or behavioural problems. Little or no data have been collected on levels of social adversity or on levels of impairment in specific domains such as school functioning, peer relationships, self-esteem, family functioning as well as treatment and medication use. Furthermore, previous community-based studies have drawn their subtype samples from general school populations, where children with more severe ADHD may be under-represented as a result of being excluded.

Second, all but two of the community-based studies have used symptom checklists to identify ADHD subtypes (Ostrander, Weinfurt, Yarnold, & August, 1998; Rowland et al., 2001). These checklists take into account only current symptoms and not other essential DSM-IV criteria such as symptom duration (at least six months), symptom onset (before the age of seven), pervasiveness (symptoms present in two or more settings), impairment, or exclusion due to other disorders. As a result it is likely these studies overestimate the prevalence of ADHD and, moreover, possibly skew correlates such as gender and age which are important in determining the discriminant validity of ADHD subtypes (Carlson et al., 1999). For example, if symptoms of ADHD are more stable among males then it is likely that the male:female ADHD prevalence ratio would increase when the symptom duration criteria (i.e., at least 6 months) is included as part of the assessment.

Third, a number of studies were unable to recruit sufficient numbers of children with hyper-impulsive type to include this subtype group in their comparisons (Carlson, Booth, Shin, & Canu, 2002; Clarke, Barry, McCarthy, & Selikowitz, 1998, 2001;

Eiraldi, Power, Karustis, & Goldstein, 2000; Eiraldi, Power, & Nezu, 1997; Hodgens, Cole, & Boldizar, 2000; Houghton et al., 1999; Karustis, Power, Rescorla, Eiraldi, & Gallagher, 2000; Landgraf, Rich, & Rappaport, 2002; Maedgen & Carlson, 2000; Nigg, Blaskey, Huang-Pollock, & Rappley, 2002; Ostrander et al., 1998; Podolski & Nigg, 2001; Power, Costigan, Leff, Eiraldi, & Landau, 2001; Rowland et al., 2001; Vaughn, Riccio, Hynd, & Hall, 1997). As a result there are very little data on children with hyper-impulsive type and how they compare with those with combined or inattentive type, particularly with respect to comorbidity and impairment. This is an important omission as this is the one subtype that does not have a historical predecessor and for whom most questions remain as to its validity (Power & DuPaul, 1996).

Fourth, a number of studies were conducted with small samples. For example, 38% of the community-based studies and 70% of the clinic-based studies identified in the literature review to follow conducted ADHD subtype comparisons with groups containing fewer than 20 children. It is likely that a number of these studies lacked the statistical power to detect even medium effect size differences.

Fifth, few studies have controlled for possible confounding factors when comparing the level of impairment associated with DSM-IV ADHD subtypes. For example, none of the community-based studies controlled for differences in age, social adversity or psychiatric comorbidity, the latter being previously found to account for impairment associated with ADHD (Kuhne, Schachar, & Tannock, 1997). To date, only one clinic-based study has attempted to control for psychiatric comorbidity when assessing impairment associated with DSM-IV subtypes (Lahey et al., 1998). This study found



that ADHD subtypes continued to rate higher on global and social impairment than community controls when the number of Oppositional Defiant Disorder, Conduct Disorder and internalizing symptoms were statistically controlled.

Finally, all but one of the studies assessing the discriminant validity of DSM-IV ADHD subtypes have been conducted with samples comprised largely of boys. This includes the initial DSM-IV field trials where 79% of the 380 children and adolescents who participated were male (Lahey et al., 1994). Thus the research evidence regarding the discriminant validity of DSM-IV subtypes pertains generally to males. To date, the only study to describe DSM-IV ADHD subtypes within a female population was conducted with a sample of adolescent twins where latent class analyses were used to approximate ADHD subtypes (Hudziak et al., 1998).

### **Literature Search**

The following section reviews the findings of studies investigating the discriminant validity of DSM-IV ADHD subtypes. Studies were identified following a search of the PsychINFO and Pubmed electronic databases by combining the key terms DSM-IV, ADHD and subtypes. The search revealed 43 studies that met the following inclusion criteria. Studies had to include data directly comparing DSM-IV ADHD subtypes in children 13 years or younger on at least one of the following areas: a) prevalence; b) social demographic variables related to gender, age and social adversity; c) comorbid internalizing and externalising problems including both dimensional and categorical measures (Conduct Disorder and depressive disorders); d) impairment relating to social functioning, family functioning, global academic performance, school behaviour problems and self-esteem, and e) service and medication use. Studies were excluded if

ADHD groups were collapsed across subtype (Hale, How, Dewitt, & Coury, 2001; Klorman et al., 1999), used non-DSM symptoms to identify subtypes (Lamminmaki, Ahonen, Narhi, Lyytinen, & Todd de Barra, 1995) or the findings had been previously reported (Barry, Clarke, McCarthy, & Selikowitz, 2002; Crystal, Ostrander, Chen, & August, 2001).

Although this study was of community-based children, this literature review includes the findings from studies of clinic-referred children due to the paucity of data from community samples. It should be noted that community- and clinic- based studies generally apply different assessment approaches to the identification of ADHD subtypes. Most community-based studies have relied solely on teacher reports of DSM-IV symptoms to identify ADHD subtypes (see Table 2.1), whereas clinic-based studies often incorporate both parent and teacher reports as well as using various standardised rating scales (see Table 2.2). Furthermore, this review also includes the findings from studies that identified approximate DSM-IV ADHD subtypes based on DSM-III-R or DSM-III criteria (Brito, Pereira, & Santos-Morales, 1999; Hudziak et al., 1998; McBurnett et al., 1999; Ostrander et al., 1998; Paternite, Loney, & Roberts, 1996). These studies were included as they provide some of the few data that exist in several domains.

To assist interpretation, the findings of studies are summarised in a series of tables. Tables 2.1 and 2.2 summarise data pertaining to the prevalence, gender ratios and age of DSM-IV ADHD subtypes for community and clinic samples respectively. Tables 2.3 to 2.11 summarise findings relating to levels of social adversity (Table 2.3), comorbid Conduct Disorder and depressive disorders (Tables 2.4 and 2.5,

respectively), comorbid externalising and internalising problems (Tables 2.6 and 2.7, respectively), social functioning (Table 2.8), family functioning (Table 2.9), global academic functioning and school behaviour problems (Table 2.10), and service and medication use (Table 2.11). To enhance comparisons with the current study, only the findings from parent reports have been included from those studies that utilised multiple informants for the same measure, although differences between informants are mentioned in the text. Similarly, where studies have separate findings for children and adolescents, only the findings pertaining to children are reported. Other caveats to the summaries provided in the tables are identified in the text.

The layout for Tables 2.3 to 2.11 was designed to address two questions considered essential to assessing the discriminant validity of DSM-IV ADHD subtypes. These questions were:

- 1) Do DSM-IV ADHD subtypes differ from controls?
- 2) Do DSM-IV ADHD subtypes differ from each other?

Assessing the extent to which DSM-IV ADHD subtypes differ from controls is important, especially with regard to establishing impairment. This is particularly relevant for those with hyper-impulsive type who have not always been found to be impaired (Gadow et al., 2000; Gaub & Carlson, 1997a). Understandably, the extent to which ADHD subtypes differ from controls will be largely influenced by the criteria used to select this group. Not surprisingly, the criteria used to select controls differed across studies. Some studies identified controls as those not meeting symptom criteria (i.e., six or more symptoms) (Gadow et al., 2000; Nolan, Gadow, & Sprafkin, 2001), whereas others employed more stringent criteria excluding those who had been referred

for mental health problems (Eiraldi et al., 1997; Hodgens et al., 2000; Lahey et al., 1998). All the community-based studies used community controls, as did 6 of the 27 clinic-based studies. The six studies not to use community controls used children who had been referred to a variety of outpatient and inpatient centers for their control groups (Eiraldi et al., 2000; Lahey et al., 1994; Paternite et al., 1996; Podolski & Nigg, 2001; Power et al., 1998; Vaughn et al., 1997). These studies are highlighted in the relevant tables and mention is made in the text where the findings differ from those studies using community controls.

## **Review of Research Findings**

### ***Prevalence*** (Tables 2.1 and 2.2)

Prevalence estimates for individual ADHD subtypes tend to vary across sample type. Among community samples (Table 2.1), the inattentive type was generally found to be the most prevalent of the three subtypes ranging from 26% to 65% of the total ADHD sample (mean weighted by sample size = 50.7%), with the combined type being somewhat more common (weighted mean = 30.3%; range = 16% to 72%) than the hyper-impulsive type (weighted mean = 19.0%; range = 2% to 53%). There were a few exceptions to this trend. Hyper-impulsive types were found to be the most common subtype in studies conducted in Brazil (Pineda et al., 1999) and the Ukraine (Gadow et al., 2000), emphasising the importance of assessing cross-cultural differences in prevalence rates. A third study conducted in North Carolina identified more children with combined type, possibly because children using stimulant medications were actively recruited (Rowland et al., 2001).

In clinic-based studies (Table 2.2) which included all three ADHD subtypes, the combined type has been found to be the most prevalent ranging from 33% to 79% of the total ADHD sample (mean weighted by sample size = 60.2%), with the inattentive type generally being more common (weighted mean = 30.1%; range = 10% to 60%) than the hyper-impulsive type (weighted mean = 9.7%; range = 3% to 25%). The predominance of the combined type in clinic samples, is not surprising given that this subtype, by definition, has more symptoms and is associated with more pervasive impairments and greater comorbidity, all of which are likely to lead to greater rates of referral.

#### ***Gender Ratios*** (Tables 2.1 and 2.2)

Studies over the past 100 years have consistently found ADHD to be more common among males than females. For example, studies using DSM-III and DSM-III-R criteria generally report male:female ratios in the order of 3:1 (Barkley, 1998b; Costello et al., 1996; Szatmari, Offord, & Boyle, 1989b). With DSM-IV, ADHD continues to be more common among males but the level of predominance varies somewhat between subtypes. Male:female ADHD prevalence ratios tend to be marginally higher among combined and hyper-impulsive types (subtypes marked by high levels of hyperactivity-impulsivity) than inattentive types. The mean male:female prevalence ratios for the three DSM-IV ADHD subtypes from the 43 studies listed in Tables 2.1 and 2.2 are as follows: inattentive type = 2.3:1 (range = 0.6:1 to 5.2:1); hyper-impulsive type = 3.3:1 (range = 1.1:1 to 9.0:1); and combined type = 3.3:1 (range = 1.1:1 to 7.5:1). Interestingly, one of the few studies not to show this trend was an Australian study where the male:female prevalence ratio for the inattentive type (3.6:1) was higher than both hyper-impulsive (1.9:1) and combined types (2.3:1)

(Gomez, Harvey, Quick, Scharer, & Harris, 1999). Although both clinic- and community-based studies generally report higher male:female prevalence ratios for the combined and hyper-impulsive types than inattentive types the level of male predominance is somewhat higher in clinic-referred samples. This point is discussed in Part Three of the literature review.

### *Age* (Tables 2.1 and 2.2)

Clinic-based studies (Table 2.2) have consistently found children with inattentive type to be the oldest, and those with hyper-impulsive type to be the youngest. However, age differences between subtypes were not always statistically significant, particularly between the combined and hyper-impulsive types (Eiraldi et al., 1997; Karustis et al., 2000; Lahey et al., 1998; Lalonde, Turgay, & Hudson, 1998), and when the sample sizes were small (Carlson et al., 2002; Eiraldi et al., 2000; Eiraldi et al., 1997; Hodgens et al., 2000; Houghton et al., 1999; Maedgen & Carlson, 2000; Power et al., 2001). Some of the age data can be difficult to interpret, as it is not always indicated whether researchers are referring to age at referral, ascertainment or symptom onset (Carlson & Mann, 2000). The two studies which report age at referral and at symptom onset both found children with inattentive type to be significantly older at referral than children in the other subtype groups (Faraone, Biederman, Weber, & Russell, 1998; Paternite et al., 1996). However, they report somewhat different findings with regard to age at symptom onset. In Faraone et al.'s study, children with inattentive type were on average 12 months older at symptom onset than children in the other subtype groups, whereas Paternite et al. reported reasonably uniform ages of symptom onset for the three subtype groups.

Surprisingly, age data have only been reported in three community-based studies (Chhabildas, Pennington, & Willcutt, 2001; Gaub & Carlson, 1997a; Willcutt et al., 1999) (Table 2.1). One study found children with inattentive type to be older than hyper-impulsive and combined types (Chhabildas et al., 2001), whereas another shows a non-significant trend to this effect (Willcutt et al., 1999). The third study reported virtually identical ages for the three ADHD subtypes (7.5 to 7.6 years) with a restricted age group (kindergarten to grade five)(Gaub & Carlson, 1997a).

### *Levels of Social Adversity* (Table 2.3)

Although previous studies report an association between ADHD and low socioeconomic status (SES) (Biederman et al., 1995; Schachar, 1991; Szatmari, Offord, & Boyle, 1989a), studies using DSM-IV criteria, to date, have not consistently found SES to be lower among children in the three ADHD subtypes compared to controls. Of the nine studies to compare ADHD subtypes and controls on SES, only two found significant differences. Faraone et al. (1998) found both children with combined and hyper-impulsive type had lower SES than controls, whereas Eiraldi et al. (1997) found only those with combined type had lower SES than controls. The lack of differentiation between ADHD subtypes and controls with regard to SES may be due to the fact that seven of the nine studies were with clinic samples that may be skewed towards higher SES. However, the two community-based studies to include SES data also found no differences between ADHD subtypes and controls (Ostrander et al., 1998; Willcutt et al., 1999). Similarly, there is no consistent pattern of ADHD subtype discrimination with regard to SES, with only three studies finding significant differences (Eiraldi et al., 1997; Faraone et al., 1998; McBurnett et al., 1999). These studies all found children with combined type to have lower SES than those with

inattentive type, however the relative SES status of children with hyper-impulsive type varied across studies. McBurnett et al. (1999) reported that children with hyper-impulsive type scored higher than combined types on the Hollingshead Index of Social Status (Hollingshead, 1975), whereas Faraone et al. (1998) reported that children with hyper-impulsive type had lower SES than both children with combined and inattentive type. It is difficult to account for these discrepant findings as Faraone et al. (1998) do not specify how SES was measured in their study.

The few studies to have investigated more specific indicators of social adversity such as family type (Eiraldi et al., 1997; Lalonde et al., 1998), family income (Lahey et al., 1998), family size (Eiraldi et al., 1997) and parent education (Gadow et al., 2000) also found no differences between ADHD subtypes and controls, nor any discrimination among ADHD subtypes.

### ***Psychiatric Comorbidity*** (Tables 2.4 and 2.5)

#### ***1. Conduct Disorder*** (Table 2.4)

Most clinic-based studies have found higher rates of Conduct Disorder among those with combined type than controls, but not those with hyper-impulsive or inattentive type (Carlson et al., 2002; Eiraldi et al., 1997; Faraone et al., 1998; Nigg et al., 2002; Podolski & Nigg, 2001; Power et al., 1998), although two of these studies involved clinic-controls (Podolski & Nigg, 2001; Power et al., 1998). In contrast, community-based studies have consistently found Conduct Disorder to be more common among ADHD subtypes than controls (Gadow et al., 2000; Nolan et al., 2001; Willcutt et al., 1999), although two of these studies based their findings on symptom severity scores (Gadow et al., 2000; Nolan et al., 2001).



With regard to subtype discrimination, higher rates of Conduct Disorder are generally reported for the combined than inattentive type within clinic samples (Carlson et al., 2002; Eiraldi et al., 1997; Faraone et al., 1998; Nigg et al., 2002; Nolan, Volpe, Gadow, & Sprafkin, 1999; Power et al., 1998), although one Canadian study reported higher rates among children with hyper-impulsive type than both combined and inattentive types (Lalonde et al., 1998). However, the reliability of this finding is questionable given the small number of children in the hyper-impulsive type group ( $n = 7$ ).

The pattern of subtype discrimination among community samples is somewhat less clear. Children with combined type were reported to have the highest rates of Conduct Disorder and children with the inattentive type the least in two studies (Nolan et al., 2001; Wolraich et al., 1996). The other three studies report no ADHD subtype discrimination, although all show a trend of greater Conduct Disorder comorbidity among children with combined type (Gadow et al., 2000; Ostrander et al., 1998; Willcutt et al., 1999). For example, Willcutt et al. found 47% of those meeting the criteria for combined type to have Conduct Disorder compared to 34% of the children with inattentive type and 27% of those with hyper-impulsive type.

## ***2. Depressive Disorders*** (Table 2.5)

Both clinic- and community-based studies have not uniformly reported higher rates of Major Depression among ADHD subtypes relative to controls, although a trend to this effect is found in those studies that do not (Eiraldi et al., 1997; Faraone et al., 1998; Power et al., 1998; Willcutt et al., 1999). For example, Eiraldi et al. found 19% of children with inattentive type and 7% with combined type had a comorbid Mood

Disorder compared to 0% for controls. With regard to subtype discrimination, studies consistently report greater rates of Major Depression among children with combined and inattentive types than hyper-impulsive type (Faraone et al., 1998; Nolan et al., 2001; Willcutt et al., 1999).

### ***Dimensional Measures of Comorbidity*** (Tables 2.6 and 2.7)

To assist interpretation, this review restricts itself to summarising the pattern of subtype discrimination found with broad-band externalising and internalising behaviour rating scales. Narrow-band ratings are used as proxies only for those studies which do not report broad-band behaviour ratings. Footnotes identify those studies that report discrepant patterns of subtype discrimination between broad-band and narrow-band scales.

#### ***1. Externalising Behaviour Problems*** (Table 2.6)

Children with combined and hyper-impulsive type are consistently found to have higher rates of externalising behaviour problems than controls in both studies of clinic and community samples. Children with inattentive type were found to have more externalising problems than controls in community samples (Gadow et al., 2000; Gaub & Carlson, 1997a), but not in 7 of the 11 clinic-based studies (Eiraldi et al., 2000; Maedgen & Carlson, 2000; Nigg et al., 2002; Paternite et al., 1996; Podolski & Nigg, 2001; Power et al., 2001; Vaughn et al., 1997), although 5 of these studies used clinic controls in their comparisons (Eiraldi et al., 2000; Paternite et al., 1996; Podolski & Nigg, 2001; Power et al., 2001; Vaughn et al., 1997).

With regard to discrimination between subtypes, clinic- and community-based studies report greater externalising problems among children with combined than inattentive type (Brito et al., 1999; Carlson et al., 2002; Eiraldi et al., 2000; Eiraldi et al., 1997; Gadow et al., 2000; Gaub & Carlson, 1997a; Maedgen & Carlson, 2000; Morgan, Hynd, Riccio, & Hall, 1996; Nigg et al., 2002; Ostrander et al., 1998; Paternite et al., 1996; Power et al., 2001; Vaughn et al., 1997), with the exception of one clinic-based study which compared subtypes on percentage of children scoring above the clinical cut-off (Faraone et al., 1998). Children with hyper-impulsive type were also found to have greater externalising problems than inattentive types in community samples (Brito et al., 1999; Gadow et al., 2000; Gaub & Carlson, 1997a), and in two of three clinic-based studies to compare these subtypes (Manning & Miller, 2001; Paternite et al., 1996).

## **2. Internalising Problems (Table 2.7)**

Clinic-based studies generally report greater internalising problems among DSM-IV ADHD subtypes relative to controls (Eiraldi et al., 2000; Eiraldi et al., 1997; Faraone et al., 1998; Maedgen & Carlson, 2000; Manning & Miller, 2001; Nigg et al., 2002; Paternite et al., 1996; Power et al., 2001; Vaughn et al., 1997), although only a trend to this effect was found for children with inattentive type in two studies (Nigg et al., 2002; Vaughn et al., 1997). Community-based studies have consistently found more internalising problems among children with inattentive type compared to controls (Gadow et al., 2000; Gaub & Carlson, 1997a; Ostrander et al., 1998), but not for those with hyper-impulsive type (Gadow et al., 2000; Gaub & Carlson, 1997a). Children with combined type had more internalising problems than controls in two studies (Gaub & Carlson, 1997a; Ostrander et al., 1998, Brito et al., 1999), but not in two

others conducted with Ukrainian (Gadow et al., 2000) and Brazilian school-children (Brito et al., 1999), with the latter study actually showing a trend of fewer anxiety problems among children with combined type.

The task of discerning differences between ADHD subtypes with regard to internalising problems is made difficult by the fact that only 6 of the 16 studies included all three subtypes. Only 3 of the 11 clinic-based studies found significant differences between subtypes, all of which report greater internalising problems among children with combined than inattentive type (Eiraldi et al., 1997; Nigg et al., 2002; Vaughn et al., 1997). Subtype differences were more evident in the community-based studies, but these were not always in the same direction. For example, children with combined type were reported by teachers as having more internalising problems than those with inattentive type in two studies, (Ostrander et al., 1998; Wolraich et al., 1996), whereas the exact opposite was found in a relatively small study of Brazilian school-children which also used teacher reports (Brito et al., 1999). Furthermore, no ADHD subtype differences were found in a study of Ukrainian school-children using parents as informants (Gadow et al., 2000). It is difficult to account for these discrepant findings given the various combinations of informant, instruments, cultural groups and sample sizes.

### ***Social Functioning*** (Table 2.8)

Clinic-based studies consistently report impaired social functioning among children with combined type relative to controls (Faraone et al., 1998; Hodgens et al., 2000; Lahey et al., 1994; Lahey et al., 1998; Maedgen & Carlson, 2000; Paternite et al., 1996; Vaughn et al., 1997). However, children with inattentive and hyper-impulsive

type have not been uniformly rated as impaired on specific sociometric measures. For example, children with hyper-impulsive type did not differ from controls on teacher-rated social preference (Lahey et al., 1994) and peer dislike scores (Lahey et al., 1998). Children with inattentive type were not impaired on teacher-rated peer dislike (Lahey et al., 1998) and parent-rated social preference scores (Maedgen & Carlson, 2000), although they had lower social preference scores than controls when rated by peers (Hodgens et al., 2000) and teachers (Lahey et al., 1994). Studies of both clinic and non-referred samples using global measures of social functioning have consistently reported poorer social functioning among ADHD subtypes relative to community controls (Faraone et al., 1998; Gadow et al., 2000; Gaub & Carlson, 1997a; Nolan et al., 2001; Ostrander et al., 1998; Paternite et al., 1996).

With regard to discrimination between subtypes, children with combined type were rated as having poorer social functioning than children with hyper-impulsive type in both clinic and community samples (Brito et al., 1999; Gadow et al., 2000; Gaub & Carlson, 1997a; Hudziak et al., 1998; Lahey et al., 1994; Lahey et al., 1998; McBurnett et al., 1999; Nolan et al., 2001), although not in one small study containing only seven children with hyper-impulsive type (Lalonde et al., 1998). The pattern of subtype discrimination becomes less clear for those with inattentive type. Although children with combined type appear to be more disliked by peers, they do not always have lower social preferences scores than those with inattentive type (Hodgens et al., 2000; Lahey et al., 1994). Some suggest that this discrepancy may reflect difference in the types of social problems experienced by these two subtype groups (Carlson & Mann, 2000). Recent research suggests that the aggressive behaviour and emotional dysregulation of combined types may lead to active peer rejection, whereas the social

passivity of the inattentive types may result in decreased peer acceptance (Maedgen & Carlson, 2000). Nevertheless, children with combined type are generally rated as having poorer global social functioning than inattentive types in community samples (Gaub & Carlson, 1997a; Hudziak et al., 1998; Nolan et al., 2001; Ostrander et al., 1998; Rowland et al., 2001), although only a trend to this effect was found in studies of Ukrainian (Gadow et al., 2000) and Brazilian school-children (Brito et al., 1999).

### ***Family Functioning*** (Table 2.9)

Although an association between impaired family functioning and ADHD has been well documented (Anastopoulos, Guevremont, Shelton, & DuPaul, 1992; Donenberg & Baker, 1993), children meeting the criteria for DSM-IV ADHD have not been uniformly found to be impaired relative to controls. All three ADHD subtype groups were reported as having lower family cohesion and greater family conflict than clinic controls in one study (Paternite et al., 1996), however another study found no differences between subtypes and community controls on family cohesion and only children with inattentive type were found to have greater family conflict using the same instrument (Faraone et al., 1998). These contradictory findings are somewhat counter-intuitive as one would expect community controls to resemble ADHD subtypes less than clinic-controls. It is possible that this discrepancy arises because Faraone et al. used community control data from an earlier study. In the other clinic-based study, the mothers of both children with inattentive and combined type rated themselves as being poorer parents than the parents of control children (Podolski & Nigg, 2001). In the only community-based study to assess family functioning, ADHD subtypes were found to have less positive mother-child relations than non-ADHD children (Gadow et al., 2000). ADHD subtypes have generally not been found to differ on family functioning

variables, although one recent clinic-based study found that children with combined type had a greater negative impact on parents and families than those with inattentive type (Landgraf et al., 2002).

### ***Global Academic Functioning*** (Table 2.10)

Using a variety of measures, studies of both clinic- and community-based samples generally report poorer academic functioning among children with inattentive and combined type relative to community controls (Brito et al., 1999; Faraone et al., 1998; Gadow et al., 2000; Gaub & Carlson, 1997a; Lahey et al., 1994; Manning & Miller, 2001). Conversely, children with hyper-impulsive type are generally not rated as having greater academic problems than controls (Faraone et al., 1998; Gadow et al., 2000; Gaub & Carlson, 1997a; Lahey et al., 1994; Paternite et al., 1996), except in one study where they received higher scores on a learning problems scale which was confounded by ADHD symptom items (Manning & Miller, 2001).

