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Trends in the prescribing of stimulant medication for the treatment of Attention Deficit Hyperactivity Disorder in children and adolescents in NSW

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Executive Summary

- Attention deficit hyperactivity disorder (ADHD) is a chronic condition, characterised by the symptoms of inattention, hyperactivity, and impulsivity. It has recently been estimated to affect as many as 11 per cent of children in Australia aged six to 17 years of age.
- Children with ADHD commonly experience a broad range of difficulties, including social problems and difficulties at school. They have an increased risk of serious long-term consequences such as slow academic achievement, peer rejection, and antisocial behaviour. The disorder also has a profound affect on parents, siblings, and teachers of children with ADHD.
- The causes of ADHD are unknown. Evidence to date suggests that ADHD is a disorder of the central nervous system, and is influenced by both familial and genetic factors.
- Stimulant medication is a common and accepted form of treatment for ADHD. Up to 90 per cent of children with ADHD who are treated with stimulant medication experience a reduction in their symptoms.
- According to research conducted overseas, the prescribing of stimulant medication for children with ADHD has significantly increased in the last decade. This increase is likely to be due to a number of factors, including an increase in public and clinician awareness and acceptance of ADHD as a disorder; a broadening of the diagnostic criteria for ADHD; a greater knowledge of the course of the disorder; an increase in the availability of ADHD-specific services, particularly paediatric and child psychiatric services; an increase in knowledge about the use and effectiveness of stimulant medication; lengthier periods of treatment; and an increase in the use of stimulant medication for the treatment of adults.
- In NSW the prescribing of stimulant medication for the treatment of ADHD in children and adolescents is restricted to specialist prescribers, and is monitored by the Pharmaceutical Services Branch of the NSW Department of Health.
- This study presents recent trends in the prescribing of stimulant medication for the treatment of ADHD in children and adolescents in NSW.
- Over the period 1990 to 2000 there was a marked increase in the number of children and adolescents with ADHD who were commenced on stimulant medication for the first time, with most of this increase occurring in the first half of the 1990s. The number of children commenced on stimulants in 2000 was five times the number commenced in 1990.
- There was also a marked increase in the rate of children and adolescents (that is, number per 1,000 people aged 2–17 years) treated with stimulant medication over this period, particularly during the first half of the 1990s. The rate in 2000 was about nine times the rate in 1990.
- At the end of 2000 there were almost 16,000 children and adolescents in NSW on stimulant medication for the treatment of ADHD, representing a rate of 11.3 per 1,000 (or 1.1 per cent) of people aged 2–17 years. Based on the estimated prevalence of ADHD, this means that as few as one in every 10 children with ADHD was undergoing treatment with stimulant medication.
- Children aged seven to 15 years had a rate of treatment greater than the average. It is often the case that soon after children commence formal schooling the impairments they experience as a result of the disorder become noticeable. The rate of treatment was highest for children aged 10 years (19.9 per 1,000 people aged 10 years).
- The majority of children treated with stimulant medication are male. The overall ratio

of boys to girls on medication at the end of 2000 was about 4:1. This was consistent through all age groups other than children aged less than four years, where the male to female ratio was 7:1. Although the prevalence of ADHD among boys is higher than it is among girls, the disparity in stimulant treatment rates is thought to be largely due to referral rates. Boys, who tend to display higher rates of disruptive behaviour, are more likely to be referred for treatment than girls.