Not surprisingly then, children with combined and inattentive type have been found to rate lower on academic performance than those with hyper-impulsive type, although this pattern is more consistent within community-based studies (Baumgaertel, Wolraich, & Dietrich, 1995; Brito et al., 1999; Gadow et al., 2000; Gaub & Carlson, 1997a; Hudziak et al., 1998; Wolraich et al., 1996) than clinic-based studies (Lahey et al., 1994; McBurnett et al., 1999).

### ***School Behaviour Problems*** (Table 2.10)

Only three studies were identified as assessing school behaviour problems. All three ADHD subtype groups were rated as having more school behaviour problems than

controls, but did not differ from each other in the one clinic-based study (Paternite et al., 1996). Of the two community-based studies, one found higher rates of classroom behaviour problems among children with combined and hyper-impulsive type than those with inattentive type (Wolraich et al., 1996), whereas the other reported a trend of proportionally fewer children with combined type “following directions or rules” than those with inattentive type (Rowland et al., 2001).

### *Self Esteem*

To date, no studies have compared DSM-IV ADHD subtype groups on self-esteem. However, children with DSM-IV ADHD collapsed across subtypes have been reported as having greater ‘negative-self esteem’ (Rucklidge & Tannock, 2001) and lower global self-worth (Dunn & Shapiro, 1999) relative to community controls. Although previous clinic and community-based studies have reported lower self-esteem among children with ADHD (Prinz & Loney, 1974; Slomkowski, Klein, & Mannuzza, 1995; Treuting & Hinshaw, 2001), the findings have not been uniform (Hoza, Pelham, Milich, Pillow, & McBride, 1993; Wilson & Marcotte, 1996). Hoza et al. found no differences between clinic-referred boys with ADHD and community controls on self-report ratings of global self-worth. Interestingly, this same study found that boys with ADHD were less likely to accept responsibility for social failures, prompting speculation that the self-perceptions of some children with ADHD may be subject to a “positive illusory bias”.

### *Service Use (Table 2.11)*

Studies investigating service use among children with DSM-IV ADHD report higher rates of counselling among children with combined type (Faraone et al., 1998; Hudziak



et al., 1998) relative to children in the other subtype groups. Conversely, those with inattentive type have greater rates of school-based service use for special education problems than those with combined type (Paternite et al., 1996), or show a trend to that effect (Nolan et al., 2001). This latter finding is interesting given that children with combined and inattentive type have not been found to differ on global ratings of academic performance (Baumgaertel et al., 1995; Faraone et al., 1998; Gaub & Carlson, 1997a; Hudziak et al., 1998; Lahey et al., 1994; Lalonde et al., 1998; McBurnett et al., 1999). These findings suggest the possibility that children with inattentive type have more readily identifiable learning difficulties.

#### ***Medication Use*** (Table 2.11)

Although the rise in stimulant prescription rates over the last decade is well documented both here in Australia (Valentine, Zubrick, & Sly, 1996) and in the United States (Safer, Zito, & Fine, 1996), little is known about the stimulant use among children with ADHD defined by DSM-IV criteria. One large community-based study in the United States found that 25 % of children meeting DSM-IV ADHD symptom criteria were reported by teachers to be taking stimulants, with those with combined type having higher rates of stimulant use than the other two subtypes (Wolraich et al., 1996). In the two other community-based studies, Nolan et al. (2001) reported roughly equivalent medication use among the three ADHD subtypes (13% to 21%), whereas Rowland et al. (2001) found that children with combined type had substantially greater medication use than those with inattentive type (64% versus 25%). However, because both of these studies involved relatively small samples (N's = 124 and 46 respectively) the reliability of these figures is low. In contrast to these community-based studies, no subtype discrimination was found for medication or stimulant use in three clinic-based

studies which possibly reflects the referral bias associated with these samples (Carlson et al., 2002; Faraone et al., 1998; Vaughn et al., 1997).

### **Summary of Research Findings**

In summary, the results of the studies reviewed suggest that ADHD subtypes differ on prevalence, gender ratios, age, comorbidity, global social functioning and academic performance. There is some evidence of subtype discrimination for school behaviour problems as well as service and medication use, but little or no evidence of subtype discrimination with regard to levels of social adversity, family functioning and self-esteem, although research data are very limited with regard to these domains.

There was some variation in the pattern of subtype discrimination between clinic and community samples. This was most evident with regard to prevalence, but minor variations were also noticeable with internalising problems, social functioning and medication use. If anything, the studies of community samples show greater subtype discrimination (eg. academic performance, internalising problems and medication use), which is not surprising given the referral bias associated with clinic samples and the fact that a number of these studies did not include a hyper-impulsive type group in their comparisons.

With regard to the pattern of discrimination, children with combined type are consistently found to be either equally or more impaired than the other subtypes in all domains. This is not surprising given that these children have high levels of both inattention and hyperactivity-impulsiveness. Studies also suggest some discrimination between children with inattentive and hyper-impulsive types with the former having

poorer academic functioning, but lower rates of Conduct Disorder and other externalising behaviour problems. Children with hyper-impulsive type were generally not found to be impaired relative to controls with regard to academic functioning or internalising problems whereas those with inattentive type were. In general the data suggest that children with DSM-IV ADHD tend to exhibit different patterns of impairment according to symptom dimensions (McBurnett et al., 2000). Children in ADHD subtype groups which have high levels of inattention (combined and inattentive types) tend to exhibit academic and school related impairments, whereas children in ADHD subtype groups marked by high levels of hyperactivity/impulsivity (combined and hyper-impulsive types) exhibit externalising behavioural problems (Faraone et al., 1998; McBurnett et al., 1999; Paternite et al., 1996).

### **Evidence for the Discriminant Validity of DSM-IV ADHD Subtypes Among Females**

Although the findings of studies reviewed in the preceding section support the discriminant validity of DSM-IV ADHD subtypes, the vast majority of these studies were conducted with predominantly male samples. Excluding the study of adolescent female ADHD subtypes by Hudziak et al. (1998), males made up between 50% (Weiler, Bellinger, Marmor, Rancier, & Waber, 1999) to 100% of the ADHD samples listed in Tables 2.1 and 2.2 (Hodgens et al., 2000; Paternite et al., 1996) with a mean proportion of 73.1%. Thus, the discriminant validity of DSM-IV ADHD subtypes among females is largely unknown.

From the limited findings of Hudziak et al. (1998), it appears that female DSM-IV ADHD subtype groups exhibit a similar pattern of impairment to that of males. For

example, girls with combined and inattentive type were more likely to be rated as “impaired at school” than those with hyper-impulsive type, and girls with combined type had the highest social impairment ratings. However, two other studies report findings in the text which suggest gender may influence patterns of comorbidity among ADHD subtypes. For example, in Nolan et al.’s (2001) study, ADHD subtypes in the female sample showed less discrimination than that in the male sample on dimensional measures of Conduct Disorder and Major Depression. However, as no scores are reported it is impossible to assess whether there was greater convergence among scores or whether the reduced discrimination was due to the relatively small number of girls in the study (the combined and hyper-impulsive type groups each contained only eight girls). In the other study, girls with combined type received higher anxiety/depression scores than those with inattentive type, whereas no differences were found between male subtypes (Weiler et al., 1999).

### **Research Hypotheses**

Although relatively little is known about DSM-IV ADHD subtypes identified in community samples, the preceding literature review suggests that they will differ on the following domains:

Prevalence:

1. The inattentive subtype will be the most common ADHD subtype.

Externalising Behaviour Problems:

2. The combined and hyper-impulsive type groups will be rated as having greater externalising problems than those with inattentive type.

### Global Academic Functioning:

3. The combined and inattentive type groups will be rated as having greater academic impairment than those with hyper-impulsive type.

### Social Functioning:

4. Children with combined type will be rated as having poorer social functioning than children in the other subtype groups.

Given the general lack of data obtained from community samples, no research hypotheses were formulated regarding DSM-IV ADHD subtype patterns for the following domains: age of child, social adversity, internalising problems, self-esteem, school behavior problems, family functioning, service and medication use. These domains were considered key areas to be explored.

## **PART III. ADHD GENDER DIFFERENCES**

### **Introduction**

The fact that ADHD is more prevalent among males than females raises the question of whether gender differences exist regarding the expression or correlates of the disorder (Heptinstall & Taylor, 1996). Unfortunately, relatively little is known about girls with ADHD and how they compare to boys with the disorder, mainly because researchers have been unable to recruit sufficient numbers of affected girls to conduct gender-based comparisons. This has led to studies either excluding girls with ADHD (Hodgens et al., 2000; Paternite et al., 1996) or using gender as a covariate (Lahey et al., 1998; Szatmari, Offord et al., 1989a).

Gender differences in either the expression or correlates of ADHD are likely to have implications for the assessment and treatment of the disorder. For example, over the past decade there has been debate as to whether boys and girls with ADHD should be identified using identical or gender-specific symptom thresholds (Arnold, 1996; Gaub & Carlson, 1997b; McGee & Feehan, 1991). Some have suggested that the symptom cut-off score should be lower for females given that normative data from rating scales consistently show females to have lower base levels of inattention and hyperactivity than boys (DuPaul et al., 1998; DuPaul et al., 1997). This discrepancy means that girls have to deviate farther from same sex peers than do boys to reach the diagnostic threshold. Although this could be corrected by using sex-specific thresholds it may lead to an over-identification of “normal” girls with the disorder. One way of assessing the relative merits of sex-specific versus identical symptom thresholds is to examine the functional impairment of boys and girls with ADHD. For example, identical thresholds

may be more appropriate if boys and girls with ADHD exhibiting identical symptom patterns were found to be equally impaired, whereas an argument could be forwarded for gender-specific thresholds should identical symptom patterns result in different levels of impairment (Gaub & Carlson, 1997b).

Although there is little research directly comparing girls and boys with ADHD, a number of studies have found girls with ADHD to be more impaired relative to girls without ADHD. Girls with ADHD have been rated by both parents and teachers as exhibiting greater comorbidity and impairment including externalising behaviour problems (Berry et al., 1985; Breen, 1989; Breen & Barkley, 1988; Horn, Wagner, & Ialongo, 1989; Rucklidge & Tannock, 2001), internalising problems (Dunn & Shapiro, 1999; Horn et al., 1989; Rucklidge & Tannock, 2001), poor social functioning (Rucklidge & Tannock, 2001), peer relationship difficulties (deHaas, 1986; Horn et al., 1989), low self-esteem (Prinz & Loney, 1974; Rucklidge & Tannock, 2001), and cognitive impairments (Breen, 1989; Horn et al., 1989; McGee, Williams, & Silva, 1987; Rucklidge & Tannock, 2001; Seidman et al., 1997). Direct observation of girls with ADHD has found them to be less compliant and to engage in more negative behaviours with parents than controls (Befera & Barkley, 1985). Mothers of girls with ADHD report greater parenting stress than the mothers of 'normal' girls (Breen & Barkley, 1988). Unfortunately, most studies have been conducted with small samples likely to have low reliability. Recent, much larger studies of girls with DSM-III-R ADHD have found them to be more likely to have conduct, mood and anxiety disorders (Biederman et al., 1999) and to be more impaired in their school functioning (e.g., higher percentages of grade repetition) and family functioning (e.g., lower family cohesion) (Greene et al., 2001) than girls without ADHD.

## Literature Review

The following section summarises the findings of studies comparing boys and girls with ADHD. Given the general lack of research in this area, this summary includes studies involving clinic samples and those that did not use DSM-IV criteria to identify children with ADHD. The studies were identified following a search of the PsychINFO and Pubmed electronic databases. Two searches were conducted. The first combined a number of ADHD terms (ADD, ADHD, hyperactivity, hyperkinetic, attention problems) with gender terms (girls, females, sex, gender). The second combined ADHD terms with prevalence terms (epidemiology, prevalence).

The search revealed 36 studies (26 of which used criteria developed prior to DSM-IV to identify children with ADHD) that met the following inclusion criteria. Studies that did not use DSM-IV criteria had to include data directly comparing boys and girls with ADHD in which the subjects were 13 years or younger, although they did not have to directly assess children. For example, two studies derived data from medical records (James & Taylor, 1990; Kashini, Chapel, Ellis, & Shekim, 1979), and another compared the results obtained from a sample of girls with ADHD with the results obtained from a previous sample of boys with ADHD (deHaas & Young, 1984).

Although the vast majority of these studies used DSM criteria as part of the selection criteria there was considerable variation as to how these criteria were assessed. Some used formal diagnostic interviews (Pelham, Walker, Sturges, & Hoza, 1989; Rucklidge & Tannock, 2001), whereas others used symptom checklists (Barkley, 1989; Pelham & Bender, 1985; Szatmari, Offord et al., 1989b). In addition to meeting DSM symptom criteria, a number of studies also required deviant scores on parent and/or teacher rating



scales (Breen & Barkley, 1988; Sharp et al., 1999) which, in some cases, were based on sex-specific norms (Mantzicopoulos & Morrison, 1994; McGee et al., 1987). Studies also differed in the number of raters used. Some relied solely on ratings from parents (Kashini et al., 1979) or teachers (deHaas & Young, 1984; McGee et al., 1987; Pelham & Bender, 1985), which may have led to the identification of more “situational” ADHD children, whereas others required elevated ratings from both parents and teachers (Breen, 1989; Brown et al., 1991; Horn et al., 1989).

Such variations in subject identification make it difficult to determine the comparability of subjects across studies, even in those using DSM criteria. As such, five studies that did not use DSM criteria were also included in the review (four did not specify a formal diagnostic classification and one identified children according to ICD-9 criteria) (see Table 2.12). Approximately 70% of the studies that did not use DSM-IV criteria were with clinic samples. These studies provide most of the functional impairment data (i.e., social and academic functioning). Most community-based studies generally restricted their investigations of ADHD gender differences to areas of symptomatology and comorbid emotional or behavioural problems.

The inclusion criteria for studies using DSM-IV criteria were less stringent due the limited number of studies. Only six studies were identified which provided data directly comparing girls and boys with DSM-IV ADHD (Carlson, Tamm, & Gaub, 1997; Dunn & Shapiro, 1999; Newcorn et al., 2001; Rucklidge & Tannock, 2001; Sharp et al. 1999; Wolraich et al., 1996), of which three investigated children with combined type only due to the small number of children identified with hyper-impulsive or inattentive type (Carlson et al., 1997; Newcorn et al., 2001; Sharp et al. 1999). Only

one study made gender comparisons within all three ADHD subtypes (Wolraich et al., 1996). Given the limited data, it was decided to include the findings of studies where gender comparisons were stated in the text but no data given (Gadow et al., 2000, Lalonde et al., 1998; Newcorn et al., 2001; Nolan et al., 1999).

All studies identified in the literature review are listed in Tables 2.12 to 2.14. Tables 2.12 and 2.13 list studies that used criteria developed prior to DSM-IV to compare boys and girls with ADHD in clinic and community samples, respectively. Table 2.14 lists studies comparing boys and girls with DSM-IV ADHD. In addition to the studies listed in these tables, the literature search identified two narrative reviews of studies investigating gender differences in ADHD (Arnold, 1996; McGee & Feehan, 1991) as well as a meta-analysis of 17 studies (Gaub & Carlson, 1997b). The findings of this meta-analysis are discussed in the summary following the review as they provide a useful overview.

The following review summarizes the findings of studies comparing boys and girls with ADHD with regard to: a) core symptoms; b) social demographic variables related to age and levels of social adversity; c) comorbid internalizing and externalising problems including both dimensional and categorical measures (Conduct Disorder and depressive disorders); d) impairment relating to social functioning, family functioning, global academic functioning, school behaviour problems and self-esteem; and e) service and medication use. The domains assessed by individual studies are shown in Tables 2.12 to 2.14. These tables are designed to provide only a brief overview of individual studies and whether significant differences between boys and girls with ADHD were reported. Specific details regarding the findings of individual studies are reported in the text.

Each section generally begins with a review of the findings of studies that did not use DSM-IV criteria to identify children with ADHD. This is then followed by a review of studies comparing boys and girls with DSM-IV ADHD.

## **Review of Research Findings**

### ***Core Symptoms***

Most of the early studies investigating gender differences in core symptoms used the hyperactivity or inattention subscales of the Child Behaviour Checklist (CBCL; Achenbach, 1991a) or the Conners Rating Scales (Conners, 1969). In these studies, clinic-referred boys and girls with ADHD were generally not found to differ on either these subscales (Ackerman, Dykman, & Oglesby, 1983; Arcia & Conners, 1998; Barkley, 1989; Breen, 1989; Brown et al., 1991; Horn et al., 1989; Pelham et al., 1989; Silverthorn et al., 1996), or on other symptom rating scales (Befera & Barkley, 1985; Berry et al., 1985), or on symptom ratings by clinicians (James & Taylor, 1990; Kashini et al., 1979). The one exception being Breen and Barkley's (1988) study where girls with DSM-III ADD+H scored higher on the CBCL Hyperactivity scale than their male counterparts (although no differences were found with teacher ratings).

Relatively few of these early studies were conducted with community samples (Table 2.13). Studies by deHaas and Young (1984) and August, Ostrander and Bloomquist (1992) found that boys and girls with ADHD did not differ with regard to hyperactivity scores on the Conners' Teacher Rating Scale and in the number of DSM-III-R symptoms, respectively. However, in a later study, deHaas (1986) found boys with ADHD had higher teacher reported hyperactivity scores than girls with ADHD. Two studies using gender-based norms to identify boys and girls with inattention problems

both found greater hyperactivity among boys than girls (Mantzicopoulos & Morrison, 1994; McGee et al., 1987), which is not surprising given that boys with ADHD had to attain a higher threshold for case identification than girls.

To date, five studies have compared the symptom expression of boys and girls with DSM-IV ADHD. Although clinic-based studies have generally reported gender differences with regard to symptom presentation, these have not always been in the same direction. The one study to assess core symptoms within all three subtypes found no gender differences in symptom severity among children with inattentive and hyper-impulsive type, but females with combined type rated higher on inattentive and hyper-impulsive symptom severity than their male counterparts (Nolan et al., 1999). Sharp et al. (1999) also reported that girls with combined type had more severe symptomatology than boys, however this was based on CBCL *T* scores which are standardised differently for boys and girls. Contrary to these findings, Newcorn et al. (2001) reported in their text that boys with combined type had greater ADHD symptom severity scores than females. It is difficult to account for the discrepant findings of Nolan et al. and Newcorn et al. as both were conducted with clinic samples using parent ratings on almost identical DSM-IV symptom checklists. The only obvious difference was the age range of the respective samples. Newcorn et al. assessed children 7 to 9 years whereas Nolan et al. investigated children 3 to 18 years of which 71% were either preschoolers or adolescents. Recently, Rucklidge and Tannock (2001) investigated gender differences with regard to the number of symptoms in a clinic-sample of boys and girls with ADHD collapsed across subtype. They found no gender differences in parent reports regarding number of inattentive symptoms, however girls with ADHD were reported as exhibiting more hyper-impulsive symptoms. In the only community-based

study to assess symptom expression, boys and girls with combined type did not differ on the Attention Problems subscale of the Teacher Report Form (Achenbach, 1991b), but boys were more likely to exhibit the symptom “does not seem to listen” than girls (Carlson et al., 1997).

### *Age*

Most of the age data come from clinic-based studies that identified children with ADHD using criteria developed prior to DSM-IV. Typically these studies found that boys and girls with ADHD did not differ on age (Ackerman et al., 1983; Arcia & Conners, 1998; Befera & Barkley, 1985; Biederman et al., 2002; Breen & Barkley, 1988; Faraone, Biederman, Keenan, & Tsuang, 1991; Greene et al., 2001; Horn et al., 1989; James & Taylor, 1990), although there were some exceptions. In one study, boys with ADHD attending a paediatrics outpatients department were found to be on average 12 months older than their female counterparts (Bhatia, Nigam, Bohra, & Malik, 1991), whereas in another, girls with ADHD were found to be somewhat older at onset (Biederman et al., 2002). Other studies by Silverthorn et al. (1996) and Berry et al. (1985) suggest that it is important to distinguish between age of onset and age at referral and also between individual ADHD subtypes, respectively. Silverthorn et al. found boys and girls with ADHD did not differ on age of onset, but girls were referred at an earlier age. Berry et al. found that among children with DSM-III ADD with hyperactivity, girls were younger at referral than boys, however among those with ADD without hyperactivity boys were younger at referral than girls. Berry et al.’s study suggests the possibility that behaviours that are incongruent to one’s gender may be more easily noticed resulting in earlier referral. The two DSM-IV studies to report age data both found no differences between boys and girls with ADHD (Rucklidge &

Tannock, 2001; Sharp et al., 1999), although one of these studies found a non-significant trend for boys with ADHD to have an earlier age of onset (Sharp et al., 1999).

### *Levels of Social Adversity*

Studies investigating socioeconomic status (SES) using the Hollingshead Index (Befera & Barkley, 1985; Berry et al., 1985; Biederman et al., 2002; Faraone et al., 1991; Greene et al., 2001) as well as studies specifically investigating social class (James & Taylor, 1990), family adversity (McGee et al., 1987), and family income (Horn et al., 1989; Silverthorn et al., 1996) found no significant differences between boys and girls with ADHD. Similarly, most studies investigating parent education report no gender differences (Barkley, 1989; Breen & Barkley, 1988; Horn et al., 1989), although the mothers' and fathers' of hyperkinetic girls in one study were found to have greater education than the parents of hyperkinetic boys (James & Taylor, 1990). Five clinic-based studies investigating family structure found no gender differences in the parental marital status of boys and girls with ADHD (Bhatia et al., 1991; Biederman et al., 2002; Brown et al., 1991; Faraone et al., 1991; Horn et al., 1989) however, one early study found girls with ADHD more likely to have parents who were divorced (Kashini et al., 1979).

The three DSM-IV studies to investigate SES found no differences between clinic-referred boys and girls with ADHD on the Hollingshead (Lockwood, Marcotte, & Stern, 2001; Sharp et al., 1999) and Bilshen Indices (Rucklidge & Tannock, 2001). Rucklidge and Tannock (2001) also found no differences between boys and girls with DSM-IV ADHD with regard to the marital status of their parents and in the education levels

achieved by both mothers and fathers. To date, levels of social adversity among boys and girls with DSM-IV ADHD in community samples have not been examined

### *Categorical Measures of Comorbidity*

#### *1. Conduct Disorder*

All five studies to compare the prevalence of Conduct Disorder among boys and girls with ADHD using criteria developed prior to DSM-IV found either greater rates among boys with ADHD (Biederman et al., 2002), or a non-significant trend to that effect (August et al., 1992; Faraone et al., 1991; Silverthorn et al., 1996; Szatmari, Boyle, & Offord, 1989). For example, 42% of boys with hyperactivity identified in the Ontario Child Health Study had a comorbid Conduct Disorder compared to 36% of girls (Szatmari, Boyle et al., 1989).

All four DSM-IV ADHD studies to assess Conduct Disorder comorbidity have been with clinic samples. Generally, these studies identify too few cases of Conduct Disorder to conduct meaningful inferential analyses, nevertheless somewhat higher rates are generally found for boys. For example, Sharp et al. (1999) found 7% ( $n = 4$ ) of boys with combined type had Conduct Disorder compared to 2% ( $n = 1$ ) of their female counterparts, whereas Lalonde et al. (1998) report Conduct Disorder prevalence rates of 9% ( $n = 6$ ) and 0% respectively for males and females with combined type. This trend was reversed in a recent study which found marginally higher rates for Conduct Disorder among girls with ADHD (13%,  $n = 3$  versus 6%,  $n = 2$ ), possibly because there were twice as many females with combined type as there were males (Rucklidge & Tannock, 2001).

## ***2. Depressive Disorders***

Although most studies assessing differences between boys and girls with ADHD with regard to comorbid Major Depression have also identified too few subjects to conduct inferential analyses, somewhat higher rates are evident among girls (August et al., 1992; Faraone et al., 1991; Rucklidge & Tannock, 2001; Sharp et al., 1999). For example, in the two DSM-IV studies (both with clinic-referred children), Sharp et al. found 7% (n = 3) of girls with combined type had Major Depression compared to 0% for boys, whereas Rucklidge and Tannock reported rates of 13% (n = 3) for girls versus 3% (n = 1) for boys with ADHD collapsed across subtype. However, in a recent large study of clinic-referred children with DSM-III-R ADHD, boys were found to have significantly higher rates of Major Depression than girls (29%, n = 40 versus 15%, n = 21) (Biederman et al., 2002). The authors attribute this discrepant finding to the fact that their sample contained predominantly prepubertal children for whom depression is more commonly found in boys. However, three of the four previously mentioned studies were also with predominantly young children (Rucklidge and Tannock being the exception).

### ***Dimensional Measures of Comorbidity***

#### ***1. Externalising Behaviour Problems***

Most clinic-based studies using criteria developed prior to DSM-IV found no ADHD gender differences with regard to externalising behaviour problems with both teacher and parent reports (Arcia & Conners, 1998; Berry et al., 1985; Breen, 1989, Breen & Barkley, 1988; Brown et al., 1991; Horn et al., 1989; James & Taylor, 1990; Silverthorn et al., 1996), although boys were found to have higher rates of parent-reported aggression in one study (Ackerman et al., 1983). In contrast, community-based studies



consistently found greater externalising behaviour problems among boys with ADHD (deHaas, 1986; deHaas & Young, 1984; McGee et al., 1987).

To date, five studies have investigated externalising behaviour problems among boys and girls with DSM-IV ADHD. In the three clinic-based studies, parents rated girls with ADHD higher on oppositional behaviour in one study (Rucklidge & Tannock, 2001), but no gender differences were found in the other two studies, although their comparisons were with CBCL *T* scores (Dunn & Shapiro, 1999; Sharp et al., 1999). In contrast, the two community-based studies both found greater externalising behaviours among boys with ADHD, although these were with different subtypes. Teachers rated boys with combined type as being more aggressive in one study (Carlson et al., 1997) whereas, in the other, parents rated boys with hyper-impulsive type as being more delinquent (Gadow et al., 2000). Unfortunately, Gadow et al. report this finding in the text and provide no data comparing boys and girls in the other subtype groups.

## ***2. Internalising Problems***

Boys and girls with ADHD were generally not found to differ on internalising problems in studies not using DSM-IV criteria (Arcia & Conners, 1998; Befera & Barkley, 1985; Breen, 1989; Brown et al., 1991; Horn et al., 1989; Mantzicopoulos & Morrison, 1994). The only exceptions to this trend were two clinic-based studies where girls with ADHD scored higher on clinician ratings of fearfulness (Kashini et al., 1979) and on the CBCL Depression Scale (Breen & Barkley, 1988), respectively. It is possible these discrepant findings reflect a gender-referral bias whereby girls are more likely to be referred for internalising problems than boys. No differences have been found between boys and girls with DSM-IV ADHD on internalising problems (Carlson et al., 1997; Dunn &

Shapiro, 1999; Rucklidge & Tannock, 2001; Sharp et al., 1999), although two of these studies were limited to children with combined type only (Carlson et al., 1997; Sharp et al., 1999).

### ***Social Problems***

Clinic-referred boys and girls with ADHD identified using criteria developed prior to DSM-IV have not been found to differ on measures of social skills (Befera & Barkley, 1985), social withdrawal (Breen, 1989; Breen & Barkley, 1988; Brown et al., 1991) and social competence (Horn et al., 1989). Furthermore, no ADHD gender differences have been found on measures of peer problems (Biederman et al., 2002; Greene et al., 2001; Horn et al., 1989), although one study found ADD girls were rejected and avoided more by peers than ADD boys, a trend that was particularly evident among the ADD without hyperactivity group (Berry et al., 1985). The two early community-based studies to investigate ADHD gender differences with regard to social functioning both utilized classroom peer nominations. Boys and girls with ADHD were not found to differ on negative peer nominations in one study (deHaas, 1986), whereas in the other, boys with ADHD were more likely to be perceived as being socially aggressive (Pelham & Bender, 1985).

Three studies have assessed social functioning in boys and girls with DSM-IV ADHD (Carlson et al., 1997; Dunn & Shapiro, 1999; Rucklidge & Tannock, 2001). In the two clinic-based studies, girls with ADHD collapsed across subtypes were rated by parents as having more social problems using *T* scores from the Conners' Rating Scale in one study (Rucklidge & Tannock, 2001), but not in another which compared CBCL *T* scores (Dunn & Shapiro, 1999). These discrepant findings could be due to scale differences or

the fact that Rucklidge and Tannock's study contained a higher proportion of girls from the combined subtype group which typically have greater social impairment. No gender differences were found among children with combined type for teacher reported social problems and peer sociometric scores in the only community-based study to be conducted (Carlson et al., 1997).

### ***Family Functioning***

The only studies to assess the family functioning of boys and girls with ADHD have been with clinic-samples. Observations studies have found that the mothers of hyperactive boys tend to provide more direction during free play than mothers of hyperactive girls but few other differences (Barkley, 1989; Befera & Barkley, 1985). Studies utilising questionnaires to assess family relations (Befera & Barkley, 1985; Biederman et al., 2002; Horn et al., 1989) and parenting stress (Breen & Barkley, 1988) have not revealed any ADHD gender differences, nor have clinical interviews assessing marital discord (Bhatia et al., 1991). To date, no studies have assessed family functioning among boys and girls with DSM-IV ADHD.

### ***Global Academic Functioning***

Clinic-referred boys and girls identified as having ADHD using criteria developed prior to DSM-IV did not differ on teacher and parent ratings of global academic functioning (Ackerman et al., 1983; Horn et al., 1989; Silverthorn et al., 1996), although these reports were not always consistent with more objective assessments. For example, in Ackerman et al.'s study, boys with ADHD scored higher on an objective assessment of arithmetic competence than their female counterparts. Another study by Berry et al. (1985) suggests the possibility of a gender by subtype interaction. They found that

among children with DSM-III ADD with hyperactivity, girls were rated by parents as having greater academic and language impairments than boys, whereas no gender differences were found in the ADD without hyperactivity group.

Two community-based studies have investigated gender differences in academic functioning among DSM-IV ADHD subtypes. Wolraich et al. (1996) found no gender differences in teacher ratings of academic problems among children with inattentive and hyper-impulsive type, however a higher proportion of girls were rated as having academic problems than boys in the combined type group. Conversely, Carlson et al. (1997) found no gender differences among those with combined type with regard to how much they were learning. However this was with in a small sample (e.g., n = 11 in the female sample) that also excluded those with oppositional defiant disorder.

### ***School Behaviour Problems***

Boys with ADHD were found to have greater school behaviour problems than girls in early clinic-based studies. In one study, boys with ADD were more likely to lose control in the playground, bus or lunchroom as well as get into fights (Berry et al., 1985). Breen and Altepeter (1990) also found boys with ADHD to be more problematic than girls with ADHD in unsupervised settings (i.e., during recess and lunch and while in hallways), but not during classes or when on excursions. Overall, boys with ADHD scored higher than their female counterparts on total school behavioural problems both in Breen and Altepeter's study, and in another study where parents were used as informants (Biederman et al., 2002). The one study not to find a significant gender difference reported a trend of higher school behavioural problems among boys with ADHD (Breen, 1989). In the only DSM-IV study to assess school behaviour to date,

proportionally more boys with inattentive type were reported by teachers as having behaviour problems than their female counterparts (45.4% v 29.2%), whereas almost identical rates were reported for boys and girls in the other subtype groups (Wolraich et al., 1996).

### *Self-Esteem*

To date, the self-esteem of boys and girls with ADHD has only been assessed in clinic samples (Berry et al., 1985; Dunn & Shapiro, 1999; Horn et al., 1989; Rucklidge & Tannock, 2001). Horn et al. found no gender differences among DSM-III-R ADHD children with regard to self-concept, however a gender by subtype interaction was evident in an earlier study of DSM-III ADD subtypes, with girls being reported by parents as having poorer self-esteem compared to boys in the ADD without hyperactivity group, but not in the ADD with hyperactivity group (Berry et al., 1985). The two DSM-IV studies to assess ADHD gender differences with regard to self-esteem both collapsed their samples across subtypes (Dunn & Shapiro, 1999; Rucklidge & Tannock, 2001). Whereas pre-pubescent boys and girls with ADHD were not found to differ on global self-esteem in one study (Dunn & Shapiro, 1999), adolescent girls with ADHD scored higher on negative self-perceptions in the other (Rucklidge & Tannock, 2001).

### *Service Use*

Little is known about service utilisation patterns among boys and girls with ADHD. The fact that the male:female ADHD ratios are typically higher in clinic than community samples has been seen as a clear indicator that boys with ADHD are more likely to receive help for their problems than girls (Gaub & Carlson, 1997b). For

example, whereas community-based studies using DSM criteria have consistently found male:female ADHD gender ratios in the order of 3:1, clinic-based studies have reported gender ratios as high as 9:1 (Barkley, 1998b). This has led some researchers to suggest that girls with ADHD may represent a neglected subgroup at risk for long-term emotional, social and academic problems (Berry et al., 1985; Brown et al., 1991).

It is suspected that the ADHD gender ratio discrepancy may reduce with DSM-IV due to the introduction of the inattentive subtype, as this appears to be the most common expression of the disorder for girls (Lahey et al., 1994; Wolraich et al., 1996). Of the DSM-IV studies conducted to date (Tables 2.12 & 2.13), higher mean male:female prevalence ratios are evident for clinic than community samples with the hyper-impulsive (clinic 4.0:1 versus community 2.8:1) and combined types (clinic 3.7:1 v community 2.9:1) with virtually identical ratios being found for those with inattentive type (clinic 2.3:1 versus community 2.2:1). However, it is important to note that these comparisons are confounded by informant differences. Most clinic-based studies use parent and/or teacher reports, whereas most studies of community samples have used teacher reports. Given that past studies have found the gender ratio discrepancy tends to be greater for teacher than parent reports (McGee & Feehan, 1991), it is possible that the sex differentiation between clinic and community samples may have been even greater had the clinic samples not included parent informants.

Different explanations have been forwarded as to why sex differentiation is greater for clinic than community samples. Some have suggested that more males with ADHD attend clinics because there is a perception that ADHD is a male disorder and thus only the most severely affected girls tend to get referred (McGee & Feehan, 1991; Quinn &

Nadeau, 2000; Whalen, 1989). Others suggest that the higher referral rates for males with ADHD reflect gender differences in associated problems and the source of treatment for those problems (Gaub & Carlson, 1997b). Boys with ADHD tend to show higher rates of disruptive behaviour problems than their female counterparts and as such are more difficult to manage in structured settings such as a classroom, which in turn makes them more likely to be referred. Conversely, girls with ADHD are more likely to exhibit learning problems that are quite often dealt with in the school system. There is some empirical support for this view. In one study of referrals to a paediatric developmental unit, hyperactive boys were more frequently referred for behavioural problems whereas girls were more frequently referred for cognitive problems such as learning disorders (Kashini et al., 1979).

### *Medication Use*

There are little data regarding medication use among boys and girls with ADHD in community samples. From the data that have been obtained it appears that stimulant use may be higher among boys with ADHD. For example, in the United States Smokey Mountain study, Angold, Erkanli, Egger and Costello (2000) found 80% of boys aged 9 to 16 years meeting the criteria for DSM-III-R ADHD had taken stimulants during the previous 4 years compared to 41% of their female counterparts. A smaller discrepancy was found in rates of stimulant use among boys and girls with DSM-IV ADHD (28% males to 20% females) in Wolraich et al.'s (1996) large community-based study of Tennessee pre-school and elementary school children, however this was based on teacher reports which may underestimate stimulant use.

## **Summary of Research Findings**

This review of research findings suggests that boys with ADHD are more likely to attend services and to be using stimulants than girls with ADHD. However, with the possible exception of externalising behaviour problems and school behaviour problems, the majority of studies in the preceding review did not find gender differences with regard to the expression and correlates of ADHD. Despite the general trend of non-significant findings, there were studies in each of the domains reviewed where significant differences were found. Such inconsistency is not surprising given the methodological variations between studies with regard to the criteria used to assess ADHD, the source of the subjects (i.e., clinic v community), the informants, the sample sizes, and the measures used.

In some domains it was evident that ADHD gender differences were more likely to be found in community rather than clinic samples. For example, of the early studies, those conducted with clinic samples generally found similar levels of symptom severity for boys and girls with ADHD, whereas boys were reported as exhibiting greater symptom severity in some community samples. Similarly, whereas community-based studies generally found boys with ADHD to have greater externalising behaviour problems, clinic-based studies generally found no gender differences. However, this pattern did not always continue with DSM-IV studies. For example, all three DSM-IV studies to assess symptom severity with clinic samples of children with combined type found gender differences (albeit not in the same direction) (Newcorn et al., 2001; Nolan et al., 1999; Sharp et al., 1999), whereas the one community-based sample of children with combined type found no gender differences in symptom severity (Carlson et al., 1997).



There was some evidence for gender differences in other domains but this was generally limited. There was a non-significant trend for boys with ADHD to exhibit greater rates of Conduct Disorder and a small minority of studies found girls with ADHD to have greater internalising problems and poorer academic performance than boys with ADHD. Virtually no gender differences with ADHD were reported for age of child, indicators of social adversity, family functioning and global social functioning.

Although this review suggests few differences between boys and girls with ADHD, any conclusion should be viewed cautiously as the methodologies employed in a number of studies reduced the likelihood that significant differences would be found. First, some studies assessed severity using the same measures to identify ADHD cases thus restricting the range of scores obtained (Berry et al., 1985; Horn et al., 1989). More serious is the fact that a number of studies were conducted with relatively small samples, particularly those studies conducted prior to the publication of DSM-IV. Approximately 50% of these studies had fewer than 20 girls, whereas 19% had fewer than 20 boys. Thus it is likely that a number of these studies lacked the statistical power to detect low to moderate effect sizes.

In an attempt to overcome the problems of interpreting the results of studies with small samples, Gaub and Carlson (1997b) conducted a meta-analysis of 17 studies comparing boys and girls with ADHD identified using criteria developed prior to DSM-IV (15 of these studies are included in this review). Initially, they calculated effect sizes for individual studies comparing boys and girls with ADHD on a range of variables. These effect sizes were then pooled across studies by each variable to assess overall trends.

The results suggested no differences between boys and girls with ADHD with regard to

levels of impulsiveness, global academic performance, social/peer functioning (global peer-liking) and parent education. However, girls with ADHD were found to display lower levels of hyperactivity and were less likely to have a Conduct Disorder or other externalising symptoms. However, some gender differences were mediated by sample source (i.e., community versus clinic samples). For example, in community samples, girls with ADHD displayed less inattention, internalising problems and peer aggression however, in clinic samples, no gender differences were found for these variables.

Overall, Gaub and Carlson (1997b) concluded by stating that the findings of their meta-analysis should be viewed with caution due to the small amount of data in a number of domains they assessed, and as such only tentative conclusions could be made regarding the comparative features of girls and boys with ADHD. Interestingly, the fact they found fewer ADHD gender differences within clinic than community samples raises the possibility that girls with ADHD who are referred to clinics may not be representative of girls with ADHD in general. If true, this would suggest that studying gender differences within clinic-based samples is likely to lead to erroneous conclusions about the nature of ADHD in girls.

Generally, little has changed since the publication of Gaub and Carlson's (1997) meta-analysis. While there have been studies conducted that have specifically compared boys and girls with ADHD these have generally been with children meeting DSM-III-R criteria (Arcia & Conners, 1998; Biederman et al., 2002; Greene et al., 2001). Overall, there remains a paucity of data on ADHD gender patterns particularly from community samples and particularly in the areas of psychiatric comorbidity, impairment, service and medication use.

## **Research Hypotheses**

The preceding literature review suggests that boys and girls with DSM-IV ADHD identified in community samples will differ on the following domains:

### **Prevalence:**

1. The prevalence of ADHD will be greater among boys than girls.

### **Externalising Behaviour Problems:**

2. Boys with ADHD will be reported as having more externalising behaviour problems than girls with ADHD.

### **Service Use:**

3. Boys with ADHD will have higher rates of service use than girls with ADHD.

### **Stimulant Use:**

4. Boys with ADHD will have higher rates of stimulant use than girls with ADHD.

The evidence from community samples pertaining to gender differences among children with DSM-IV ADHD is limited or inconsistent for symptom expression, age of child, levels of social adversity, internalising problems, global academic functioning, school behaviour problems, social functioning, family functioning, and self-esteem. Although no research hypotheses were proposed for these domains, they were considered key areas to be explored.

## **CHAPTER THREE**

### **METHOD**

#### **PARTICIPANTS**

The participants for this study were 2,404 children (1215 boys and 1189 girls) aged 6 to 13 years who took part in the Child and Adolescent Component of the National Survey of Mental Health and Well-being in Australia which was conducted in 1998 (Sawyer et al., 2000). This sample represents a subgroup of the total sample of 4,500 children aged 4 to 17 years who participated in the National Survey. Four and five year olds could not be included in this study, as the presence of psychiatric disorders was not assessed in this age group. Adolescents aged 14 to 17 years were excluded from the study so as to reduce the level of heterogeneity associated with the sample. The decision was made to include younger adolescents aged 13 years so as to ensure that there were at least 20 children in each of the subtype by gender cells.

The National Survey utilised a multi-stage probability methodology designed to identify a sample of 4500 Australian children aged 4 to 17 years. 'Clusters' of 10 fully responding households with children in the required age-range were sampled from each of 450 Census Collector's Districts (CD's) across Australia. The number of CD's sampled within each state or territory was in proportion to the size of the target populations within each region, and was also distributed proportionately across metropolitan and non-metropolitan areas (except for the Northern Territory and

Australian Capital Territory, where only children residing in metropolitan areas were sampled).

Within each Collector's District, a random starting point was nominated and interviewers then approached the household at this point. From this starting point, interviewers were requested to select every third adjacent household as potential participants until a total of ten households were identified in the Census District. Only one child was selected to participate from each household. The method of selection utilised the "birthday technique" whereby the child with the birthday nearest the date of the interview was selected from all the eligible children in the household. Interviewers were instructed to make up to four call-backs to those households where initial contact was not made with the occupants. These call-backs were to be made on different days of the week and at different times of the day. If no contact was made with members of the household following this procedure, or if the household did not contain a child of the appropriate age, a replacement household was to be identified according to a specified protocol.

Prior to collecting data for the survey all interviewers participated in a three day training program conducted by myself in my role as the senior project manager for the survey. The training was predominantly aimed at providing interviewers with instructions and practice sessions in administering the standardised interview (details below). In total, 120 interviewers were trained for the survey in Melbourne, Sydney, Brisbane, Adelaide and Perth. Fieldwork for the National Survey commenced early in February 1998 and was completed by May 1998.

In conducting the survey, interviewers requested that the child's primary caregiver complete the survey instrument (described below). In the majority of cases this was the child's mother (83.5%), however the child's father (10.2%), and in a few cases either both parents (3.5%) or another family member (2.9%) were the informants.

The participation rate, calculated as the number of participants who agreed to participate divided by the number of eligible households contacted was 86%. The response rate was somewhat lower at 70% as its calculation took into account the estimated number of non-contacted households that were likely to contain a child between the ages of 4 and 17 years. The major reason for the reduced response rate was that some interviewers contacted new households and conducted interviews before they had completed the four callbacks to households that they had visited earlier and found no one to be at home.

To assess the possibility of bias, the demographic characteristics of the children and families who participated in the study were compared with Australian population figures (based on the 1996 Australian Census). Comparisons included the child's age, gender, family structure, number of children living in the home, whether or not the child was attending school and children's place of birth. Parental (male and female caregiver) characteristics such as age, place of birth, occupation, educational characteristics, labour force status, and weekly income were also compared. Overall, it was found that the demographic characteristics of the survey sampled in all areas were highly comparable with the Australian Bureau of Statistics Census figures.

## **MEASURES**

The survey instrument consisted of: (a) a structured interview assessing children's mental disorders, physical health problems and service and medication use, and (b) a self-completed questionnaire assessing parent's perceptions of children's emotional and behavioural problems and their quality of life. Some questions regarding the demographic characteristics of the household were included in the structured interview, which was conducted first, and others in the self-completed questionnaire which was collected from the parents at a later date.

### **Mental Disorders**

Parents completed the Diagnostic Interview Schedule for Children Version IV (DISC-IV; National Institute of Mental Health) to identify the past year prevalence of the following disorders: Attention Deficit Hyperactivity Disorder (inattentive, hyper-impulsive and combined subtypes), Conduct Disorder, Major Depressive Disorder and Dysthymic Disorder. The DISC-IV was not administered to teachers.

The DISC is a highly structured diagnostic instrument designed for use by lay interviewers in large scale, epidemiological studies of children aged 6 to 17 years. The current version of the DISC, released in 1997, is based on DSM-IV classifications. Diagnoses are made through a series of structured questions focussing on the presence of symptoms, age of onset of symptoms, and impairment associated with symptoms.

The ADHD module is shown in Appendix A.1.

The parent version of the DISC-IV has been shown to have moderate to good diagnostic reliability within community samples with the following one-year test-retest reliability

kappa coefficients recorded: ADHD = 0.79, Conduct Disorder = 0.43 and Major Depressive Episode = 0.66 (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000). Although the DISC-IV has yet to undergo formal validity testing, good agreement has been found between parent responses on the DISC-2.3 based on DSM-III-R criteria and clinician ratings (ADHD, kappa = .72; Conduct Disorder, kappa = 0.74; Major Depression, kappa = 0.60) (Shaffer et al., 2000).

Diagnoses for the present study were based on the most current algorithms recommended to identify children meeting the criteria for ADHD at some point during the past year (Version H, July 2001). It is important to note that children meeting the criteria for ADHD at some stage during the past year may not be currently symptomatic (i.e., exhibiting at least six symptoms of inattention or hyper-impulsivity in the previous four weeks). Children with current ADHD were assessed in an earlier study (Graetz, Sawyer, Hazell, Arney & Baghurst, 2001). This study included all children who had met the criteria for ADHD at some point over the past year so as to ensure sufficient numbers of children in each of the subtype by gender cells. The decision to widen the sample to include children who met symptom thresholds at some stage over the previous year did not compromise the validity of the study as most correlates were assessed on the basis of their presence during the previous six to twelve months.

It should also be noted that the DISC (Version H) algorithms do not take into account criteria D (impairment) and criteria E (exclusion due to other disorders) when identifying subtypes. Although there is an experimental set of algorithms to determine clinically significant impairment, these were not used to identify subtypes because one of the main aims of the study was to investigate ADHD subtype and gender differences



with regard to impairment in various domains. By not including the impairment criteria this study was also able to examine the appropriateness of the current six symptom thresholds. It was not possible to include criteria E as the survey did not assess a number of disorders which could better account for ADHD symptoms. Children not meeting the criteria for ADHD were identified as controls.

### **Symptom-Specific Impairment**

For children who meet the criteria for ADHD, the DISC-IV assesses six domains of impairment as a function of their symptoms. These domains and accompanying summary names (where applicable) are as follows: (1) parental annoyance and distress (Annoyance to Parents); (2) keeps child from participating in family activities (Interference with Family Activities); (3) keeps child from participating in peer activities (Interference with Peer Activities); (4) problems with schoolwork or grades; (5) teacher annoyance and distress (Annoyance to Teachers); and (6) personal distress (Distress to Child). In each case, caregivers are asked to rate the level of impairment at the time during the last year when the child's symptoms were causing the most problems. Ratings employ a three point scale labelled "a lot of the time/some of the time/hardly ever" or "very bad/bad/not too bad". According to the latest published scoring algorithms for the DISC-IV, children are defined as being impaired if they score at least one severe rating or two intermediate ratings on these questions (Version H, July, 2001).

### **Service Use**

Parents were asked, "During the past 6 months has [CHILD'S NAME] received any help for emotional or behavioural problems?". Those parents who indicated that their

child had received help were then asked to list the main problems (up to a maximum of three) for which their child received help. Due to the non-specific nature of most of the externalising and internalising problems reported (e.g., behaviour problems, violence, anger, self-esteem, emotional-crying), most were grouped into a number of general categories some of which were taken from the Factors Influencing Health Status chapter of the International Classification of Diseases and Related Health Problems (ICD-10; World Health Organisation, 1992). The full list of categories were: (1) Attention Deficit/Hyperactivity Disorder; (2) Other externalising behaviour problems; (3) Depression; (4) Other internalising problems; (5) Problems related to education and literacy; (6) Problems related to social environment; (7) Problems related to negative life events in childhood; (8) Other problems related to primary support group including family circumstances; and (9) Other problems.

Parents were then presented with a list of 15 services and asked if their child had attended any of these services. These services were divided into two categories:

- (1) School or Education Based Services (counselling in school, attending a special school or class, or any other school or education based service).
- (2) Clinic-Based Service (family doctor, private paediatrician, private psychiatrist and private psychologist or social work, mental health clinic, drug or alcohol clinic, counselling services through the church, a telephone counselling service and any other community health service).

### **Medication Use**

Parents were asked, “During the past 6 months has [CHILD’S NAME] taken any prescribed medicine for emotional or behavioural problems?”. Parents who reported

that their child had received medication were asked to show the interviewer the child's medicine so that it could be correctly recorded. To assist data analysis, medications identified by parents were grouped into (1) stimulants and (2) "other" non-stimulant medications. The "other medications" category was comprised of a wide range of drugs including anti-depressants, anti-convulsants, mood stabilizers, and antipsychotics and some herbal drugs.

### **Child Behaviour Checklist**

The Child Behaviour Checklist (CBCL; Achenbach, 1991a) is a widely used standardized instrument for the assessment of childhood emotional and behavioural problems (Appendix A.2). The CBCL consists of 113 items which parents rate as either: "not true", "somewhat true" or "very true" over the last six months. Responses to these items are summed to provide scores for eight syndrome scales (Withdrawn, Somatic Complaints, Anxious/Depressed, Social Problems, Thought Problems, Attention Problems, Delinquent Behaviour, and Aggressive Behaviour) and the following two broad-band behaviour scales: Internalising Behaviour (ratings of fearful, inhibited or overcontrolled behaviour) and Externalising Behaviour (ratings of aggressive, antisocial or undercontrolled behaviour). In addition, a Total Problems score comprising of the sum of all the scores on the behaviour items can be obtained.

The CBCL has been shown to have good internal consistency and seven-day test-retest reliability and there are data supporting the discriminant validity of CBCL items and scales with both clinic and non-referred samples (Achenbach, 1991a). Although the CBCL provides normalized *T* scores to identify children who fall within a "clinical" range, these scores are standardised differently across gender and thus do not enable

direct gender comparisons to be made. For this reason, raw scores were used for the analyses conducted in this study.

### **Child Health Questionnaire**

The 50-item parent version of the Child Health Questionnaire (CHQ-PF50) (Landgraf, Abetz, & Ware, 1996) measures the quality of life of children across a number of domains (Appendix A.3). The specific scales used in this thesis are as follows:

- (1) Self-Esteem (satisfaction with school and athletic ability, looks/appearance, ability to get along with others and family, and life overall).
- (2) Role/Social Functioning due to Emotional/Behavioural problems (limitations with schoolwork and activities with friends due to emotional or behavioural problems)
- (3) Family Activities (frequency of disruption to “usual” family activities).
- (4) Family Cohesion (how well the family “gets along with one another”).
- (5) Parent Impact-Emotional (distress and worry experienced by the parents in the following areas - child’s physical health, emotional well-being, attention or learning abilities).
- (6) Parent Impact-Time (limitations in personal time experienced by parent due to the following - child’s physical health, emotional well-being, attention or learning abilities).

Six CHQ scales were not included in this thesis; four assessing the physical health of the child (General Health, Physical Functioning, Bodily Pain/Discomfort and Role/Social Functioning due to Physical limitations) and two assessing internalizing and externalising problems (Mental Health). The physical health scales were not included as they were not relevant to the main research questions. Furthermore, parents had been

asked as to whether their child had experienced any significant physical health problems during the previous six months as part of the structured interview. Chi-square analyses revealed no between-group differences in the proportion of children with a physical health problem in either the male sample ( $\chi^2_3 = 0.5, p = .93$ ) or female sample ( $\chi^2_3 = 1.1, p = .76$ ), and by gender for those with ADHD ( $\chi^2_1 = 1.1, p = 0.3$ ). The two mental health scales were excluded because they were small scales (five items each) comprised predominantly of CBCL items.

The CHQ has been shown to be reliable with high levels of internal consistency on all scales. The CHQ manual reports a median reliability estimate of 0.84 (Cronbach alpha) for the 12 CHQ-PF50 scales in a normative sample of 379 United States children aged 5 to 18 years (Landgraf et al., 1996). More importantly, the instrument was found to discriminate between clinically referred ADHD children and 'healthy' controls. Compared to controls, children with ADHD were rated as having lower self-esteem and to be experiencing greater limitations in their schoolwork and peer activities due to emotional or behavioural problems. Furthermore, parents of children with ADHD experienced marked limitations in the time available for their own needs and greater concern over their child's health and behaviour compared to the parents of healthy controls (Landgraf et al., 1996).

As recommended in the CHQ manual, prior to the analysis of results the raw score on each scale was transformed to a 0-100 scale with higher scores indicating a better quality of life. The use of a common metric across all the scales makes it possible to compare the functioning of children in the different domains assessed by the measure.

## **Parents' Perceptions of Children's Problems**

As part of the self-complete questionnaire parents were asked, "In the last 6 months, do you think your child has had any emotional or behavioural problems?". Those parents who reported that their child did have a problem, were asked a follow-up question "Do you think he/she needs or needed professional help with these problems?".

## **Demographic Characteristics**

During face-to-face interviews parents were asked to indicate the following: (a) current age of the child; (b) number of children living with target child; and (c) family type. To assess family type parents were asked, "Which best describes the household in which [CHILD'S NAME] is presently living?". The options were (a) original family, (b) step or blended family, (c) sole parent family, and (d) other.

The self-complete questionnaire contained a number of questions designed to assess the demographic characteristics of the household. In general, these characteristics were described using the classification system employed by the Australian Bureau of Statistics.

The following three measures, along with family type and number of children living with target child, were identified as indicators of social adversity.

(1) Household Income: Primary and Secondary caregivers were asked to nominate their usual before-tax weekly income from 1 of 15 categories ranging from (1) nil income to (15) \$1,500 or more per week (\$78,000 or more). When estimating their income, respondents were asked to include wages, salaries, overtime, family allowance, and other benefits such as child support, superannuation, interest received, dividends, and

business income. Household income was calculated by adding the individual gross incomes of the primary caregiver and any spouse or partner. To assist data analysis, the variable household income was dichotomized into those earning equal to or more than \$500 per week and those earning less than \$500 per week which was the cut-off point for the lower quartile.

(2) Age Parent Left School: Primary and secondary caregivers were asked, “ How old were you when you left secondary school?”. Analyses were based on the parent in the household with the greatest number of years in secondary school.

(3) Parental Employment: Primary and secondary caregivers were asked, “Last week, did you have a full-time or part-time job of any kind?”. The options were: (a) Yes, worked for payment or profit; (b) Yes, but absent on holidays, on paid leave, on strike or temporarily stood down; (c) Yes, unpaid work in a family business; (d) Yes, other unpaid work; and (d) No, did not have a job. To assist data analysis, parents were considered employed if either parent indicated yes to any of the first three options.

## CHAPTER FOUR

### APPROACH TO DATA ANALYSIS

#### MISSING DATA

Missing data were found for a number of variables used in the study. Generally this was less of a problem for variables assessed via the structured interview (e.g., mental disorders, service and medication use). Due to interviewer error, the presence of mental disorders could not be determined for some children (ADHD  $n = 29$ , 1.2%; Conduct Disorder  $n = 48$ , 2.0%; and depressive disorders  $n = 49$ , 2.0%). Children for whom the presence of ADHD could not be determined were found to score significantly higher on the CBCL Attention Problems scale than those not meeting the criteria for ADHD (3.7 versus 1.8;  $t_{1892} = 3.9$ ,  $p < .0001$ ), but significantly lower than those with ADHD (7.3;  $t_{32.4} = 6.6$ ,  $p < .0001$ ). This suggests that at least some of the children for whom the presence of ADHD could not be determined may have had this disorder.

Missing data were more problematic for measures assessed via the parent questionnaire (e.g., CBCL, CHQ, demographic characteristics), as 191 parents failed to return the questionnaire and a further 21 did not complete any part of the questionnaire. A comparison of the children's ADHD status, gender, age, and family type was made between those failing to return or complete any part of the questionnaire and those who returned the questionnaire. None of these comparisons was found to be significant which suggests that non-responders did not systematically differ from those who did



respond.

Questionnaire data were not available for 26 children found to meet the criteria for ADHD (inattentive type n = 11, hyper-impulsive type n = 2, combined type n = 13). These children did not differ from those children with ADHD for whom questionnaire data were available with regard to gender, or the likelihood of attending a service for emotional or behavioural problems. No attempt was made to substitute missing data with valid values, which accounts for why subject numbers may vary across tables.

### **ASSESSING THE DISCRIMINANT VALIDITY OF DSM-IV ADHD SUBTYPES**

To assess the discriminant validity of DSM-IV ADHD subtypes in males and females, this study compared same sex subtypes with each other and controls on variables related to prevalence, age of child, levels of social adversity, comorbidity, impairment, service and medication use. These variables were comprised of a number of categorical and continuous variables.

Between-group differences on categorical variables were examined using logistic regression analyses as this allowed for the control of possible confounding variables. Prior to investigating between-group differences on continuous variables, the distribution of scores for each variable was examined separately for males and females across the four groups. Scores for the social demographic variables (mean age at assessment, mean age at onset, number of children living at home) were normally distributed across the four groups in both the male and female samples. However, most CBCL scale scores were positively skewed in both the male and female samples, particularly in the control groups. Conversely, most CHQ scale scores were found to be

negatively skewed in both the male and female samples, again particularly with the control groups. Furthermore, Levene's test for the homogeneity of variance assumption indicated that levels of between-group variance was significantly different ( $p < .05$ ) on all CBCL scales except Somatic Complaints (females only), and on all CHQ scales except Self-Esteem. These significant between-group differences in the level of variance were generally due to the control group which had much smaller variation around its mean scores than did the three ADHD subtype groups.

In an attempt to reduce differences in between-group variance, square root and log transformations were conducted on the CBCL and CHQ scale scores in both the male and female samples respectively. Square root transformations on the CBCL scores with the female sample were generally successful with only two scales continuing to have significant between-group differences in variance following transformation (Thought Problems and Attention Problems). However, square root transformations of CBCL scores with the male sample was less successful as between-group differences in variance remained significant for all but three of the scales (Delinquent Behavior, Internalising and Total Problems). Even less success was achieved with data transformations on the CHQ scale scores with between-group differences in the level of variance remaining significant for all scales.

As CBCL and CHQ scores could not be readily transformed to approximate normal distributions, efforts were made to identify other parametric distributions that would provide a better fit for the data. CBCL scores fitted well with a Gamma distribution, but the distribution of CHQ scores could not be reasonably fitted to any member of the exponential family of distributions. Accordingly, non-parametric tests using a

cumulative logit model were used to assess between-group differences on CHQ scale scores for males and females. To conduct these analyses, scores on the CHQ scales were recoded to a simple ordinal scale. The lowest score on the particular scale was recoded to '1', the second lowest score was recoded to '2' and so on. Scores on a number of the CHQ scales had to be grouped due to idiosyncrasies of the original scoring program. Those scales that had more than 10 data points were recoded as follows: (0 to 20 = 1; 21 to 30 = 2; 31 to 40 = 3; 41 to 50 = 4; 51 to 60 = 5; 61 to 70 = 6; 71 to 80 = 7; 81 to 90 = 8; 91 to 99 = 9; 100 = 10). Recoding the data in the manner described above facilitated the fitting of generalized linear models on which comparisons between subtypes of ADHD and controls could be undertaken, with appropriate allowance for covariates and potential confounding variables.

Analyses investigating the discriminant validity of DSM-IV ADHD subtypes were conducted in two stages. The initial set of analyses did not attempt to control for potential confounders such as social adversity and psychiatric comorbidity so that the findings could be readily compared to that of previous studies which had generally been unable to control for such measures. Subsequent analyses were then conducted with the inclusion of possible confounding variables into the model. With respect to psychiatric comorbidity, the analyses controlled for the presence or absence of specific disorders.

As the overall number of covariates included in the analyses was quite high, a forward stepwise procedure was adopted so that the most parsimonious set of covariates was selected. Only those covariates that were significant at  $p < .10$  were retained in the final model for each dependent variable. The stepwise approach also had the advantage of

negating the potential problem of multicollinearity. Table footnotes indicate where the inclusion of covariates has altered the initial findings.

Effect-size statistics (group differences expressed in units of standard deviations) were also calculated for those continuous variables related to comorbidity (CBCL scale scores) and impairment (CHQ scale scores), primarily because the power to detect between-group differences was greater in the male sample than the female sample. By calculating effect sizes, this study was able to compare the relative magnitude of effect for between-group differences across the two samples. This study calculated effect sizes using Cohen's (1988) effect size correlation ( $d$ ), except that the standard deviation was pooled instead of averaged so as to take into account differences in sample sizes.

The complete formula is as follows:

$$d = \frac{M_1 - M_2}{\sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{(n_1 + n_2 - 2)}}}$$

Following Cohen's (1992) recommendations, effect sizes were considered small ( $ES > .20$ ), moderate ( $ES > .50$ ) or large ( $ES > .80$ ).

## COMPARING BOYS AND GIRLS WITH ADHD

The second major aim of this study was to compare the characteristics of boys and girls with ADHD. The approach to data analysis in this section is essentially the same as that addressing the discriminant validity of DSM-IV subtypes, except that the control group was removed from the analyses and gender was added as a second factor to that of ADHD subtype.

Removing the control group from the comparisons resulted in greater normality in the score distributions for continuous variables. Levene's test for the homogeneity of variance assumption found significant ( $p < .05$ ) between-group variance for only a few variables. These were: a) number of children living in household; b) CBCL Delinquent Behavior; Aggressive Behavior and Externalising Behavior scales; c) CHQ Role/Social Functioning scale; and d) mean numbers of inattentive and hyper-impulsive symptoms. Square root and log transformations were able to reduce the between-group variance to non-significant levels for all variables except the mean number of inattentive and hyper-impulsive symptoms. Between-group differences in variance for these variables were accounted by the ADHD subtype which, by definition, had fewer symptoms (e.g., the hyper-impulsive type group for the number of inattentive symptoms). Rather than attempt to transform the data, it was decided to remove these subtype groups from the respective analyses.

Given that the score distributions for the other continuous variables were either normal or could be transformed to approximate normality, Analyses of Variance (ANOVAs) were used to investigate between-group differences for these variables. As indicated earlier, these analyses were conducted using gender and ADHD subtype as the main

effects. These main effects were fitted initially without a gender by subtype interaction term as the initial objective of the analyses was to identify whether there was a gender effect across the total sample of children with ADHD. The interaction term was then added to the model to assess whether the gender patterns varied across ADHD subtype. Finally, the significance level for all inferential tests was set at ( $p < .05$ ), and all analyses were conducted using SAS Version 8.02 statistical software (SAS Institute, 1999).

### **THE ISSUE OF MULTIPLE COMPARISONS AND TYPE I ERRORS**

By assessing ADHD subtype and gender differences across a large number of variables this study inflated the probability of Type I errors (i.e., identifying a significant difference between groups when there was none). This study afforded some protection against experimentwise Type I errors by adopting the strategy of conducting multiple comparisons only when the omnibus test for an individual measure was found to be significant. When conducting multiple comparisons, this study used both post-hoc analyses and planned comparisons. Post-hoc analyses, using Tukey's Honestly Significant Differences Test, were conducted when there was a significant univariate  $F$  for differences between ADHD subtypes and controls. This test was chosen because it protects against Type 1 errors without severely compromising statistical power, which was an issue given the small numbers for some groups (e.g., girls with hyper-impulsive type) (Jaccard & Guilamos-Ramos, 2002). Pairwise t-tests and chi-square tests were conducted when there was a significant gender by ADHD subtype interaction to examine gender differences within individual subtypes. Finally, no attempt was made to correct for Type I errors within or across measurement families (i.e., the probability of Type I errors across multiple outcomes) as to do so would have resulted in an unacceptable loss of power.

## **CHAPTER FIVE**

### **RESULTS: PREVALENCE OF ADHD AND SYMPTOM EXPRESSION**

#### **CHAPTER OVERVIEW AND SUMMARY OF FINDINGS**

This chapter identifies the prevalence of the three DSM-IV ADHD subtypes among boys and girls, and examines ADHD gender differences regarding the expression of core symptoms. The major findings reported are that boys have a higher prevalence for each of the three subtypes, and that the inattentive type is the most common subtype for both boys and girls. With regard to symptom expression, boys and girls with ADHD did not differ with respect to the number of inattentive, hyper-impulsive or total number of ADHD symptoms reported by parents and there were few differences with respect to the prevalence of individual symptoms.

#### **PREVALENCE OF ADHD**

The prevalence of the three DSM-IV ADHD subtypes for children 6 to 13 years participating in the Child and Adolescent Component of the Australian National Survey of Mental Health and Well-being is shown in Table 5.1. The inattentive type was found to be the most common ADHD subtype representing approximately half of all the ADHD cases in both samples (48% for males and 53% for females). The relative prevalence of the combined and hyper-impulsive types differed across the two samples. The combined type was nearly twice as common as that of the hyper-impulsive type in

males (39% versus 18%;  $\chi^2_2 = 10.5, p < .01$ ), but was only marginally greater than that of the hyper-impulsive type in females (26% versus 21%).

When collapsed across subtype, the prevalence of ADHD among boys was approximately twice that of girls (18.7% versus 8.4%;  $\chi^2_1 = 52.6, p < .0001$ ). This male predominance was consistent across the three ADHD subtypes with the male:female prevalence ratios ranging from 1.9:1 for the hyper-impulsive type and 2.0:1 for the inattentive type up to 2.9:1 for combined types. Overall, the male:female ADHD prevalence ratio did not differ significantly across subtype ( $\chi^2_2 = 1.8 p = .4$ ).

## **GENDER DIFFERENCES IN ADHD SYMPTOM PATTERNS**

### **Symptom Number**

The mean number of ADHD symptoms reported for boys and girls in each of the three subtype groups is shown in Table 5.2. Significant between-subtype differences were found for the number of symptoms reported, with the combined type group having more symptoms of inattention than the inattentive type group, and more symptoms of hyper-impulsivity than the hyper-impulsive type group. When collapsed across subtype, boys and girls with ADHD did not differ on the total mean number of symptoms reported by parents (boys = 11.6 versus girls = 10.9).

### **Symptom Type**

The symptom profiles of boys and girls in each of the three subtype groups are shown in Figures 5.1 to 5.6. Each figure shows the proportion of boys and girls reported by parents as exhibiting individual ADHD symptoms. It can be seen that the symptom profiles tend to be uniformly high (all in excess of 60%) for those symptom dimensions



that are predominant for the particular subtype (e.g., hyper-impulsive symptoms for those with hyper-impulsive type). This is not surprising given that children require at least six out of nine symptoms to meet symptom criteria. Greater variability was found in the symptom profiles among those symptoms not predominant for a particular subtype (e.g., hyper-impulsive symptoms for those with inattentive type)

There were only minor differences in the symptom profiles of boys and girls with ADHD. Among children with inattentive and combined type, proportionally more boys were reported as exhibiting the symptom “often runs about or climbs excessively in situations in which it is inappropriate” (inattentive type: boys 23.0% versus girls 7.7%; combined type: boys 89.5% v girls 73.1%). Conversely, proportionally more parents of girls in both the hyper-impulsive and combined type groups endorsed “often talks excessively” (hyper-impulsive type: girls = 95.2% versus boys = 73.2%; combined type: girls = 92.3% versus boys = 69.7%). Finally, boys with hyper-impulsive type were also found to have higher rates for two inattention symptoms (“often fails to give close attention to details or makes careless mistakes in schoolwork...” (29.3% v 4.8%), and “often forgetful in daily activities” (22.0% v 0.0%).

Figures 5.7 and 5.8 shows the individual symptom profiles collapsed across the three ADHD subtypes. Significant gender differences were found for only 3 of the 18 symptoms. Proportionally, more boys with ADHD were reported as exhibiting the symptoms “often runs about or climbs excessively in situations in which it is inappropriate” (55.6% v 38.4%) and “often leaves seat in classroom or in other situations in which remaining seated is expected” (52.4% v 37.4%), whereas girls with ADHD had higher rates for the symptom “often talks excessively” (59.6% v 46.7%). It

is important to acknowledge that 3 significant findings in a set of 18 comparisons reflects what might be expected by chance alone when a  $p < .05$  level of protection is applied (Field & Armenakis, 1974).

## **CHAPTER SIX**

### **RESULTS: SOCIAL DEMOGRAPHIC CHARACTERISTICS**

#### **CHAPTER OVERVIEW AND SUMMARY OF FINDINGS**

This chapter outlines ADHD subtype and gender patterns regarding children's age, location of residence and levels of social adversity. The main findings are that children with inattentive type tend to be older, and that social adversity is generally limited to those with combined type. When collapsed across subtype, boys and girls with ADHD did not differ with respect to age (either at assessment or symptom onset) or social adversity, however girls with ADHD were more likely to be living in metropolitan areas than boys.

#### **ADHD SUBTYPE PATTERNS**

##### **Age of Child and Location of Residence**

Table 6.1 shows between-group differences for age of child (at assessment and symptom onset) and location of residence. For both boys and girls with ADHD, the inattentive type group was the oldest at assessment and the hyper-impulsive type group the youngest. The mean age difference between these two subtypes was 1.6 years in the male sample and 1.4 years in the female sample which, in the case of the latter, just failed to reach significance. Children with inattentive type were generally older at symptom onset than children in the other subtype groups, although girls with inattentive

type did not have significantly later age of symptom onset than girls with hyper-impulsive type.

With respect to location of residence, boys with combined type were more likely to be living in non-metropolitan areas than boys in the non-ADHD and hyper-impulsive type groups, but not when the analyses controlled for Conduct Disorder (higher rates of Conduct Disorder were found in non-metropolitan areas). No between-group differences were found in the female sample with regard to location of residence.

### **Levels of Social Adversity**

Table 6.2 shows the pattern of between-group differences for social adversity measures. In both the male and female samples, children with inattentive and hyper-impulsive type did not differ from their non-ADHD counterparts with respect to measures of social adversity, with the exception that girls with hyper-impulsive type were less likely to have parents in employment than non-ADHD girls.

Conversely, there was evidence of social adversity among children with combined type. This was particularly evident with regard to the proportion of children living in 'original' two parent families, where children with combined type had rates approximately 25% less than that of their non-ADHD counterparts in both the male and female samples. Although the test for between-group differences for family type in the female sample was not significant ( $p = .07$ ) when depressive disorders were statistically controlled (depressive disorders being more common among girls from sole-parent families), the individual odds ratio indicated that girls with combined type were still less likely to be living in 'original' two parent families. Boys with combined type were also

more likely to be living in households where parental employment and household income was lower compared to non-ADHD boys, (although depressive disorders accounted for differences in household income). Similar differences were not observed between girls with combined type and their non-ADHD counterparts, although a trend of lower parental employment was evident among girls with combined type. Overall, only boys with ADHD discriminated on social adversity measures. Boys with combined type were less likely to be living in original two parent families than boys in both the other subtype groups and they were less likely to have parents who were employed than boys with inattentive type.

### **ADHD GENDER PATTERNS**

Table 6.3 reports the test statistics for gender, subtype and gender by subtype interactions for children with ADHD with regard to social demographic variables.

When collapsed across subtype, boys with ADHD were, on average, six months older than girls with ADHD at the time of assessment (9.3 years versus 8.7 years) which just failed to reach significance ( $p = .06$ ). Boys and girls with ADHD had identical mean ages for symptom onset (2.7 years), and proportionally more girls with ADHD were living in metropolitan areas than boys with ADHD (68% v 55%).

Boys and girls with ADHD did not significantly differ on any of the social adversity measures, nor were there any significant gender by subtype interactions. When collapsed across subtype, boys and girls with ADHD had identical percentages for living in 'original' two parent families (63%) and having one or more employed parents (74%). With regard to household income, 74% of girls with ADHD were living in families where the weekly income was greater or equal to \$500 compared to 66% of

boys with ADHD, whereas 60% of girls with ADHD had parents who left school at 17 years or later compared to 52% of boys. Finally, the mean number of children living in a household was 2.5 for both boys and girls with ADHD.

# **CHAPTER SEVEN**

## **RESULTS: COMORBIDITY**

### **CHAPTER OVERVIEW AND SUMMARY OF FINDINGS**

This chapter reports ADHD subtype patterns and gender differences with regard to comorbidity using both categorical and dimensional measures. The prevalence of Conduct Disorder and depressive disorders (Major Depression and Dysthymia) are reported initially, followed by mean scores on the Child Behavior Checklist scales which provides a broader assessment of children's emotional and behaviour problems.

The main findings are that children with combined type were rated as having the highest levels of externalising behaviours and children with inattentive type the lowest. With respect to internalising problems, the pattern of subtype differences varied across gender. Among males, those with combined type were consistently rated as having the most internalizing problems with the inattentive and hyper-impulsive type groups having equivalent levels. Among females, those with inattentive and combined type had higher levels of internalising problems than girls with hyper-impulsive type. When collapsed across subtype, boys and girls with ADHD did not differ on the broad-band internalising and externalising behaviour problem scales.

## **CONVENTIONS USED IN THE REPORTING OF RESULTS**

In describing the pattern of results, this chapter initially begins by summarising whether DSM-IV subtype groups differed from non-ADHD controls, and then proceeds to examine whether there were differences between subtypes. This convention is generally followed in subsequent chapters on impairment (Chapter 8) and reported problems, service and medication use (Chapter 9). As with the previous chapters, the text is accompanied by a series of tables. However, unlike the tables in the previous chapter, the non-ADHD group is not included in the notations at the right hand side denoting significant between-group differences. This is because the non-ADHD groups were consistently found to have lower comorbidity than ADHD subtype groups, although there were a couple of exceptions to this rule. Removing the non-ADHD group from the table notation makes it easier to discern differences between subtypes. This convention is also followed in future chapters.

## **PSYCHIATRIC COMORBIDITY**

### **ADHD Subtypes versus Controls**

Table 7.1 reports between-group differences for psychiatric comorbidity. All three ADHD subtype groups in both the male and female samples had higher rates of Conduct Disorder than their non-ADHD counterparts. With regard to depressive disorders, all three subtypes in the male sample had higher rates of Major Depression and Dysthymic Disorder, however only girls with inattentive type had higher rates of depressive disorders than girls in the non-ADHD group. Inferential analyses of between-group differences for rates of Major Depression and Dysthymia in the female sample were not conducted due to the small numbers involved. For example, no girls with combined



type met the criteria for Major Depression and no girls with hyper-impulsive type met the criteria for Dysthymic Disorder.

## **ADHD Subtype Patterns**

### ***Conduct Disorder***

In both males and females, the combined type group had at least twice the rates of Conduct Disorder than the other subtype groups, although differences were not significant among girls with ADHD ( $p = .16$ ). The prevalence of Conduct Disorder among children with inattentive and hyper-impulsive type was not consistent across gender, with the inattentive type group having marginally higher rates in the male sample but somewhat lower rates in the female sample.

The percentage of individual Conduct Disorder symptoms reported for each of the three subtype groups was examined so as to identify the saliency of individual symptoms for children with combined type (Table 7.2). It should be noted that the symptom percentages for individual subtypes were collapsed across gender because of the low frequency of a number of symptoms, particularly among girls with ADHD. The combined type group consistently had the highest rates for individual symptoms with the only notable exception being “used a weapon” where children with hyper-impulsive type had the highest rates. Chi-square tests revealed that the combined type group had higher rates than both the other subtype groups for two symptoms (“stolen without confrontation” and “lies to obtain goods”), and higher rates than the inattentive type group for another three symptoms (“destroyed property”, “initiates physical fights” and “stays out late”).

### ***Depressive Disorders***

ADHD subtype groups in both the male and female samples did not discriminate on rates of depressive disorders, however the relative rates for individual subtypes varied across gender. Among males, those with combined type had rates of depressive disorders at least twice that of the other subtypes, whereas among females, the inattentive type group had twice the rates of the other subtype groups. Unfortunately, the rates for individual symptoms cannot be reported as parents were not asked about additional symptoms if their child was not depressed or irritable.

### **ADHD Gender Patterns**

Table 7.3 reports the test statistics for gender, subtype and gender by subtype interactions for psychiatric comorbidity among children with ADHD. When collapsed across subtype, approximately twice as many boys with ADHD met the criteria for Conduct Disorder as girls (19.2%  $n = 41$  versus 10.4%  $n = 10$ ), a difference that failed to reach significance ( $p = .15$ ). Table 7.4 shows the percentage of individual symptoms of Conduct Disorder reported for boys and girls with ADHD. Boys with ADHD had higher rates for “destroyed property” and showed a trend of higher rates for all but four other symptoms (“stolen without confrontation”, “lies to obtain goods and favours”, “physically cruel to people” and “stolen with confrontation”). Finally, when collapsed across subtype, boys and girls with ADHD had similar rates of depressive disorders (Boys = 11%,  $n = 24$ ; girls = 8%,  $n = 8$ ).

## **CHILD BEHAVIOR CHECKLIST (CBCL) SCALES**

### **ADHD Subtypes versus Controls**

Table 7.5 reports CBCL scale scores for ADHD subtype groups and their non-ADHD counterparts. Mean CBCL scores were generally higher for all three subtype groups than their non-ADHD counterparts in both males and females, with the exception that statistical significance was not observed for the small group of girls with hyper-impulsive type ( $n = 20$ ) with respect to the Withdrawn, Somatic Complaints and Thought Problems scales. Nevertheless, effect size statistics show that differences between girls with hyper-impulsive type and non-ADHD controls for the Withdrawn, Somatic Complaints and Thought Problems were generally small ( $d$ 's ranging from .11 to .28). This is in contrast to the medium to large effect sizes found for differences between girls in the other subtype groups and non-ADHD girls for these three scales (inattentive type:  $d$ 's ranging from .59 to 1.33; combined type:  $d$ 's ranging from 1.09 to 1.35). Effect size statistics for group differences on CBCL scores are shown in Appendix B (Tables B.1 and B.2 for males, and Tables B.3 and B.4 for females).

### **ADHD Subtype Patterns**

The following section initially describes ADHD subtype patterns with regard to the broad-band summary scales (Total Problems, Externalising, Internalising Problems) and their respective subscales. This is followed by descriptions of the three additional CBCL narrow-band scales (Social Problems, Thought Problems and Attention Problems).

The mean scores for the individual items that comprise the eight narrow-band scales were also examined so as to assess the consistency of ADHD subtype patterns across

the complete item set, and to identify those items which differentiate subtypes. With respect to the latter goal, inferential tests using Analyses of Variance (ANOVAs) were conducted. Prior to conducting these additional analyses, the score distributions for the individual items were inspected and data transformations attempted for those non-normal distributions. Violations of the homogeneity of variance assumption are indicated in the respective tables. Tables showing the mean scores for individual items on these respective scales are shown in Appendix B (Tables B.5 to B.32).

### ***Total Problems***

Among both boys and girls with ADHD, the combined type group received the highest scores on the Total Problems scale (Table 7.5). Interestingly, the relative scores for those with inattentive and hyper-impulsive type varied across gender, with the inattentive type group have somewhat lower scores in the male sample but somewhat higher scores in the female sample.

### ***Externalising Scales***

In both males and females, the combined type group received the highest scores on the broad-band externalising scale and those in the inattentive type group the lowest. Generally, this trend was consistent across the two narrow-band externalising scales (Delinquent and Aggressive Behavior), although differences between subtypes were less evident on the Delinquent Behavior scale, particularly among girls with ADHD where no significant differences were found. In fact, no subtype differences were found on any of the 13 items comprising the Delinquent Behavior scale in the female ADHD sample, although there was a trend for higher mean scores for the combined type group on some items (e.g., “swears and steals at home”) (Table B.5). Conversely, significant

differences were found between boys with combined type and those in the other subtype groups on 9 of 13 items that comprise the Delinquent Behavior scale (Table B.6).

It is interesting that boys with hyper-impulsive type received higher scores on the Externalising scale than those with inattentive type given that they had marginally lower rates of Conduct Disorder. Inspection of the two narrow-band scales indicates that boys with hyper-impulsive type received higher scores on this scale predominantly because they scored higher on the Aggressive Behavior scale which contains relatively few symptoms of Conduct Disorder (Table B.7). Compared to the inattentive type group, boys with hyper-impulsive type show a trend of higher mean scores on all 20 items of the Aggressive Behaviour scale with significant differences being found for 4 items (“demands a lot of attention”, “showing-off or clowning”, “talks too much” and “unusually loud”). Conversely, boys with combined type scored higher than boys with inattentive type on all 20 items. Again fewer significant differences were found between subtypes in the female sample on individual items, although girls with combined type show a trend of higher mean scores for all but two items (“shows off” and “talks too much”) (Tables B.8).

### ***Internalising Scales***

Scores for ADHD subtype groups on the Internalising scales were not consistent across gender. Among males, those with combined type received the highest scores on the broad-band Internalising problems scale with boys in the inattentive and hyper-impulsive type groups having almost identical mean scores. This pattern was consistent across the three narrow-band internalizing scales (Withdrawn, Somatic Complaints, Anxious Depressed), although differences were less evident with Somatic Complaints.

Significance tests revealed that boys with combined type scored higher than boys with inattentive type on two of the internalizing scales (Internalising and Anxious-Depressed). Inspection of the mean scores for the individual items which comprise the Anxious-Depressed, Withdrawn and Somatic Complaints scales for each of the three subtype groups in the male sample generally show a trend of higher mean scores for boys with combined type on most items (Tables B.9 to B.11 respectively). The one notable exception to this pattern was found for the item “shy or timid” on the Withdrawn scale where boys with combined type received lower scores than boys with inattentive type.

Among females, those with inattentive type received higher scores on the broad-band Internalising scale than girls with hyper-impulsive type with girls in the combined type group also showing a trend to this effect. This pattern was also consistent across the three narrow-band scales (Withdrawn, Somatic Complaints and Anxious-Depressed). Significance tests revealed that girls with hyper-impulsive type received lower scores than those with inattentive type on three of these scales (Internalising, Withdrawn and Anxious-Depressed), and lower scores than girls with combined type on two of these scales (Somatic Complaints and Withdrawn). This pattern of scores between ADHD subtypes was consistent across the individual items for these respective scales (Tables B.12 to B.14).

### ***Other CBCL Scales***

Although differences between ADHD subtypes were evident on the three other CBCL scales (Social Problems, Thought Problems and Attention Problems), these again varied across gender.

### ***1. Social Problems***

Among males, those with combined type scored higher on Social Problems than boys in other subtype groups, although they did not score significantly higher than boys with hyper-impulsive type when both depressive disorders and mean age at assessment were statistically controlled. Inspection of the individual items that comprise the Social Problems scale generally show a trend of higher mean scores for boys with combined type particularly for those items related to peer acceptance and rejection (i.e. “doesn’t get along with other kids”, “teased a lot”, “not liked by other kids”) (Table B.15).

In the female sample, both the combined and inattentive type groups received higher scores for Social Problems than the hyper-impulsive type group, although girls with combined type did not score significantly higher when family type was statistically controlled (girls from sole parent families were rated as having more social problems). This pattern of subtype differences was also consistent across individual items on the Social Problems scale, although fewer significant differences were found between subtypes (Table B.16).

### ***2. Thought Problems***

Among males, those with combined type received higher scores on Thought Problems than boys in the other subtype groups, although again they did not score significantly higher than boys with hyperactive type when both depressive disorders and mean age at assessment were statistically controlled. In the female sample, both the combined and inattentive type groups rated higher on Thought Problems than those with hyper-impulsive type. These respective patterns were generally consistent across individual items on the Thought Problems scale (Table B.17 and B.18).

### ***3. Attention Problems***

In the male sample, the combined type group scored higher on Attention Problems than boys in the other subtype groups, although they did not have significantly higher scores than boys with hyper-impulsive type when mean age at assessment was statistically controlled (younger children were reported as having greater attention problems).

Among females, those with combined type scored higher than those with hyper-impulsive type, although the differences were not significant when both Conduct Disorder and family type were statistically controlled (girls in step/blended and sole parent families were reported as having more attention problems).

Significant differences were found between subtypes on a number of items in both the male and female samples that were generally consistent with DSM-IV ADHD symptom dimensions (Tables B.19 and B.20). For example, both boys and girls in the combined and hyper-impulsive type groups received higher mean scores for the item “can’t sit still, restless or hyperactive” than their counterparts in the inattentive type group. However, it is interesting to note that girls with inattentive type received almost identical mean scores for the item “impulsive or acts without thinking” as girls with hyper-impulsive type and that they scored higher than girls with combined type for the items “poor school work” and “confused”.

### **ADHD Gender Patterns**

Table 7.6 reports the test statistics for gender, subtype and gender by subtype interactions for the 11 CBCL scale scores among children with ADHD. When collapsed across subtype, the only ADHD gender difference found was for the Somatic Complaints scale with girls receiving higher mean scores (1.8 versus 1.4). Inspection of



the mean scores for the individual items that comprise this scale showed that girls with ADHD received higher scores for the item “stomach aches and cramps” and showed a trend to this effect on all other items with the exception of “feels dizzy” (Table B.21).

Although there were no other significant main effects for gender, significant gender by subtype interactions were identified for Social Problems and Attention Problems. These two significant gender by subtype interactions are depicted in Figures 7.1 and 7.2, respectively. To further examine these interactions, *t* tests were conducted comparing boys and girls within each of the three subtype groups. With Social Problems, girls with inattentive type received higher scores than their male counterparts ( $t_{147} = -2.23, p = 0.03$ ), but no gender differences were found in the hyper-impulsive ( $t_{58} = 1.14, p = 0.26$ ) and combined ( $t_{87} = 1.05, p = 0.3$ ) type groups, although boys in these groups show a trend of higher mean scores. This trend was consistent across individual items on the Social Problems scale. For example, compared to their male counterparts, girls with inattentive type show a trend of higher mean scores on seven of the eight items of the Social Problems scale, receiving significantly higher scores for two of these items (“clings to adults or too dependent” and “teased a lot”). Conversely among those with hyper-impulsive and combined type, boys show a trend of higher mean scores on most items (Tables B.22 to B.24).

On the Attention Problems scale, boys with hyper-impulsive type received higher ratings than their female equivalents ( $t_{58} = 2.42, p = 0.02$ ), but no gender differences were found in the inattentive ( $t_{147} = -1.94, p = 0.053$ ) and combined ( $t_{87} = 1.36, p = 0.18$ ) type groups. This pattern was again consistent across individual items on the Attention Problems scale. For example, compared to their female equivalents, boys

with hyper-impulsive type showed a trend of higher scores on 10 of the 11 items, which was significant for two of these items (“acts too young for age” and “confused or seems to be in a fog”) (Tables B.25 to B.27).

Additional analyses were conducted to assess whether psychiatric comorbidity could account for the significant gender by subtype interactions found for the Social Problems and Attention Problems subscales. (No such analyses were conducted for Somatic Complaints as this is a measure of internalizing problems). When Conduct Disorder and depressive disorders were both statistically controlled, the gender by subtype interaction remained significant for Attention Problems ( $\chi^2_2 = 4.3, p = 0.02$ ), but not for Social Problems ( $\chi^2_2 = 2.7, p = 0.07$ ) where both depressive disorders and Conduct Disorder were found to be significant predictors.

Finally, mean scores received by boys and girls with ADHD collapsed across subtype on the individual items of the other five narrow-band CBCL scales were also inspected (Tables B.28 to B.32). Significant differences were found on only 11 of the 60 items contained on these five narrow-band scales, which is only slightly more than what would be expected by chance when a  $p < .05$  level of protection is applied (Field & Armenakis, 1974). Of the 11 items where significant differences were found, boys with ADHD received higher scores for 6 items which were generally reflective of conduct problems (“hangs around those who get in trouble”, “vandalism”, “destroys own things”, “disobedient at school”, “gets in many fights”, “repeats certain acts”). Conversely, the five items where girls with ADHD received higher scores reflected a broader range of problems (“feels too guilty” and “complains of loneliness”, “easily jealous” and “talks too much”, “thinks about sex too much”).

# CHAPTER EIGHT

## RESULTS: IMPAIRMENT

### CHAPTER OVERVIEW AND SUMMARY OF FINDINGS

This chapter outlines ADHD subtype and gender patterns with regard to impairment.

Impairment was assessed using the Diagnostic Interview Schedule for Children (DISC) impairment questions which address the specific impact of ADHD symptoms on children's functioning, and the Child Health Questionnaire (CHQ), which assesses quality of life.

The major finding reported in this chapter is that although ADHD subtype groups in both the male and female samples were found to differ on measures of impairment, the pattern of differences was not uniform across gender. Among males, the combined type group was consistently rated as the most impaired, whereas among females, both the combined and inattentive type groups were generally rated as more impaired than girls with hyper-impulsive type who, in turn, did not generally differ from their non-ADHD counterparts. When collapsed across subtype, proportionally more boys with ADHD were rated as having school-related problems than girls. Although no other main effects for gender were found, there were a number of significant gender by subtype interactions.

## **DISC SYMPTOM-SPECIFIC IMPAIRMENT**

### **ADHD Subtype Patterns**

Table 8.1 shows the percentage of boys and girls in each subtype group who were rated as exhibiting impairment as a function of their ADHD symptoms across the domains assessed by the DISC. Impairment ratings were not available for the non-ADHD group. Among males, the combined type group had the highest impairment percentages on 5 of the 6 domains (Annoyance to Parents being the exception where the impairment percentages were uniformly high across the three subtype groups). Significance tests revealed that proportionally more boys in the combined and hyper-impulsive type groups were restricted in their family activities than boys with inattentive type. Boys with combined type were also more likely to be experiencing restrictions in their peer activities because of their symptoms than boys with inattentive type, as were boys with hyper-impulsive type when mean age at assessment was statistically controlled (impairment increased with age). Finally, proportionally more boys with combined type were having problems with their schoolwork or grades, and annoying or upsetting their teachers than boys in the other subtype groups.

Among females, those with combined and inattentive type had the highest impairment percentages across all domains except Annoyance to Parents, where again the rates of impairment were uniformly high across the three subtypes. Significant differences between ADHD subtype groups were found for the two domains assessing functioning at school (Problems with Schoolwork and Annoyance to Teachers). Proportionally more girls with inattentive type were having problems with their schoolwork or grades than girls with hyper-impulsive type, and both girls with inattentive and combined type

were more likely to be annoying or upsetting their teachers than girls with hyper-impulsive type.

Although the test for overall differences between subtypes in the female sample for Interference with Family Activities ( $p = 0.11$ ), Interference with Peer Activities ( $p = 0.07$ ) and Distress to Child ( $p = 0.13$ ), failed to reach significance, inspection of the individual odds ratios indicate that girls with hyper-impulsive type were less likely to be rated as impaired than girls with combined type on the first two of these domains, and less likely to be impaired than girls with inattentive type on the third domain.

The current DISC algorithms indicate that clinically significant impairment (Criteria D) is met if a child has at least one severe or two intermediate impairment ratings across any of the six impairment domains. ADHD subtype groups in both the male and female samples did not differ significantly on rates of overall impairment (although the individual odds ratios indicated that boys with combined type were more likely to meet this criteria for impairment than boys in the other subtype groups). If the DISC criteria for impairment were included in case identification, the overall past year prevalence for DSM-IV ADHD would have been 12.1% (16.8% for boys and 7.3% for girls).

### **ADHD Gender Patterns**

Table 8.2 reports the test statistics for gender, subtype and gender by subtype interactions for the DISC Impairment questions among children with ADHD. When collapsed across subtype, proportionally more boys with ADHD were rated as annoying or upsetting their teachers than girls (64% versus 38%). Boys with ADHD were also more likely to be having problems with their schoolwork or grades (65% to 47%),

however this was qualified by a significant gender by subtype interaction. A significant gender by subtype interaction was also found for Interference with Peer Activities. Pairwise chi-square comparisons were conducted to further examine these interactions. For Interference with Peer Activities, boys with hyper-impulsive type were more likely to be rated as impaired than girls ( $\chi^2_1 = 6.1, p = .01$ ), but no gender differences were found with the inattentive ( $\chi^2_1 = 0.7, p = .4$ ), and combined ( $\chi^2_1 = 1.9, p = .17$ ) type groups. For Problems with Schoolwork or Grades, boys in both the combined ( $\chi^2_1 = 17.0, p < .0001$ ) and hyper-impulsive ( $\chi^2_1 = 7.0, p = .008$ ) type groups were more likely to be rated as impaired than their female counterparts, but no gender differences were found in the inattentive type group. Graphic representations of these two significant gender by ADHD subtype interactions are shown in Figures 8.1 (Interference with Peer Activities) and 8.2 (Problems with Schoolwork or Grades), respectively.

Again, additional analyses were conducted to assess whether psychiatric comorbidity could account for those significant findings in relation to gender. When Conduct Disorder and depressive disorders were both statistically controlled, boys continued to have higher rates of impairment than girls for Annoyance to Teachers ( $\chi^2_1 = 5.0, p = 0.02$ ), and the gender by subtype interactions for Interference with Peer Activities ( $\chi^2_2 = 7.9, p = 0.02$ ) and Problems with Schoolwork or Grades also remained significant ( $\chi^2_2 = 9.3, p = 0.01$ ).

### **CHILD HEALTH QUESTIONNAIRE (CHQ)**

Table 8.3 shows the mean scores for ADHD subtype groups and non-ADHD children for the six CHQ scales. This section begins by describing whether ADHD subtype groups differed from controls and then proceeds to examine differences between

subtypes. Using a similar approach to that undertaken with the CBCL, the mean scores for the individual items that comprise the six scales were also examined to assess whether subtype patterns found for individual scales were consistent across the complete item set, and to identify those items that differentiate subtypes. Again, inferential tests using Analysis of Variance (ANOVA) were conducted to identify those items where ADHD subtype groups differed. These analyses are shown in Appendix C.

### **ADHD Subtypes versus Controls**

All three ADHD subtype groups in the male sample, and girls with inattentive and combined type received lower ratings than their non-ADHD counterparts on all CHQ scales. This would suggest a lower quality of life. Girls with hyper-impulsive type were rated as being more disruptive to family activities, but they did not significantly differ from non-ADHD girls on the other five CHQ scales (Self-Esteem, Role/Social Functioning, Family Cohesion, Parent Impact – Emotional and Parent Impact - Time). Furthermore, the effect size statistics for differences between girls with hyper-impulsive type and non-ADHD girls for these scales were generally small for the Role/Social Functioning, Self-Esteem and Parent Impact - Emotional scales ( $d$ 's ranging from .03 to .025), and medium for the Parent Impact - Time and Family Cohesion scales ( $d = .41$  for both). Effect size statistics are shown in Appendix C (Tables C.1 and C.2 for males and Tables C.3 and C.4 for females).

### **ADHD Subtype Patterns**

#### ***Self-Esteem***

Among males, those with combined type were rated as having lower self-esteem than boys with hyper-impulsive type, but not when both Conduct Disorder and mean age at

assessment were statistically controlled (self-esteem decreased with age). This pattern was consistent across individual items on the CHQ Self-Esteem scale (Table C.5). Notably, both boys in the combined and inattentive type groups were rated as having lower “satisfaction with school ability” than those with hyper-impulsive type which is consistent with the pattern of subtype differences found for the CBCL item “poor school work” and on the DISC item “problems with schoolwork or grades”.

Among females, the inattentive type group was rated as having lower self-esteem than the hyper-impulsive type group. They also received lower ratings than girls with combined type when Conduct Disorder was statistically controlled. This pattern was consistent across the individual items that comprised this scale, with girls in the inattentive type group being rated as having lower “satisfaction with friendships” and “satisfaction with school ability” than girls in both the hyper-impulsive and combined type groups (Table C.6). The findings with regard to the latter item are consistent with the female subtype differences found for the CBCL item “poor school work”.

Although individual children with ADHD received ratings of “5” (“very dissatisfied”) on some items of the Self-Esteem scale, it is important to note that the mean scores for male and female ADHD subtype groups ranged between 1 (“very satisfied”) to 3 (“neither satisfied nor dissatisfied”) for the six items on this scale. This would suggest that even though children with ADHD have lower self-esteem than controls they do not as a group, at least according to parents, have severe problems with self-esteem.



### ***Role/Social Functioning***

Among males, those with combined type received lower scores on the Role/Social Functioning scale than boys in the other subtype groups, indicating that they experience greater restrictions in their schoolwork and peer-group activities. However, boys with combined type were not found to differ significantly from boys with hyper-impulsive type when Conduct Disorder, depressive disorders, parental employment and mean age at assessment were all statistically controlled. This pattern was consistent across the individual items comprising this scale, with boys in the combined type scoring lower than boys in the other subtype groups on all three items (Table C.7).

Among females, those with inattentive and combined type received lower scores on Role/Social Functioning than girls with hyper-impulsive type. Furthermore, when Conduct Disorder and parental employment were statistically controlled, girls with inattentive type were rated as having greater impairment on this scale than girls with combined type. Inspection of the individual item scores show that girls with inattentive type scored significantly lower than girls in the hyper-impulsive type group on two of the items (“limited in the kind of schoolwork or activities with friends he/she could do” and “limited in performing schoolwork or activities with friends”), and exhibit a trend to this effect on the third item (“limited in the amount of time he/she could spend on schoolwork or activities with friends”) (Table C.8).

Overall, it is again notable that the lowest mean scores reported for both male and female subtype groups on any of the three items was 2.96 which is approximately equivalent to the rating of “limited a little”. This suggests that, as a group, children

with ADHD were only experiencing minor limitations in their schoolwork or peer-group activities.

### *Family Activities*

Among males, those with combined and hyper-impulsive type were rated as being more disruptive to family activities than boys with inattentive type. Boys in the combined type group scored lower than those with inattentive type on all six items that comprise the Family Activities scale, with boys in the hyper-impulsive type group also showing a trend of lower mean scores on each of these items (Table C.9).

Conversely, among girls, the combined type group were rated as being more disruptive to family activities than those with hyper-impulsive type, although not when Conduct Disorder was statistically controlled. Girls with combined type show a trend of lower scores on all six items of the CHQ Family Activities scale, with the differences being significant on two items (“interrupted various everyday family activities” and “caused tension and conflict at home”) (Table C.10).

The mean scores for individual items on the Family Activities scale generally ranged between 3 “sometimes” to above 4 “almost never” for ADHD subtype groups in both the male and female sample. Only boys and girls with combined type received mean scores lower than 3 on any of the items. This would suggest that, as a group, the problems of children with inattentive and hyper-impulsive type did not greatly disrupt family activities.

### ***Family Cohesion***

Neither male nor female subtype groups differed on the single item measure of family cohesion.

### ***Parent Impact - Emotional***

Among males, reports from the parents of boys with combined type suggest that they experience greater worry and concern over their child's problems than the parents of boys in the other subtype groups. However, these differences were not significant when both depressive disorders and Conduct Disorder were statistically controlled.

Inspection of the mean scores for the three items that comprise this scale indicates that parents of boys with combined type were generally more worried about their child's "emotional well-being and behavior" and "attention and learning abilities" rather than their "physical health" (Table C.11). The mean scores for boys with combined type on these first two items were between 3 "some" and 4 "quite a bit" which suggests that some parents were experiencing considerable distress.

Among females, reports from the parents of girls with combined and inattentive type suggest that they experience greater worry over their child's problems than the parents of girls with hyper-impulsive type. Inspection of the mean scores shows that the parents of girls with combined and inattentive type were significantly more worried about their child's "attention or learning abilities" than the parents of girls with hyper-impulsive type, although a trend to this effect was also observed for their child's "emotional well-being or behaviour" and "physical health" (Table C.12).

### ***Parent Impact - Time***

Among males, reports from the parents of boys with combined type suggest that they experience greater limitations in their personal time because of their child's problems than the parents of boys in the other subtype groups. However, again these differences were not significant when both depressive disorders and Conduct Disorder were statistically controlled. Inspection of the mean scores for the three items which comprise this scale, indicates that the parents of boys with combined type tended to experience greater time restrictions as a function of their child's "emotional well-being or behaviour" and their "attention and learning abilities" rather than their "physical health" (Table C.13). Among females, the reports from the parents of both girls with combined and inattentive type indicate that they experience greater restrictions in their personal time as a function of the child's problems than parents of girls with hyper-impulsive type. This trend was consistent across all three items (Table C.14).

Both boys and girls in the inattentive and hyper-impulsive type groups received mean scores ranging between 3 "Yes, limited a little" to 4 "No, not limited" across the three items. This indicates that, on average, the parents of these children had not experienced severe time restrictions. Among boys and girls with combined type, the mean scores were someone lower for those items addressing time restrictions due to "emotional well-being or behaviour" and "attention and learning problems", however they still did not fall below 2 ("Yes, limited some").

### **ADHD Gender Patterns**

Table 8.4 reports the test statistics for gender, subtype and gender by subtype interactions for the CHQ scales for children with ADHD. When collapsed across

subtype, boys and girls with ADHD did not differ on any the CHQ scales, however significant gender by subtype interactions were found for three of the six CHQ scales (Self-Esteem, Role/Social Functioning and Parent Impact - Emotional). These significant interactions are depicted in Figures 8.3 to 8.5, respectively.

To further examine these interactions, *t* tests were conducted comparing boys and girls within each of the three subtype groups. On the Role/Social Functioning scale, girls were rated more impaired than boys in the inattentive type group ( $t_{142} = -2.4, p = 0.02$ ) but less impaired in the combined type group ( $t_{87} = 2.8, p = 0.006$ ). No gender differences were found for those with hyper-impulsive type ( $t_{56} = 1.3, p = 0.27$ ). Inspection of the mean scores for the individual items that comprise this scale show a consistent trend of lower scores for boys than girls in the combined type group (indicating greater impairment), whereas among those with inattentive type, girls show a consistent trend of lower mean scores (Tables C.15 to C.17). On the Parent Impact - Emotional scale, girls were rated as more impaired than boys in the inattentive type group ( $t_{141} = -2.1, p = 0.04$ ) but less impaired in the hyper-impulsive type group ( $t_{56} = 2.6, p = 0.02$ ), with no gender differences being found for those with combined type ( $t_{86} = 1.4, p = 0.16$ ). This trend was consistent across the individual items that comprise this scale (Tables C.18 to C.20).

None of the tests assessing gender differences on the Self-Esteem scale reached significance (inattentive;  $t_{141} = -1.6, p = 0.12$ , hyper-impulsive;  $t_{57} = 1.3, p = 0.27$ , combined;  $t_{86} = 1.6, p = 0.12$ ), although girls show a trend of higher scores than boys in the inattentive type group (indicating greater impairment), and lower scores than boys in

the hyper-impulsive and combined type groups. These patterns were consistent across individual items on this scale (Tables C.21 to C.23).

When Conduct Disorder and depressive disorders were statistically controlled, the gender by subtype interactions remained significant for Role/Social Functioning ( $\chi^2 = 6.6, p = 0.002$ ) and Parent Impact - Emotional ( $\chi^2 = 5.6, p = 0.004$ ), but not for Self-Esteem ( $\chi^2 = 2.5, p = 0.08$ ) where both depressive disorders and Conduct Disorder were found to be significant predictors. Finally, when collapsed across subtype, boys and girls with ADHD did not differ on any of the individual items that comprise the Family Activities and Parent Impact - Time scales (Tables C.24 and C.25, respectively).

## **CHAPTER NINE**

### **RESULTS: REPORTED TO HAVE PROBLEMS, SERVICE AND MEDICATION USE**

#### **CHAPTER OVERVIEW AND SUMMARY OF FINDINGS**

This chapter reports ADHD subtype and gender patterns with regard to parent reports of children's emotional or behaviour problems, the need for professional help, service and medication use in the six months prior to the survey. It also examines whether ADHD gender patterns with regard to comorbidity and impairment vary according to service use.

The main findings reported are that ADHD subtype groups differed with respect to the proportion of children reported to have problems and for service use, with the pattern of differences again varying across gender. Among males, the combined type group had higher rates of reported problems and service use than those in the other subtype groups, whereas in the female sample, the combined and inattentive type groups generally had higher rates for these measures than the hyper-impulsive type group. Conversely, subtype patterns with regard to stimulant use were consistent across gender, with children in the combined type group having the highest rates and those with inattentive type the lowest. When collapsed across subtype, boys with ADHD had greater rates of stimulant use than girls. Finally, ADHD gender patterns with regard to comorbidity and impairment did not vary as a function of service use.

## **ADHD SUBTYPES VERSUS CONTROLS**

Table 9.1 reports between-group differences for Reported to Have Problems, Service and Medication Use. Among males, all three ADHD subtype groups were more likely to be reported as having emotional or behavioural problems, and had higher rates of service and medication use than their non-ADHD counterparts. In the female sample, only girls with inattentive and combined type had higher rates for these variables than their non-ADHD counterparts. Girls with hyper-impulsive type were more likely to be reported as having emotional or behavioural problems than non-ADHD girls, but not when Conduct Disorder was statistically controlled. Moreover, only one girl with hyper-impulsive type was reported to be in need of professional help for emotional or behavioural problems, and this girl had a comorbid Conduct Disorder. Finally, girls with hyper-impulsive type did not differ significantly from non-ADHD girls on service use, although their rates of attendance were more than twice that of non-ADHD girls.

## **ADHD SUBTYPE PATTERNS**

### **Reported to Have Problems**

Among males, those with combined type were more likely to be reported as having emotional or behavioural problems than boys in the other subtype groups, with the rates being noticeably low for those with inattentive type (just over 50%). When both Conduct Disorder and depressive disorders were statistically controlled, differences between boys with combined and hyper-impulsive type for “Has Problems” were no longer significant. Given that boys with combined type had higher rates of reported problems, it is not surprising that they were also more likely to be reported as being in need of professional help than boys with inattentive type, although it is interesting that only just over 50% of boys with combined type were reported to be in need of help.



In the female sample, proportionally twice as many girls with inattentive and combined type were reported to have problems than girls with hyper-impulsive type. Girls with combined and inattentive type were also more likely to be reported to be in need of professional help for their emotional or behavioural problems than girls with hyper-impulsive type, although less than 50% of girls with combined and inattentive type were reported as needing help.

It is interesting to note that the percentage of children with ADHD reported as having emotional or behavioural problems was less than that rated as being clinically impaired on the DISC. This was particularly evident among girls with ADHD. For example, approximately 30% fewer girls with inattentive and combined type were reported as having a problem than were rated to be clinically impaired on the DISC. With girls in the hyper-impulsive type group the percentage decrease was approximately 40%. This suggests that the DISC threshold for clinical impairment may be somewhat over-inclusive.

### **Service Use**

Among males, those with combined type had higher rates of service use than boys in the other subtype groups, although they did not differ significantly from boys with hyper-impulsive type when Conduct Disorder, depressive disorders and family type were all statistically controlled (service use was greater among children from sole parent families).

The parents of boys who attended services also reported the most important emotional or behavioural problems for which their child received help. Twenty four percent (9/37)

of boys with combined type received help for ADHD, compared to 20% (2/10) of boys with hyper-impulsive type and 19% (5/27) of boys with inattentive type. None of the 48 boys in the non-ADHD group who had attended a service in the previous six months had received help for ADHD. Overall, externalising behaviour problems (including general behaviour problems) were the most common problem for which boys in each of the three subtype groups received help. The respective percentages were: inattentive type (41%; 11/27), hyper-impulsive type (60%; 6/10) and combined type (41%; 15/37). A full breakdown of the most important emotional or behavioural problems ADHD subtypes in the male sample received help for is shown in Table 9.2.

With regard to the types of services attended, boys with combined type were more likely to have attended a mental health clinic than boys in the other subtype groups, although differences between boys with combined and hyper-impulsive type were not significant when both Conduct Disorder and depressive disorders were statistically controlled. The three male subtypes did not differ in the use of school-based services, although marginally higher rates are evident among boys with combined type.

ADHD subtypes in the female sample did not differ on service use, although proportionally more than twice as many girls with inattentive and combined type had attended services for emotional or behavioural problems than girls with hyper-impulsive types. This pattern of subtype differences was evident for both school-based and clinic services.

Among those girls who had attended a service, ADHD was listed as a major problem for which help was received by 43% (3/7) of girls with combined type, compared to 0%

(0/2) for girls with hyper-impulsive type, and 8% (1/13) for girls with inattentive type. None of 39 girls in the non-ADHD group who had attended a service in the previous six months had received help for ADHD. Externalising behaviour problems (including general behaviour problems) were reported by the parents of girls with combined and hyper-impulsive type as the most common major problem for which help was received (combined type = 57%, 4/7; hyper-impulsive type = 100%, 2/2). Conversely, for girls with inattentive type, internalising problems (39%, 5/13) was the most common problem cited. A full breakdown of the most important emotional or behavioural problems for which ADHD subtypes in the female sample received help for is shown in Table 9.3.

### **Medication Use**

In both the male and female samples, stimulant use was greatest for those with combined type and lowest for those with inattentive type. One striking finding was that boys with combined type had rates of 'non-stimulant medication' use approximately eight times greater than that of boys in the other subtype groups. Overall, 16 boys with combined type had taken 'other' medications in the six months prior the study. These other medications included clonidine (n = 6), anti-depressants (n = 4), herbal medicines (n = 4), anti-convulsants (n = 4), anti-psychotics (n = 2), and not specified (n = 1). Three boys in the inattentive type group had taken 'other' medications for emotional or behavioural problems in the past six months (anti-convulsant n = 1, herbal medicines n = 1, anti-depressant n = 1) compared to one boy in the hyper-impulsive type group (clonidine n = 1), and four boys in the control group (anti-psychotic = 2, clonidine n = 1, analgesics n = 1).

The low number of girls using ‘other’ non-stimulant medications precluded inferential tests for between-group differences. Overall, four girls in the inattentive type group had taken ‘other’ medications for emotional or behavioural problems in the past six months (anti-depressant  $n = 1$ , anti-convulsant  $n = 1$ , anti-psychotic  $n = 1$ , not-specified  $n = 1$ ) compared to three girls in the combined type group (anti-psychotic  $n = 1$ , clonidine  $n = 1$ , anti-depressant  $n = 1$ ), no girls in the hyper-impulsive type group and one girl in the non-ADHD control group (herbal medicines  $n = 1$ ).

## **ADHD GENDER PATTERNS**

Table 9.4 reports the test statistics for gender, subtype and gender by subtype interactions for Reported to Have Problems, Service and Medication Use among children with ADHD.

### **Reported to Have Problems**

Significant gender by subtype interactions were found for ‘Has Problems’ and ‘Needs Professional Help’ (see Figures 9.1 and 9.2 respectively). Pairwise chi-square comparisons were conducted to further examine these interactions. With “Has Problems”, both boys with combined ( $\chi^2_1 = 5.6, p = .02$ ) and hyper-impulsive ( $\chi^2_1 = 4.3, p = .04$ ) type were more likely to be rated as having emotional or behavioural problems than their female counterparts, but no gender differences were found for those with inattentive type ( $\chi^2_1 = 1.0, p = .33$ ). With “Needs Professional Help” proportionally more boys with hyper-impulsive type ( $\chi^2_1 = 7.5, p < .007$ ) were rated as needing help than their female counterparts, but no gender differences were found in the combined ( $\chi^2_1 = 0.6, p = .42$ ) and inattentive ( $\chi^2_1 = 1.0, p = .33$ ) type groups. When additional analyses were conducted controlling for both Conduct Disorder and depressive

disorders, the gender by subtype interaction remained significant for 'Has Problems' ( $\chi^2_2 = 7.7, p = .02$ ), but not for 'Needs Professional Help' ( $\chi^2_2 = 5.6, p = .06$ ) where both Conduct Disorder and depressive disorders were found to be significant predictors.

### **Service Use**

A non-significant gender by subtype interaction trend was evident for service use. Among the combined and hyper-impulsive type groups, boys had service use rates approximately twice that of their females counterparts, whereas among those with inattentive type boys and girls had identical rates of service use. With regard to the type of problems for which help was received, 22% (16/74) of boys with ADHD who had attended a service received help for ADHD, compared to 19% (4/22) for girls with ADHD. Overall, externalising behaviour problems, were the most common reasons cited by parents for why boys and girls with ADHD received help (Boys = 43%, 32/74; Girls = 41%, 9/22) (Table 9.5).

### **Medication Use**

Simple main effects for gender were found for medication and stimulant use in favour of boys with ADHD. Overall, 24.2% ( $n = 54$ ) of boys with ADHD had used medications for emotional and behavioural problems in the six months prior to the study compared to 11.3% ( $n = 11$ ) of girls with ADHD. With stimulant use, the rates were 18.2% ( $n = 41$ ) for boys with ADHD compared to 5.1% ( $n = 5$ ) for girls. Both these main effects remained significant when additional analyses were conducted to control for Conduct Disorder and depressive disorders (Overall Medication Use  $\chi^2_1 = 4.5, p = .04$ ; Stimulants  $\chi^2_1 = 7.2, p = .007$ ).

## **DO ADHD GENDER PATTERNS VARY ACCORDING TO SERVICE USE?**

In their meta-analysis of ADHD gender differences (discussed in Chapter 2), (Gaub & Carlson, 1997b) found fewer gender differences in clinic than in non-referred samples. In non-referred samples, girls with ADHD had less inattention, internalizing problems and peer aggression than their male counterparts whereas no gender differences were found for these variables in clinic samples. This led them to suggest the possibility that some ADHD gender differences may be mediated by sample source.

To assess whether the pattern of ADHD gender differences in this study varied across sample type, boys and girls with ADHD were stratified according to whether or not they had attended a service for emotional or behavioural problems in the six months prior the study. Between-group differences with regard to comorbidity and impairment were then assessed.

Prior to conducting the analyses, the score distributions for each of the continuous variables were examined. Although there was little evidence of non-normality, Levene's test of homogeneity of variance assumption indicated that between-group variance was significantly different for the CBCL Externalising, Aggressive Behavior and Delinquent Behavior scales and the CHQ Role/Social Functioning and Parent Impact - Time scales. Data transformations were successful in reducing the level of between-group variance to non-significant levels for all but the Parent Impact – Time scale. Thus caution needs to be used in interpreting the findings regarding this scale.

Table 9.6 reports the test statistics for service use, gender and service use by gender interactions for those measures assessing comorbidity. It can be seen that children with

ADHD who attended a service in the six months prior to the survey had greater psychiatric comorbidity as well as more emotional or behavioural problems than those with ADHD who had not attended a service. The one exception was the CBCL Somatic Complaints scale where, as previously reported, girls with ADHD received higher mean scores. Girls with ADHD also received higher mean scores on the CBCL Internalising scale when controlling for service use. Importantly, none of the interactions for service use by gender were significant which indicates that the ADHD gender differences with regard to comorbidity were not influenced by sample type. However, this claim does come with a caveat in that, although not significant at the  $p = .05$  level, service use by gender interactions trends were evident for measures of internalising behaviour (i.e., depressive disorders  $p = .07$ ; CBCL Internalising  $p = .09$  and Withdrawn scales  $p = .08$ ). It can be seen that girls with ADHD generally exhibited a trend of greater internalizing problems than males, however this trend was far more evident among those who had attended a service compared to those who had not.

Table 9.7 reports the tests statistics for service use, gender and service use by gender interactions for those measures assessing impairment. As previously reported, proportionally more boys with ADHD experienced problems with their school work or grades than girls. However, the predominant finding was that children with ADHD who had attended a service were consistently more impaired than those who had not.

Furthermore, ADHD gender patterns with regard to impairment did not differ according to service use.

# **CHAPTER TEN**

## **DISCUSSION**

### **INTRODUCTION**

This study had two major aims. The first was to assess the discriminant validity of DSM-IV ADHD subtypes in non-referred boys and girls. The second was to examine whether the characteristics of boys and girls with ADHD differed. The findings with regard to these aims are discussed respectively in Part I (Discriminant Validity) and Part II (ADHD Gender Differences) of this chapter. Each part begins by reviewing the findings with regard to the specific research hypotheses and then proceeds to examine data relating to those domains which were considered key areas to be explored. In reviewing the findings, particular emphasis is given to comparing the results of this study with that of previous research. The clinical implications of the findings are considered at the conclusion of each section.



## **PART I. THE DISCRIMINANT VALIDITY OF DSM-IV ADHD SUBTYPES**

### **Review of Findings for Research Hypotheses**

#### ***Hypothesis 1: Prevalence***

As hypothesized, the inattentive type was found to be the most common subtype representing approximately half of all the ADHD cases in both samples (48% for males and 53% for females). This is consistent with findings of previous studies of non-referred children (Baumgaertel et al., 1995; Gaub & Carlson, 1997a; Gomez et al., 1999; Nolan et al., 2001; Wolraich et al., 1996).

The Child and Adolescent component of the Australian National Survey of Mental Health and Well-Being found the past year prevalence of DSM-IV ADHD among children 6 to 13 years to be 13.6% (12.1% when the DISC impairment criteria was applied). Previous epidemiological studies report prevalence rates ranging from 2.4% (Gomez et al., 1999) to 20% (Gadow et al., 2000) depending on the number of DSM-IV criteria assessed, the number of informants required to determine symptom presence, and the age range of the population surveyed. Lower prevalences are reported for studies requiring impairment criteria (Rohde et al., 1999; Wolraich, Hannah, Baumgaertel, & Feurer, 1998) and parent-teacher agreement regarding symptomatology (Gomez et al., 1999), whereas higher prevalences are reported for samples restricted to elementary school children (Baumgaertel et al., 1995; Wolraich et al., 1996). Most epidemiological studies report ADHD prevalence estimates based on the number of children currently meeting symptom criteria. These studies report prevalence estimates ranging from 8% (Gaub & Carlson, 1997a) to 20% (Gadow et al., 2000). The DISC provides an estimate of current prevalence based on the number of children meeting

diagnostic criteria during the previous four weeks. The current prevalence of ADHD as assessed by the DISC would have been 9.3% for this study (or 8.4% with impairment), which is closer to the 3 to 7% prevalence figure reported in the revised edition of the DSM-IV (DSM-IV-TR; American Psychiatric Association, 2000).

### ***Hypothesis 2: Externalising Behaviour Problems***

The hypothesis that children with combined and hyper-impulsive type would be rated as having greater externalising problems than those with inattentive type was generally supported for males and females. Among boys with ADHD, the combined type group scored higher on all three CBCL Externalising scales than those with inattentive type, whereas the hyper-impulsive type group scored higher on the Aggressive Behaviour and Externalising scales. The only discrepant finding in the male sample was that boys with inattentive type had marginally higher rates of Conduct Disorder than those with hyper-impulsive type (15% to 10%), although this trend was also evident in an earlier community-based study (Willcutt et al., 1999).

In the female sample, girls with combined type scored higher on the CBCL Aggressive and Externalising Behaviour scales than those with inattentive type. Although girls with hyper-impulsive type did not score significantly higher than those with inattentive type on any of the CBCL externalising scales, a trend to this effect was evident in all three scales. It is possible that, with a larger sample of girls with hyper-impulsive type, some of the differences may have been significant given that some of the effect size statistics were around the moderate range (e.g., Externalising = .46; Aggressive Behaviour = .56).

Children with combined type had at least twice the rates of Conduct Disorder than children in the other subtype groups in both males and females. This is generally consistent with the findings of previous community-based studies (Ostrander et al., 1998; Willcutt et al., 1999; Wolraich et al., 1996), although there is noticeable variation in the reported rates. Wolraich, et al. found teacher-reported rates of Conduct Disorder among DSM-IV ADHD subtypes to be 30% for combined type, 20% for hyper-impulsive type and 6% for inattentive type, with a reduced list of Conduct Disorder symptoms. Willcutt et al. reported somewhat higher rates conducting structured interviews with the parents of children aged 8 to 18 years (47% for combined type, 27% for hyper-impulsive type and 34% for inattentive type). This study found somewhat lower rates of Conduct Disorder among the three ADHD subtype groups using a similar methodology (collapsed across gender the rates were 28% for combined type, 10% for hyper-impulsive type and 12% for inattentive type). These lower rates may reflect the younger age of the participants (6 to 13 years).

### ***Hypothesis 3: Global Academic Functioning***

There was good support for the hypothesis that children with combined and inattentive type would be rated as having greater academic impairment than those with hyper-impulsive type. In both the male and female samples, the proportion of children rated as having problems with schoolwork or grades tended to be greater among those with combined and inattentive type than those with hyper-impulsive type, although the differences were not always significant. For example, both boys with inattentive type and girls with combined type did not significantly differ from their hyper-impulsive counterparts, although their rates of impairment were 19% and 25% higher respectively. Previous studies have consistently documented poorer academic functioning among

combined and inattentive types in samples made up of predominantly males (Baumgaertel et al., 1995; Gaub & Carlson, 1997a; Lahey et al., 1994; McBurnett et al., 1999; Wolraich et al., 1996) and in a female only sample (Hudziak et al., 1998).

#### ***Hypothesis 4: Social Functioning***

There was good support for the hypothesis that children with combined type would be the rated as more socially impaired than children in the other subtype groups in the male sample, but not the female sample. Among boys with ADHD, the combined type group scored higher on the CBCL Social Problems scale than boys in the other subtype groups which is consistent with previous community-based studies that have used the Achenbach scales (Gadow et al., 2000; Gaub & Carlson, 1997a). Boys with combined type were also more likely to be rated as experiencing restrictions in their peer activities than boys with inattentive type, and exhibited a trend of this effect relative to boys with hyper-impulsive type. Finally, boys with combined type were rated as more impaired on the CHQ Role/Social Functioning scale than boys in the other subtype groups.

Conversely, among females, both girls with inattentive and combined type scored higher on the CBCL Social Problems scale than girls with hyper-impulsive type, although only girls with inattentive type scored significantly higher when family type was statistically controlled. Girls with inattentive type also received higher impairment ratings than girls with hyper-impulsive type on the CHQ Role/Social Functioning scale. These findings are somewhat at odds with those of Hudziak et al. (1998) who found girls with combined type to be more impaired in “relations with friends” than girls with inattentive type, although this was with an adolescent sample.

## **Review of Findings for Key Areas Explored**

This study also examined DSM-IV ADHD patterns on the following domains for which there are relatively little data with community samples: age of child, social adversity, internalising problems, school behaviour problems, self-esteem, family functioning, service use and medication use.

### ***Age of Child***

#### ***1. At Assessment***

Children with inattentive type were, on average, older than those with hyper-impulsive type at the time of assessment in both males and females. The mean age difference for the two subtypes was 1.6 years for the male sample and 1.4 years for the female sample which, in the case of the latter, just failed to reach significance. The ADHD subtype patterns found for age in this study are consistent with previous reports from both clinic-based studies (Faraone et al., 1998; Lahey et al., 1994; Lahey et al., 1998; Manning & Miller, 2001; McBurnett et al., 1999; Nolan et al., 1999), and the few community-based studies (Chhabildas et al., 2001; Willcutt et al., 1999).

#### ***2. At Symptom Onset***

In both the male and female samples, children with inattentive type were generally older at symptom onset than children in the other subtype groups, although differences between girls with inattentive and hyper-impulsive type failed to reach significance. Although age of symptom onset among ADHD subtypes has not been previously reported in community samples, the findings of this study are consistent with those clinic-based studies which report a later age of symptom onset for children with

inattentive type (Faraone et al., 1998), or a non-significant trend to that effect (Paternite et al., 1996).

### *Levels of Social Adversity*

The presence of social adversity among children with DSM-IV ADHD subtypes has been largely unexplored in studies of non-referred children probably because of their reliance on teacher reports. Although the current study did not investigate SES, it was possible to examine other indicators of social adversity including family type, number of children living in the household, household income, age parent left school and parental employment.

Evidence of social adversity was generally limited to those with combined type. This was especially evident with regard to the proportion of children living in 'original' two parent families, where the combined type group had rates approximately 25% less than that of their non-ADHD counterparts in both the male and female sample. A trend for fewer children with combined type to be living in intact families is also evident in other studies, although these have been with clinic-referred children (Eiraldi et al., 1997; Lalonde et al., 1998). For example, Eiraldi et al. found that the proportion of children with combined type living in sole-parent families was 22% higher than those with inattentive type, and 17% higher than controls (no hyper-impulsive type group was included).

This study also found that boys with combined type were more likely to be living in households where parental employment and household income was lower compared to non-ADHD children, (although depressive disorders accounted for differences in

household income). Although there were no significant between-group differences in the female sample, parental employment rates were somewhat lower among girls with combined type relative to those of non-ADHD girls. Previous studies have not documented parental employment rates among DSM-IV ADHD subtypes, however household income was investigated in one clinic-based-study which found the three ADHD subtype groups did not differ from controls (Lahey et al., 1998).

### ***Internalising Problems***

There was a different pattern of internalising problems across ADHD subtypes for males and females. Among males, those with combined type received the highest ratings on all four CBCL Internalising scales and had the highest rates of depressive disorders, with little difference between those with inattentive and hyper-impulsive type. Among females, both the inattentive and combined types generally received higher scores on all four CBCL internalizing scales than those with hyper-impulsive type, with girls in the inattentive type group also showing a trend towards higher rates of depressive disorders than girls in both the other subtype groups.

As mentioned in the introduction, the few studies to have assessed internalizing problems among non-referred DSM-IV ADHD subtypes have produced inconsistent findings. Some found greater internalising problems among children with combined than inattentive type (Ostrander et al., 1998; Wolraich et al., 1996), with others reporting the exact opposite (Brito et al., 1999) or no differences (Gadow et al., 2000). Although differences in informants, instruments, cultural groups and sample size are likely to have contributed to these discrepant findings, the results of this study suggest that subtype patterns may have also been influenced by the relative gender balance of

the inattentive type groups. The two studies that reported fewer internalising problems among children with inattentive type contained proportionally fewer females (Ostrander et al. = 16%; Wolraich et al. = 30%), compared to the study that reported greater internalising problems for this group (Brito et al. = 44%).

Although the prevalence of depressive disorders in a non-referred sample of DSM-IV ADHD subtypes has not been previously reported, Willcutt et al. (1999) found the prevalence of Major Depressive Disorder to be higher among children with combined type (22%) and inattentive type (24%) than those with hyper-impulsive type (0%) based on the combined reports of parents and children. This study found uniformly low rates of Major Depression among DSM-IV ADHD subtypes when collapsed across gender (combined type = 8.2%, hyper-impulsive type = 4.2% and inattentive type = 5.2%), which is perhaps not surprising given that this study relied solely on parent reports, and was conducted with a younger group of children.

### ***School Behaviour Problems***

In both the male and female samples, children with combined type had the highest impairment percentages for the DISC impairment category of Annoyance to Teachers, and those with hyper-impulsive type the lowest. Although teacher annoyance of children's ADHD symptoms has not been previously studied, teachers have rated more children with combined and hyper-impulsive type as having school-related behavioural problems than children with inattentive type (Wolraich et al., 1996). This is consistent with the finding of greater externalising problems for these two subtypes.



### ***Self-Esteem***

This is the first study to compare the self-esteem of DSM-IV subtypes. In both the male and female samples, parents rated children with hyper-impulsive type as having the highest self-esteem, however their scores relative to those in the other two subtype groups varied across gender. Among males, the combined type group rated lower on self-esteem than those with hyper-impulsive type whereas among females, the inattentive type group received significantly lower ratings.

### ***Family Functioning***

Both the DISC and CHQ assessed family functioning (DISC Interference to Family Activities and CHQ Family Activities and Family Cohesion scales), and the impact on parents (DISC Annoyance to Parents and CHQ Parent Impact - Emotional and Parent Impact - Time scales). Although there were exceptions, children with combined type in both the male and female samples generally had the highest impairment ratings on both the family functioning and impact on parents scales, although they did not always significantly differ from children in the other subtype groups, particularly when psychiatric comorbidity was statistically controlled. The relative impairment of children with inattentive and hyper-impulsive type varied across gender. Among males, the hyper-impulsive type group had marginally higher impairment ratings than those with inattentive type, with significant differences being found for the two scales assessing disruption to family activities (DISC Interference to Family Activities, CHQ Family Activities). In contrast, among females, those with inattentive type had somewhat higher impairment ratings which was significant for the two CHQ impact on parents scales (CHQ Parent Impact - Emotional, Parent Impact - Time).

Although few studies have assessed family functioning among DSM-IV ADHD subtypes, Landgraf et al.'s (2002) recent finding that children with combined type had a greater negative impact on family and parent functioning than those with inattentive type is consistent with the findings of this study. Furthermore, as with previous studies, DSM-IV ADHD subtypes did not differ on family cohesion (Faraone et al., 1998; Paternite et al., 1996).

### *Service Use*

The pattern of service use among ADHD subtype groups varied across gender. Among males, the combined type group had the highest rates of service use, although not more than those with hyper-impulsive type when psychiatric comorbidity and family type were statistically controlled. Among females, service use was twice as great among the combined and inattentive type groups than those with hyper-impulsive type. ADHD subtype patterns with regard to service use were generally consistent across clinic and education-based services, which is interesting given that previous studies have found that children with combined type have higher rates of counselling but somewhat lower rates of school-based service use than those with inattentive type (Faraone et al., 1998; Hudziak et al., 1998; Nolan et al., 2001; Paternite et al., 1996). This study may have failed to detect subtype variations for the type of service attended because it only inquired about service use for emotional or behaviour problems.

### *Medication Use*

In both the male and female samples, children with combined type had the highest rates of stimulant use and those with inattentive type the least. Wolraich et al. (1996) also found greater stimulant use among children with combined type in a large representative

sample of Tennessee schoolchildren. However their rates of current stimulant use (combined type = 32%, hyper-impulsive and inattentive type = 21%) were somewhat larger than that reported in this study (collapsed across gender the rates were: combined type = 25%, hyper-impulsive type = 13% and inattentive type = 8%). This discrepancy may be somewhat larger given that Wolraich et al. used teacher reports which possibly underestimate stimulant use. Although these figures may accurately reflect differences in prescription rates between the United States and Australia, it is unknown whether the stimulant use rates identified by Wolriach et al. are nationally representative given that there are substantial regional variations in stimulant prescription rates in the United States (Jensen et al., 1999).

### **Summary of Findings**

DSM-IV ADHD subtypes in both the male and female samples were found to differ on prevalence, age, comorbidity, impairment, service and stimulant use, although the pattern of differences was not uniform across gender. Male and female ADHD subtype groups showed similar patterns of discrimination with regard to prevalence, age of child (both at interview and symptom onset), externalising behaviour problems and stimulant use. For example, children with inattentive type were the most predominant subtype, and had a later age of symptom onset than those in the other subtype groups as well as being older at ascertainment than those with hyper-impulsive type. Conversely, children with hyper-impulsive type, and particularly those with combined type, rated higher on externalising problems than those with inattentive type (although differences did not always achieve statistical significance with the female sample). Finally, children with combined type had the highest rates of stimulant use and those with inattentive type the lowest.

On measures of internalizing problems, impairment and service use, the pattern of subtype differences varied across gender. Among males, the combined type group rated higher on internalising problems and impairment than boys in the other subtype groups (except on measures of family functioning where differences between boys with combined and hyper-impulsive type were either minimal or not significant after controlling for psychiatric comorbidity). Not surprisingly then, boys with combined type had higher rates of service use. With regard to differences between boys with hyper-impulsive and inattentive type, the former were rated as being more disruptive to family activities (DISC Interference with Family Activities, CHQ Family Activities), whereas a non-significant trend of greater academic problems was evident among the latter. Among girls with ADHD, the inattentive and combined type groups were consistently rated as having the greatest internalising problems, impairment and service use, although they did not always significantly differ from girls with hyper-impulsive type. Girls with inattentive type and combined type did not generally differ on these variables, with the exception that girls with inattentive type were rated as more impaired on the CHQ Self-Esteem and Role/Social Functioning scales when covariates were statistically controlled.

It is possible that male and female subtype patterns diverged for internalising problems, impairment and service use because of the influence of other disorders not accounted for by this study. For example, given the association between anxiety and depression (Axelson & Birmaher, 2001), it is possible that some girls in the inattentive type group had comorbid anxiety disorders which either accounted for or compounded their difficulties. Although none of the parents of the 16 girls with inattentive type who attended a service specifically identified 'anxiety' as a major problem for which their

child received help, two girls were reported as receiving help for “fear” and “stress knotted-up shoulders” suggesting the possibility of an anxiety disorder. More telling, perhaps, was that parents of girls with inattentive type indicated internalizing problems as the most common problem for which professional help was sought, whereas externalising problems was the most common problem children in the other female and male subtype groups received help. This raises the possibility that the ADHD “diagnosis” for some girls with inattentive type may have been inappropriate as their symptoms may have been better accounted for by anxiety or depressive disorders. Nevertheless, it should be noted that girls with inattentive type continued to be rated as having greater impairment than those with hyper-impulsive type and, in some domains, those with combined type when comorbid depressive disorders and Conduct Disorder were statistically controlled.

Of course, the relatively high levels of impairment found for girls with inattentive type cannot be viewed in isolation to that of the comparatively low levels of impairment reported for girls with hyper-impulsive type. Whereas, boys with hyper-impulsive type were more impaired relative to non-ADHD boys, girls with hyper-impulsive type did not differ from non-ADHD girls on five of the six CHQ impairment measures. Furthermore, although one in three girls with hyper-impulsive type were reported to have an emotional or behavioural problem only one of these girls was considered by their parents to have a problem which required professional help and, as previously mentioned, this girl had a comorbid Conduct Disorder.

## **Clinical Implications**

The fact that male and female ADHD subtype groups did not show the same pattern of discrimination with respect to internalizing problems, impairment and service use has important clinical implications. First, and most obviously, it raises the possibility that the findings from the vast majority of studies that have investigated the discriminant validity of DSM-IV ADHD subtypes in samples consisting predominantly of males may not generalize to females.

Second, it suggests the need to consider gender in both the treatment and assessment of ADHD. For example, researchers who target children with combined type for prevention and treatment programs on the basis that this group typically has the most severe deficits may be neglecting the needs of girls with inattentive type. Furthermore, given that girls with inattentive type possibly have a greater incidence of depressive disorders, it is possible that their difficulties are further compounded with the onset of adolescence. Finally, differential diagnosis may be particularly problematic for girls with inattentive type given that symptoms of depression and anxiety can often ‘mimic’ ADHD symptoms. For example, an inability to concentrate is also characteristic of those with depressive disorders. Clearly, it is important to establish whether their inattentive symptom pattern reflects a primary deficit or an underlying depressive or anxiety disorder.

The findings of this study suggest the possibility that the current symptom thresholds for determining the presence of ADHD maybe somewhat over-inclusive when applied to non-referred populations. Firstly, although parents generally rated children with ADHD as being more impaired than children in the non-ADHD group, inspection of the

mean scores for the individual items on the CHQ scales indicates that parents did not always consider their child with ADHD to be greatly impaired. This was particularly evident for the Self-Esteem and Role/Social Functioning scales. Even more telling was the relatively low number of children with ADHD reported by parents to have an emotional or behavioural problem. With the exception of boys with combined type, fewer than 70% of parents of children in the other subtype groups reported their child to have a problem, with only 38% of girls with hyper-impulsive type reported to have a problem.

The fact that girls with hyper-impulsive type did not differ from their non-ADHD counterparts on five of the six CHQ measures and were generally not reported to be in need of professional help for emotional or behavioural problems raises questions as to the validity of this subtype in non-referred female populations. Perhaps, it would be best to view girls who meet symptom criteria for hyper-impulsive type as being at risk (Power & DuPaul, 1996), especially for externalising behaviour problems where their levels were elevated relative to non-ADHD girls. However, it is important to acknowledge the possibility that the parents of children with ADHD in this study underestimated their child's impairment and need for help.

## **PART II. ADHD GENDER DIFFERENCES**

### **Review of Findings for Research Hypotheses**

#### ***Hypothesis 1: Prevalence***

As hypothesised, ADHD was more common among boys with their overall prevalence being approximately twice that of girls (18.7% versus 8.4%). Boys were also predominant in each of the three subtype groups. The male:female prevalence ratios for inattentive (2.0:1) and combined types (2.9:1) were generally consistent with previous community-based studies (Baumgaertel et al., 1995; Carlson et al., 1997; Gadow et al., 2000; Wolraich et al., 1996), but were somewhat lower for the hyper-impulsive type (1.9:1) (Baumgaertel et al., 1995; Carlson et al., 1997; Wolraich et al., 1996). The use of parent informants may have contributed to the lower male:female ratio for hyper-impulsive types as most previous studies have used teacher reports which generally show a greater male predominance for this subtype (Gomez et al., 1999; Pineda et al., 1999). Overall, the male:female ratio's for the prevalence of ADHD did not significantly differ across subtype. Previous studies have found girls more likely to meet the criteria for inattentive type than boys, but these findings have been limited to clinic samples (Biederman et al., 2002; Lahey et al., 1994).

#### ***Hypothesis 2: Externalising Behaviour Problems***

The hypothesis that boys with ADHD would be rated as having more externalising problems than girls with ADHD was not supported, as no main effect for gender was found for Conduct Disorder or any of the CBCL externalising scales. Although, previous community-based studies have reported more externalising behaviour problems among boys with ADHD using dimensional scales, all but one of these studies



were based on teacher reports (Carlson et al., 1997; deHaas, 1986; deHaas & Young, 1984; McGee et al., 1987). The only study to find greater externalising problems among boys with ADHD using parents as informants was that of Gadow, Sprafkin, and Nolan (2001) where boys with hyper-impulsive type were found to have higher CBCL Delinquency scores than their female counterparts (a finding which was not replicated in this study).

Although not significant, when collapsed across subtype, boys with ADHD had rates of Conduct Disorder almost twice that of girls (19% v 10%) which is generally consistent with previous studies (August et al., 1992; Faraone et al., 1991; Lalonde et al., 1998; Sharp et al., 1999; Szatmari, Boyle et al., 1989). Somewhat surprising was the fact that the rates reported in this study were generally equivalent to those reported in three clinic-based DSM-IV studies which varied from 6% to 17% for boys with ADHD and 0% to 17% for girls with ADHD (Lalonde et al., 1998; Rucklidge & Tannock, 2001; Sharp et al., 1999). Given that children referred to clinics tend to have more severe problems, relatively lower rates of Conduct Disorder were expected in this study. The most likely explanation lies with the different approaches taken to assess Conduct Disorder. Whereas the three clinic-based studies had mental health professionals conduct clinical interviews, this study had lay interviewers administer a highly structured diagnostic interview that does not provide opportunities for clarification of symptom severity. It is possible that the parents in this study endorsed conduct disorder symptoms with the DISC which would not have been considered serious violations by professionals.

### *Hypothesis 3: Service Use*

Although rates of service use among boys and girls with ADHD has not been previously reported, boys were expected to have higher rates because male:female ADHD prevalence ratios are typically higher in clinic-referred samples than community samples (Berry et al., 1985; Brown et al., 1991). When collapsed across subtype, boys with ADHD in this study did not have significantly higher rates of service use (33% for boys compared to 22% for girls), although a trend for greater service use among boys was evident among those subtypes with high levels of hyperactivity-impulsivity (combined and hyper-impulsive type groups).

As mentioned in the literature review, some researchers have speculated that the higher referral rates found for boys with ADHD reflect gender differences in associated problems and the source of treatment for those problems (Gaub & Carlson, 1997b). Specifically, it is suggested that boys with ADHD are more often referred to clinics because they exhibit more disruptive behaviours which make them more difficult to manage in structured settings such as a classroom, whereas girls with ADHD are more often 'treated' within the school system because they have greater learning difficulties. The contention that teachers have greater difficulty in coping with the behaviour of boys with ADHD was supported by the findings of this study that proportionally more boys with ADHD had upset or annoyed their teachers than girls. However, there was little support for the view that girls with ADHD are more likely to be treated within the school system because they have more learning problems. First, boys and girls with ADHD did not differ on use of school-based services (when collapsed across subtype the percentages were 18% for boys and 14% for girls) and, second, it was boys with ADHD who were more likely to be reported as having problems with their schoolwork

or grades. However, as mentioned previously, it should be remembered that this study only inquired about service use for emotional or behavioural problems, and not learning difficulties. Furthermore, a child who has problems with school work or grades because of their ADHD symptoms does not necessarily have learning problems. Certainly, previous studies have documented lower cognitive functioning in girls with ADHD, although these have been limited to clinic-referred samples (Berry et al., 1985; Brown et al., 1991; James & Taylor, 1990).

#### ***Hypothesis 4: Stimulant Use***

As hypothesised, boys with ADHD had higher rates of stimulant use than girls with ADHD. When collapsed across subtype, 18% of boys with ADHD had taken stimulants in the six months prior to the study compared to 5% of girls. These percentages are somewhat smaller than the rates of current stimulant use reported by teachers (28% males to 20% females) in a representative survey of Tennessee pre- and elementary school children meeting symptom criteria for DSM-IV ADHD (Wolraich et al., 1996). As mentioned previously, although this discrepancy may accurately reflect differences in prescription rates between children in the United States and Australia, it is unknown whether stimulant use rates found in Wolraich et al.'s Tennessee sample are nationally representative (Jensen et al., 1999). Interestingly, the male:female ratio for stimulant use in Wolraich et al.'s study is considerably lower than found in this study (1.4: 1 to 3.6:1). It may be that girls with ADHD in Australia are less likely to be referred for treatment than those in the United States.

## **Review of Findings for Key Areas Explored**

This study also examined whether boys and girls with ADHD differed on a number of domains for which there are little or inconsistent research data with community samples. These areas were: symptom expression, age of child, levels of social adversity, internalising problems, global academic functioning, school behaviour problems, social functioning, family functioning, and self-esteem.

### ***Symptom Expression***

Boys and girls with ADHD did not differ on the number of ADHD symptoms exhibited. Comparisons of DSM-IV ADHD symptom numbers among boys and girls with ADHD has not been previously reported in community-based studies, although adolescent girls with ADHD were reported as having more hyper-impulsive symptoms than their male counterparts in one recent clinic-based study (Rucklidge & Tannock, 2001). Most studies have used checklists such as the CBCL to investigate gender differences in symptom expression. Consistent with previous research, this study found no differences in mean CBCL Attention Problems scores between boys and girls with ADHD (Ackerman et al., 1983; Arcia & Conners, 1998; Barkley, 1989; Breen, 1989; Brown et al., 1991; Horn et al., 1989; Pelham et al., 1989; Silverthorn et al., 1996).

This study also found few differences in the individual symptom profiles of boys and girls with ADHD. When collapsed across subtypes, ADHD gender differences were found for only 3 of the 18 symptoms with proportionally more boys being reported as exhibiting the symptoms “leaves seat” and “runs about and climbs excessively”, whereas proportionally more girls were reported for “talks excessively”. The one previous community-based study to report ADHD gender differences with regard to

individual symptoms found that boys with combined type had higher severity ratings for the symptom “does not seem to listen” than their female counterparts (Carlson et al., 1997). As this study only assessed symptom presence rather than symptom severity, it is difficult to compare these findings. Nevertheless, the findings of this study suggest few gender differences in the manifestation of current DSM-IV ADHD symptoms in children meeting the diagnosis for ADHD.

## *Age of Child*

### *1. At Assessment*

Although boys with ADHD were, on average, six months older than girls, this difference was not significant. This is generally consistent with the findings of previous studies of clinic-referred children (Ackerman et al., 1983; Arcia & Conners, 1998; Befera & Barkley, 1985; Breen & Barkley, 1988; Faraone et al., 1991; Horn et al., 1989; James & Taylor, 1990; Rucklidge & Tannock, 2001; Sharp et al., 1999).

### *2. At Symptom Onset*

When collapsed across subtype, boys and girls with ADHD had identical mean ages for symptom onset (2.7 years). Three previous clinic-based studies have generally shown a non-significant trend of girls with ADHD having a later age of symptom onset, possibly reflecting a bias in clinic-samples (Biederman et al., 2002; Sharp et al., 1999; Silverthorn et al., 1996). Interestingly, these three studies report virtually identical ages of onset for both girls with ADHD (3.5 to 3.6 years) and boys with ADHD (2.7 to 2.8 years).

### ***Location of Residence***

Although not specifically identified as a key area to be explored, boys with ADHD were found to be more likely living in non-metropolitan areas than girls with ADHD (although, as mentioned previously, non-metropolitan in this study was not equivalent to rural). Although ADHD gender differences for location of residence has not been previously investigated, a few studies have found ADHD to be more common in urban areas (Baumgaertel et al., 1995; Szatmari, Offord et al., 1989b), This study found the prevalence of ADHD in metropolitan areas (13%) to be roughly equivalent to that of non-metropolitan areas (14.7%).

### ***Levels of Social Adversity***

Consistent with most previous studies, boys and girls with ADHD did not differ with respect to family type (Bhatia et al., 1991; Brown et al., 1991; Faraone et al., 1991; Horn et al., 1989; Rucklidge & Tannock, 2001), household income (Horn et al., 1989; Silverthorn et al., 1996), and parent education (Barkley, 1989; Breen & Barkley, 1988; Brown et al., 1991; Horn et al., 1989; Rucklidge & Tannock, 2001). There was also no ADHD gender effect for mean number of children living in the household and parental employment, both of which have not been previously investigated.

### ***Internalising Problems***

When collapsed across subtype, boys and girls with ADHD did not differ on internalising problems, with the exception that girls received higher scores on the CBCL Somatic Complaints scale. Previous DSM-IV studies have also found no differences between boys and girls with ADHD on the broad-band CBCL Internalising scale (Carlson et al., 1997; Rucklidge & Tannock, 2001; Sharp et al., 1999). Furthermore,

the only DSM-IV study to report narrow-band CBCL scores also found greater somatic complaints among girls in a sample of children with combined type (Carlson et al., 1997).

Although not significant, when collapsed across subtype, girls with ADHD had marginally lower rates of Major Depression than boys (8%,  $n = 5$  versus 11%,  $n = 16$ ). This is in contrast to previous studies which consistently show a trend of higher rates of Major Depression among females with ADHD (August et al., 1992; Faraone et al., 1991; Rucklidge & Tannock, 2001; Sharp et al., 1999), although it would be unreasonable to read too much into these findings given the very small number of children found to have Major Depression.

### ***Global Academic Functioning***

There were no gender differences among those with inattentive type, but boys with combined and hyper-impulsive type were more likely to be rated as having problems with their schoolwork and grades than girls. This is in contrast to the findings of a previous community-based study which found greater academic impairment among girls with combined type, but no gender differences among those with inattentive and hyper-impulsive type (Wolraich et al., 1996). Wolraich et al.'s findings are consistent with those of an earlier clinic-based study of DSM-III ADD subtypes which found greater academic impairment among girls with ADD with hyperactivity compared to males, but no gender differences in the ADD without hyperactivity group (Berry et al., 1985). The discrepancy between the findings of this study and these previous studies may be due to the use of different informants (parents versus teachers), or because this study only assessed symptom-specific impairment rather than overall academic impairment.

### ***School Behaviour Problems***

When collapsed across subtype, proportionally more boys with ADHD were reported as annoying or upsetting to their teachers than girls (65% versus 47%). Teachers have previously rated boys with ADHD to be more problematic in unsupervised settings (Berry et al., 1985; Breen & Altepeter, 1990) and to have poorer classroom behaviour overall (Breen & Altepeter, 1990; Wolraich et al., 1996), however these ratings were not specifically based on the child's ADHD symptoms. Some researchers have suggested that boys with ADHD are more problematic in structured settings such as classrooms because of their comorbid externalising problems (Gaub & Carlson, 1997b), but the findings of this study suggest that they may well experience more problems as a function of their symptoms alone. However, it is not obvious why parents rated the ADHD symptoms of boys as being more likely to annoy or upset their teachers than girls given that their symptom patterns were generally equivalent. One possibility is that boys with ADHD exhibit symptoms of a higher frequency and/or severity than girls, qualities that the DISC does not specifically assess.

### ***Social Functioning***

This study found significant gender by ADHD subtype interactions on all three measures assessing social functioning (CBCL Social Problems, DISC Peer Interference and CHQ Role Social Functioning). These three interactions were similar in nature with boys being rated as having more social difficulties than girls in the combined and hyper-impulsive type groups but fewer difficulties than girls in the inattentive type group, although the differences were not always significant. In the one previous DSM-IV study to assess ADHD gender differences in social problems boys with combined type were rated as having marginally, but not significantly, poorer social functioning



than girls (Carlson et al., 1997). However, it is interesting to note that the findings of an earlier study of DSM-III ADD subtypes detected a similar gender by subtype interaction for social functioning (Berry et al., 1985) as that obtained in this study. In Berry et al.'s study, girls with ADD were rated as experiencing greater peer rejection/avoidance than boys, however the trend was much more evident in the ADD without hyperactivity group.

### ***Family Functioning***

Boys and girls with ADHD generally did not differ on family functioning measures assessed by the DISC and CHQ. The one exception was the significant gender by ADHD subtype interaction found for the CHQ Parent Impact - Emotional scale in which girls were rated as causing more distress than boys in the inattentive type group but causing less distress in the hyper-impulsive type group. Although, previous studies have assessed ADHD gender differences with regard to family functioning these have generally been in domains not relevant to the findings of this study, such as mother-child interactions (Barkley, 1989; Befera & Barkley, 1985) and family psychopathology (Befera & Barkley, 1985; Horn et al., 1989). None have specifically assessed the impact of children's ADHD symptoms or problems on parents or families, although Breen and Barkley (1988) found no ADHD gender differences in general parenting stress in DSM-III children with ADD+H. Furthermore, consistent with the findings of this study, Biederman et al. (2002) found no ADHD gender differences with regard to parent reports of family cohesion.

### ***Self-Esteem***

This study found a significant gender by subtype interaction for the CHQ Self-Esteem scale with boys showing a trend of poorer self-esteem than girls in the combined and hyper-impulsive type groups, but better self-esteem in the inattentive type group.

Although gender differences among DSM-IV ADHD subtypes for self-esteem have not been previously reported, the significant interaction found in this study is consistent with the findings of a previous study which investigated gender differences in self-esteem among DSM-III ADD subtypes. Berry et al. (1985) found that girls were rated by parents as having lower self-esteem than boys in the ADD without hyperactivity group, but had marginally greater self-esteem in the ADD with hyperactivity group.

### **Summary of Findings**

This study found that boys and girls with ADHD collapsed across subtype did not differ on core symptoms, age (both at assessment and onset), social adversity, comorbid externalising and internalising problems (with the exception of somatic complaints) and on most measures of impairment. However, boys with ADHD were more likely to be rated as having poorer school functioning as a function of their symptoms (i.e., more problems with schoolwork or grades and greater annoyance or distress to teachers), and to have greater rates of stimulant use than girls.

Although ratings for boys and girls with ADHD did not generally differ when collapsed across subtype, significant gender by subtype interactions were evident on impairment domains related to social problems, school functioning, self-esteem and the emotional impact of children's behaviour on parents. These interactions were generally consistent with boys being rated as more impaired than girls in the combined and hyper-impulsive

type groups but equally or less impaired than girls in the inattentive type group, although the differences did not always attain statistical significance.

As previously indicated, these gender by subtype interaction patterns could be due to the effects of disorders not accounted for in this study. For example, the higher impairment found for boys in the combined and hyper-impulsive type groups could be due to the effects of a comorbid oppositional defiant disorder. Conversely, girls with inattentive type may exhibit greater impairment than their male counterparts because they have higher rates of comorbid anxiety disorders. Nevertheless, it should be acknowledged that these subtype by gender interactions remained significant even when the presence of Conduct Disorder and depressive disorders were statistically controlled.

### **Clinical Implications**

The gender by subtype interaction pattern found for impairment domains has a number of important clinical implications. First, it suggests that studies which examine ADHD gender differences with samples collapsed across subtype may not detect important gender differences with regard to impairment. This could account for why few ADHD gender differences are typically reported in such samples (Biederman et al., 2002; Rucklidge & Tannock, 2001). Second, it suggests the possibility that there are gender-specific risks with regard to symptom expression. Specifically, it may be that high levels of hyperactivity/impulsivity may have somewhat more negative consequences for boys than girls in the areas of school and peer functioning. Conversely, high levels of inattention in the absence of high levels of hyperactivity-impulsivity may have more negative social consequences for girls than boys.

One of the aims of this study was to examine ADHD gender differences with regard to impairment as a means of examining the question of whether identical or gender-specific thresholds should be used to identify boys and girls with ADHD. As discussed earlier, some researchers have proposed a lowering of the symptom threshold for girls on the basis that, at a population level, they typically exhibit fewer symptoms (Arnold, 1996; Gaub & Carlson, 1997b; Heptinstall & Taylor, 1996; McGee & Feehan, 1991). Examining the relative impairment of boys and girls with ADHD is viewed as providing a parsimonious solution to this dilemma. For example, identical symptom thresholds would seem more appropriate if boys and girls with ADHD were found to equally impaired, whereas an argument could be made for gender-specific thresholds should gender differences in impairment be found (Arnold, 1996; Gaub & Carlson, 1997b). Unfortunately, the findings of this study do little to clarify which approach may be more appropriate. While ADHD gender differences were found for impairment, these differences were not in the same direction across the three subtypes. Thus, on the basis of these findings, if gender-specific thresholds were to be established they would need to vary according to symptom dimensions, an approach likely to generate considerable confusion. Certainly, the findings do not support the view that the symptom thresholds for ADHD should be lowered for either girls or boys (at least when applied to community samples) as there already appears to be a relatively high false positive rate with the current threshold.

The one impairment domain for which there was a consistent ADHD gender difference was school functioning where proportionally more boys with ADHD were rated as being annoying to their teachers and having problems with their schoolwork or grades because of their ADHD symptoms. This suggests that boys with ADHD may be at

greater risk for academic problems and classroom exclusion, both of which could ultimately lead to early school dropout. The only other domain where there was a consistent ADHD gender effect was in the area of stimulant use where proportionally more than three times as many boys had used stimulants in the past six months than girls. There are a number of possible explanations for this gender difference. It is possible that parents' of girls with ADHD thought their symptoms to be of insufficient severity to warrant medication. Conversely, it could be that parents and mental health professionals more readily identify the symptoms of boys as being indicative of ADHD because they perceive it to be a male disorder (McGee & Feehan, 1991; Quinn & Nadeau, 2000).

## CHAPTER ELEVEN

### LIMITATIONS, FUTURE DIRECTIONS AND CONCLUSIONS

#### LIMITATIONS

While this study represents one of the most comprehensive examinations of gender patterns among DSM-IV ADHD subtypes to date, there were a number of methodological limitations with the design. Perhaps the main weakness of the study was the exclusive reliance on parent reports to identify diagnostic groups and for impairment data. Teacher reports would have been desirable, both to assess the level of parent-teacher agreement regarding symptomatology which current research suggests is relatively low (Gomez et al., 1999; Mitsis, McKay, Schulz, Newcorn, & Halperin, 2000), and to obtain data regarding social and academic functioning. Ideally, ratings of academic achievement would be supplemented with more objective tests given that adult ratings do not always accurately reflect levels of attainment (Ackerman et al., 1983). These would include specific cognitive and academic assessments. Child reports would have also been useful with regard to assessing internalising behaviours and self-esteem, especially given the findings of a recent study that girls with ADHD report higher levels of anxiety and depression than boys (Gadow et al., 2000). The need for multiple informants is further supported by the fact that previous research suggests a different pattern of correlates for ADHD subtypes with different informants (Crystal et al., 2001; Eiraldi et al., 1997; Manning & Miller, 2001; Paternite et al., 1996; Vaughn et al., 1997). For example, in Crystal et al.'s study, children with combined type were

rated as having more conduct problems than those with inattentive type with parent reports, but not with teacher reports.

Although this study was able to investigate ADHD subtype and gender differences on a number of impairment domains for which there were little or no previous research data, this greater breadth of coverage was undermined by a lack of sensitivity in some measures. For example, assessments of academic functioning, school behaviour problems and family cohesion were limited to single-item global measures that are likely to have low reliability and provide no information as to specific deficits. Furthermore, the measure of academic functioning only assessed the impact of children's ADHD symptoms on school grades and work completion. It did not assess either global academic performance or performance in individual curriculum areas, which would have been desirable given research showing children with inattentive type have greater deficits in mathematics than those with combined type (Marshall, Hynd, Handwerk, & Hall, 1997; Morgan et al., 1996; Rowland et al., 2001).

Some of the multi-item scales used to assess impairment also lacked the desired sensitivity. For example, previous research suggests that, although both children with combined and inattentive type exhibit social impairments, the nature of their social deficits is quite distinct. Specifically, children with combined type tend to be actively rejected whereas children with inattentive type have decreased peer acceptance (Maedgen & Carlson, 2000). Unfortunately, the measures used to assess social problems in this study did not include items relating to social rejection and acceptance.

While this study was able to assess most of the DSM-IV criteria for ADHD it was not able to assess Criteria E, namely whether symptoms were better accounted for by other disorders. Including such criteria in the assessment may have lowered the prevalence of ADHD and altered the pattern of subtype differences. For example, the symptoms of some children with ADHD in the current study may be better accounted for by anxiety disorders which previous research suggests are associated more with combined and inattentive types than hyper-impulsive types (Wolraich et al., 1996).

Another limitation was the unequal sample sizes across ADHD subtype groups and gender. Overall, the power to detect significant between-group differences was greater in the male sample than the female sample because of the larger number of boys with ADHD. As mentioned previously, this may have partially explained why girls with hyper-impulsive type (which was the smallest of the ADHD subtype groups with a sample size of  $n = 21$ ) were not found to significantly differ from non-ADHD girls on most measures of comorbidity and impairment. Moreover, the findings regarding girls with hyper-impulsive type may be relatively unreliable given the small sample size.

Some of the significant ADHD subtype and gender differences may have represented Type I errors given the large number of comparisons made. As noted, in some instances, the number of significant ADHD gender differences found were not much more than what would be expected by chance. For example, although significant ADHD gender differences were found on 3 of the 13 variables assessing comorbidity, between 2 and 3 significant differences could be expected by chance alone when a  $p < .05$  level of protection is applied (Field & Armenakis, 1974).



Due to the cross-sectional nature of the study, the stability of children's ADHD subtypes could not be determined, nor was it possible to assess whether there is a causal link between ADHD subtypes and impairment. Finally, it is possible that some of these non-ADHD controls had a psychiatric disorder not assessed in the current study with approximately 8% of male and 10% of female non-ADHD control children having a Child Behavior Checklist Total Problems *T* Score that fell within the clinical range ( $T > 60$ ) (Achenbach, 1991a). This also may have partially explained why girls with hyper-impulsive type did not differ from their non-ADHD counterparts on most measures of impairment.

## **FUTURE DIRECTIONS**

### **Discriminant Validity**

#### *Specific Directions from the Current Study*

To the best of my knowledge, this is the first study to describe and compare DSM-IV ADHD subtypes in males and females. As such the finding that ADHD subtype patterns for internalizing problems and impairment differed across gender needs to be replicated. In attempting to replicate these findings it is recommended that future studies conduct a more thorough and comprehensive assessment of ADHD and related conditions than that undertaken in this study. Specifically, the assessment should carefully assess all diagnostic criteria, paying careful attention to rule out those mental disorders and physical conditions which better account for children's ADHD symptoms, and identify those disorders which are indeed comorbid. Ideally, the assessment would cover such disorders as mental retardation, pervasive developmental disorders, other disruptive behaviour disorders, depression and anxiety, hearing and vision loss, sleep disorders, thyroid disorder and fetal alcohol syndrome. Just as important is the need to

obtain teacher reports of children's ADHD symptoms so as to exclude children with non-pervasive symptoms.

The other major finding that needs to be replicated is the apparent low level of impairment found for girls with hyper-impulsive type. Unfortunately, the assessment of impairment in this study was limited to a few domains, not all of which included data from the non-ADHD group. A more comprehensive assessment of functioning at school, home and with peers using multiple informants is required to adequately assess the level of impairment of children with ADHD and of girls with hyper-impulsive type specifically. Again, teacher reports are essential when assessing academic and school functioning. Furthermore, subjective assessments of children's functioning at school should be supplemented by objective assessments of cognitive and academic achievement.

### ***General Directions***

#### ***1. Separate Subtypes or Separate Disorders?***

Currently there is considerable debate as to whether the inattentive and combined types represent subtypes of the same disorder or are distinct and unrelated disorders (Barkley, 2001; Hinshaw, 2001; Lahey, 2001; Milich, Balentine, & Lynam, 2001). The argument that they are separate disorders stems from research indicating that the two subtypes do not share the same deficits in inattention. These studies suggest that children with inattentive type tend to exhibit excessive sluggishness, drowsiness, and daydreaming; symptoms collectively referred to as "sluggish cognitive tempo", whereas children with combined type tend to be more easily distracted (Carlson & Mann, 2000, 2002; Lahey et al., 1997; McBurnett, Pfiffner, & Frick, 2001). For example, in a recent community-

based study, children with inattentive type scored higher than those with combined type on four of the five items contained in the Teacher Report Form (Achenbach, 1991b) considered to be indicative of slow cognitive tempo (Carlson & Mann, 2002). These four items were: (a) daydreams or gets lost in his or her thoughts; (b) apathetic or unmotivated; (c) stares blankly; and (d) underactive, slow moving or lacks energy. The only item on which children with inattentive type did not receive significantly higher ratings was “confused, seems lost in a fog”. Moreover, children in the inattentive type group showed different patterns of comorbidity according to whether they had elevated scores on these slow cognitive tempo items. Those who scored high on slow cognitive tempo rated higher on internalising problems and lower on externalising problems. Carlson and Mann speculate that the current DSM-IV symptom criteria results in the identification of a heterogeneous inattentive subtype group which possibly contains two distinct groups: those with high levels of slow cognitive tempo and internalising problems and those who would be better described as a sub-threshold combined type group.

It is interesting to note that, in this study, children with combined and inattentive type in both the male and female samples did not differ on any of the slow cognitive tempo items contained on the CBCL identified by Carlson and Mann (2002), with the exception that girls with inattentive type received higher mean scores for “confused or seems to be in a fog” (Tables B.17 and B.18). It is possible that Carlson and Mann found greater differentiation between children with inattentive and combined type because they used teachers as informants who may be better placed to observe both problems of inattention and to detect normative variations.

Regardless of whether slow cognitive tempo is a distinguishing feature of those with inattentive type, there is a need for research to elucidate the specific inattention deficits of ADHD subtypes. To achieve this, researchers will likely need more direct and objective assessments of inattention as rating scales lack sufficient sensitivity (Milich et al., 2001). The development of valid and reliable neuropsychological and neurophysiological measures is seen as an important precursor to the identification of specific deficits. Thus far, neuropsychological research has been able to identify a number of different components of inattention including sustained persistence, arousal, alertness, orientating and focus/selective (Barkley, 2001).

To date, the relatively small number of studies to have examined the neuropsychological profiles of DSM-IV ADHD subtypes have found few differences, although most have not included a hyper-impulsive type group. Specifically, ADHD subtypes have consistently not differed on tests of intelligence (Faraone et al., 1998; Morgan et al., 1996; Nigg et al., 2002; Paternite et al., 1996), nor on measures of attention, impulsivity, response inhibition and executive functioning (Chhabildas et al., 2001; Houghton et al., 1999; Nigg et al., 2002; Paternite et al., 1996), although there are exceptions with the latter. For example, Klorman et al. (1999) found that children with inattentive type performed better on two tests of executive functioning than a group of children comprised of either combined or hyper-impulsive type, although these findings were not repeated in another study using virtually the same measures (Houghton et al., 1999).

Even fewer studies have examined DSM-IV ADHD subtype differences using neurophysiological measures, although recent studies have found electroencephalogram

differences between children with inattentive and combined type (Clarke et al., 1998, 2001). Specifically, Clarke et al. found that children with combined type show a higher incidence of theta waves (indicating underarousal), with the pattern of results suggestive of greater frontal lobe dysfunction. In conclusion, although reliable differences between ADHD subtypes are yet to be found with neuropsychological and neurophysiological measures, with further development these measures hold the promise of becoming valuable tools in the search to identify more reliable and valid diagnostic criteria with which to distinguish ADHD subtypes.

## ***2. Studies of Family History and Treatment Response***

Family studies of DSM-IV ADHD children should be conducted to assess whether ADHD subtypes 'breed true'. Finding that a proband's ADHD subtype predicts that of a relative would provide additional support for the discriminant validity of the current subtype classifications. In the only family study to be conducted to date, greater rates of ADHD were found among relatives of each the three subtype groups than that for relatives of controls, however subtypes did not 'breed true' (Faraone, Biederman, & Friedman, 2000). However, this study was with a clinic-referred sample using DSM-III-R criteria to identify 'approximate' ADHD subtypes

Support for the discriminant validity of DSM-IV ADHD subtypes would also be bolstered if studies were to find that subtypes differed in their response to treatment. This is especially relevant for stimulant medications which remain the main treatment approach. Unfortunately, such studies have yet to be conducted with even the United States National Institute of Mental Health Multimodal Treatment Study restricting itself to examining children with combined type only (Richters et al., 1995). Previously,

Barkley, DuPaul and McMurray (1991) examined the responsiveness of DSM-III ADD subtypes to stimulant medication, finding that children with ADD without hyperactivity had greater rates of 'no clinical responsiveness' to methylphenidate (24%) than those with ADD with hyperactivity (5%).

### ***3. Longitudinal Studies***

There is a need to track the developmental course of ADHD subtypes. This is particularly important for the hyper-impulsive type group given the possibility that this subtype may represent a transient phase from which children either 'recover' (i.e., their symptoms of hyperactivity diminish to sub-threshold levels as they get older), or develop combined type (i.e., their problems of inattention become more evident as they struggle to meet the demands of a classroom setting) (Carlson et al., 1999). Conversely, with overt hyperactivity diminishing with age (Hart, Lahey, Loeber, Applegate, & Frick, 1995), it is possible that some children with combined type eventually attract a diagnosis of inattentive type because their number of hyper-impulsive symptoms decreases to sub-threshold. Examining the developmental trajectories of ADHD subtypes will be important to determining the validity of subtypes. If young children with hyper-impulsive type typically mature into children with combined type then a strong argument could be made for collapsing the two subtypes on the basis that they represent different developmental stages of the same disorder. Conversely, the validity of the current ADHD subtypes would be enhanced if they were found to have unique clinical outcomes. It is worth noting that this study identified children with hyper-impulsive type as old as 13 and 12 years in the male and female samples respectively which suggests that this subtype group remains a distinct entity, at least in some older children.

Follow-up studies would also provide the means to explore the causal link between ADHD subtype membership and impairment. Assessing the long-term outcomes of ADHD subtype groups may give some indication as to the saliency of certain impairment domains as well as provide clues as to the mechanisms leading to dysfunction. It may be that the patterns of impairment for ADHD subtypes change over time. For example, although girls with hyper-impulsive type in the present study were not reported as being greatly impaired, they may experience considerable social and academic difficulties if they continue to exhibit high levels of hyperactivity during adolescence. Such speculation is supported by research findings indicating that academic and social difficulties of children with ADHD compound with age (Nussbaum, Grant, Roman, Poole, & Bigler, 1990), and that the presence of hyperactivity may be a better predictor of negative outcomes than inattention (Lynam, 1996). Understanding the long-term outcomes of ADHD subtypes will also assist in the development of appropriate prevention plans which target children at risk for particular problems. For example, the findings of this study suggest the need to carefully assess internalizing problems among girls with inattentive type given that the risk for developing a depressive disorder is somewhat stronger than in other female subtype groups.

#### ***4. The Need for Theoretical Models and Improved Diagnostic Rules for Subtype***

##### ***Classification***

Theoretical models need to be formulated to explain the development and dysfunction of ADHD subtypes. Although current theoretical models of ADHD, which emphasise behavioural inhibition as the core deficit (Barkley, 1997; Quay, 1997; Schachar, Mota, Logan, Tannock, & Klim, 2000), are useful in accounting for the problems of children

with hyper-impulsive and combined type, they do not distinguish between these two subtypes nor do they apply to those with predominantly inattentive type (Milich et al., 2001). The development of more encompassing theoretical models or even the development of a separate model for those with inattentive type would prompt more theory-driven research which, in turn, may assist researchers to take a more critical view as to the appropriateness of specific measures.

Finally, on a more practical level, researchers may have more success in distinguishing ADHD subtypes if the diagnostic boundaries were made clearer. For example, currently a child with six symptoms of inattention and six symptoms of hyper-impulsivity is designated as meeting the criteria for combined type, whereas a child with six symptoms of inattention and five symptoms of hyperactivity meets the criteria for inattentive type. With such a fine line for differential diagnosis, subtype classifications will likely vary between informants and measures and show little stability. Some suggest reducing the ‘fuzziness’ of these boundaries by changing the diagnostic rules. One possibility is that children with inattentive type be identified partly on the basis of two or fewer hyperactivity symptoms, but this may leave some children with high levels of symptoms in diagnostic limbo (Barkley, 2001; Milich et al., 2001).

## **ADHD Gender Differences**

### ***Specific Directions from the Current Study***

The gender by subtype interaction patterns found for impairment needs to be replicated given that this study provides some of the first data pertaining to gender patterns within individual subtypes. As mentioned previously, it is recommended that future studies conduct a more thorough and comprehensive assessment of ADHD and related



conditions than were undertaken in this study. Again, particular emphasis should be given to ruling out those comorbid conditions that may better account for children's ADHD symptoms. By accounting for these comorbid conditions, researchers will be better able to determine whether there are gender-specific risks associated with high rates of inattentive or hyper-impulsive symptoms.

It would be useful to investigate whether teachers agree with parent reports that boys with ADHD are more likely to experience school difficulties than girls with ADHD as a function of their symptoms. In conducting such research there is a need to clarify whether informants are indicating that boys with ADHD are worse academically (which would contradict some previous research findings. (eg Ackerman et al., 1983; Berry et al., 1985; Brown et al., 1991; James & Taylor, 1990) or whether their ADHD symptoms had interfered more with their capacity to complete schoolwork.

Furthermore, given that there were few differences in the symptom profiles of boys and girls with ADHD, there is a need to understand why the symptoms of boys were considered to cause more difficulties at school. Was it their higher rates for two hyperactivity symptoms ("leaves seat" and "runs about and climbs excessively") or, alternatively, was it because they exhibit symptoms of higher intensity and/or frequency? To this end, it may be useful to obtain from teachers their perceptions as to the specific challenges they face in teaching boys and girls with ADHD. Such information may also provide some important clues as to why boys with ADHD tend to have higher rates of referral.

It would also be useful to explore why boys with ADHD in the present study were more likely to be prescribed stimulants than girls with ADHD. It has been suggested that there is a lower level of detection of ADHD among females because of the perception that it is a male disorder (McGee & Feehan, 1991; Quinn & Nadeau, 2000; Whalen, 1989). One way of investigating whether there is a bias in adult perceptions is to have parents, teachers and mental health professionals read a vignette describing a 'typical' child with ADHD and ask them to speculate as to the likelihood that the symptoms reflect certain disorders (i.e., Anxiety, Conduct, ADHD). By systematically varying only the gender of the child in the vignette it is possible to assess whether adults are more likely to identify ADHD in boys. It would also be interesting to assess whether the reports given by adults vary as function of the predominant symptom pattern (i.e., inattentive versus hyperactive-impulsive).

### ***General Directions***

#### ***1. Longitudinal Studies***

Long-term follow-up studies are needed to assess the developmental trajectories of boys and girls with ADHD. Research has shown that, as children mature, the prevalence of ADHD among males decreases at a greater rate than that for females (Cohen, Cohen, & Brook, 1993), presumably because overt hyperactivity declines with age. This gender-differential age effect for the prevalence of ADHD may also influence the findings with regard to impairment. Although few studies have attempted to consider age as a factor, they hint at the possibility that the problems of girls with ADHD may increase relative to that of boys with the disorder. For example, Berry et al. (1985), reported a 10% increase in the number of girls with ADD+H who were rejected and avoided by peers from preschool to elementary school, whereas with boys the percentages remained

identical. Brown et al. (1991) found that girls with DSM-III-R ADHD were rated as more unpopular and performed more poorly on neurocognitive tasks related to attention and academic achievement as they got older, whereas with boys popularity rates and neurocognitive performances were generally stable over time.

## ***2. Identification of Normative Gender Differences***

Research that documents differences between boys and girls with ADHD should be mindful of the need to distinguish between those differences specifically attributable to the disorder and those that arise from normal sex differences (Arnold, 1996; Biederman et al., 2002). For example, this study found that girls with ADHD rated higher on somatic complaints than boys with ADHD. However, given that this gender difference is also evident among the non-ADHD group, it is unlikely that this difference reflects a sex-specific pathology. Thus there is a need to document normative gender differences on those measures commonly used to assess boys and girls with ADHD so as to provide some means of assessing the significance of ADHD gender differences (Arnold, 1996). For example, the finding that cerebral glucose metabolism is lower in adolescent girls with ADHD compared to boys needs to be viewed in the context that this gender difference is also evident in normal adolescent samples (Ernst et al., 1994).

## ***3. Testing Theoretical Models Regarding Etiology***

The aim of this study, like most research on ADHD gender differences, was to compare the phenomenology of the disorder among boys and girls. While this has obvious clinical significance, the study of ADHD gender differences has the potential to provide some important clues as to the etiology of the disorder (Heptinstall & Taylor, 1996). Indeed, it has been suggested that any viable etiological model of ADHD needs to

account for why the disorder is much more common among males than females (Faraone et al., 1995).

The two main biological models used to account for the male predominance, the polygenetic multiple threshold model and the constitutional variability model, have generated considerable research interest because they give diametrically opposed explanations as to why more males have ADHD (Eme, 1992; Gaub & Carlson, 1997b). The polygenetic multiple threshold model posits that ADHD is more prevalent among males because they have a lower threshold for the disorder due to their proclivity for prenatal, perinatal and postnatal trauma. The higher threshold for females means that they need a higher 'genetic dose' to manifest the disorder which, in turn, means that they are more likely to have biological relatives with the disorder. Conversely, the constitutional variability model posits that ADHD is more common in boys because their genetic material is transcribed at a slower rate (regulated by the Y chromosome), allowing more perturbations to occur during this process. Because this happens at the level of the genome, boys with ADHD are more likely to have biological relatives with the disorder. Females, on the other hand, are more likely to develop the disorder as a result of pathological processes such as brain damage.

Thus these two theories predict a different pattern of correlates for boys and girls with ADHD. The polygenetic multiple-threshold model predicts that males with ADHD are less likely to have relatives with the disorder but are more likely to show neurological abnormalities than females with the disorder, whereas the constitutional variability model posits the exact opposite (i.e., males are more likely to have relatives with the disorder, but are less likely to show neurological problems).

The few studies that have explicitly tested these two etiological models have produced inconsistent findings (James & Taylor, 1990; Silverthorn et al., 1996). James and Taylor found some support for the constitutional variability model in their retrospective review of children attending two hospitals over a 14 year period. Girls with ICD-9 hyperkinetic syndrome had higher rates of language and neurological disorders, whereas males were more likely to have relatives with history of hyperkinesis. The more recent findings of Silverthorn et al. were generally not consistent with either model in that whereas boys with DSM-III-R ADHD were more likely to have fathers with a history of ADHD, no gender differences were found for maternal history of ADHD, or on any of the neurocognitive measures which included assessments of prenatal/perinatal traumas and cognitive performance.

Other studies specifically assessing ADHD gender differences with regard to family history also report contradictory findings. Whereas some report higher familial aggregation among male probands (Faraone et al., 1995), others find higher rates among female probands (Pauls, Shaywitz, Kramer, Shaywitz, & Cohen, 1983) or no differences at all (Epstein et al., 2000). While research findings have not consistently supported either the polygenetic threshold or constitutional variability models, it should be noted that these were conducted with clinic-samples which may be confounded by the differential referral biases for boys and girls. It is likely that data obtained from community-based studies would provide a better test for these competing theoretical models.

## **CONCLUSION**

Much of what we know about ADHD comes from studies of clinic-referred boys. Little is known about girls with ADHD in the community and how they compare to boys with the disorder. This study addressed this important gap in current research by examining and comparing the DSM-IV ADHD subtype profiles of boys and girls. The findings suggest that the manifestation of ADHD is influenced by gender and that this has implications for both the assessment and treatment of the disorder.