- Over the period 1990 to 2000, however, there was a slight upward trend in the proportion of children and adolescents commenced on stimulant medication for the first time who were female. Also, the increase in the rate of girls on stimulant medication was slightly greater than the increase in the rate of boys on medication. This proportional increase in the number of girls being treated with stimulant medication is consistent with findings from overseas.
- Since 1993 more children and adolescents have been commenced on dexamphetamine than have been commenced on methylphenidate, probably because dexamphetamine is the least expensive of the two medications. However, the rate of children treated with dexamphetamine over the period 1990 to 2000 was roughly the same as the rate of children treated with methylphenidate over the same period. It is common for a child to find one stimulant drug more effective than the other, but it is difficult to predict which drug will produce the better outcome prior to the commencement of treatment.
- Among children and adolescents treated at the end of 2000, the average daily dose was the same for children and adolescents on dexamphetamine as it was for those on methylphenidate (2.9 tablets per day).
- There was a positive association found between age and dose: the greater the age, the higher the average daily dose (in tablets).
- Marked differences were found in rates of treatment according to health area. The Hunter area had the highest rate (18.4 per 1,000 people aged 2–17 years) while the Far West area had the lowest rate (1.2 per 1,000 people aged 2–17 years). Treatment rates for the other health areas were less variable, ranging from 4.5 to 15.1 (per 1,000 people aged 2–17 years). Regional differences in prescribing may have been due to a number of reasons, including the prevalence of ADHD symptoms and variations in the use of diagnostic criteria and methods; the availability of ADHD-specific services; the clinician's approach to the treatment of ADHD; socioeconomic factors; and parental and familial attitudes toward health services and treatment strategies.
- Long-term use of medication was found to be common. At the end of 2000, about one quarter of children and adolescents undergoing treatment had been on medication for more than three years. This is not surprising given the chronic nature of ADHD.
- Early attrition from treatment was also found to be common. Almost one fifth of children and adolescents aged 3–15 years commenced on stimulant medication did not continue treatment after their first prescription. This is consistent with the fact that stimulant medication is not effective for at least 10 per cent of children with ADHD.
- Stimulant medication has been shown to be a very effective form of treatment of ADHD. This study demonstrates that the NSW Department of Health supports and encourages stimulant prescribing that accords with modern, appropriate, and effective management of ADHD.

1. Introduction

They are the children who impulsively grab toys, butt in, push others and who can't wait their turn. They are the children who are full of uncontrolled activity, who throw tantrums, and who don't listen or follow instructions. They are the children who can't concentrate, who are easily distracted, and who are too disorganised and unfocused to complete tasks. Who are they? They are the children with attention deficit hyperactivity disorder (ADHD), and for many of these children, life can be difficult.

Life for the parents and families of children with ADHD can also be difficult. Parents often feel powerless and frustrated. Mothers, in particular, are more likely to experience depression and distress than mothers who do not have children with ADHD. Parents usually find that the normal methods of managing children, such as withholding attention, reasoning, and scolding, do not work with their ADHD children. Seemingly ordinary tasks, like shopping, can become highly onerous activities for the parents of children with ADHD. The time that parents have available for socialising becomes greatly restricted, especially when willing child-minders cannot be found.

The brothers and sisters of children with ADHD are challenged on several fronts. Not only do they contend with a sibling who is difficult to understand and live with, but they often enjoy far less attention in their household. This can sometimes lead to feelings of jealousy and resentment toward their sibling. Siblings also have an increased risk of having similar problems to their affected brothers or sisters, which can exacerbate the situation.

Teachers can also have difficulty dealing with children with ADHD. Such children frequently disrupt classroom routines and require individual behavioural management. This is a significant challenge for teachers who may often have neither the resources to carry out such management or the necessary knowledge, skills or training to do so.[a]

Thus, the impact of childhood ADHD cannot be underestimated; it can be both serious and far-reaching. Research has shown that children with ADHD (particularly those who exhibit symptoms characterised by disruptive behaviours) have an increased risk for a range of potentially serious consequences including slow academic achievement, peer rejection, personal injury, criminal activity, and possibly substance abuse.[1–6] For a significant proportion of children diagnosed with ADHD, their impairment will persist into adulthood.[7,8]

Australian children are diagnosed with the disorder every day. For a significant number of these children, treatment with stimulant medication will ultimately be required. In New South Wales (NSW), the prescribing of stimulant medication for the treatment of ADHD in children and adolescents is regulated and monitored by the NSW Department of Health. The regulatory and monitoring system currently in place was developed over many years, and provides important guidance for clinicians throughout Australia.[b]

This study, published as a supplement of the *NSW Public Health Bulletin*, aims to present information on the prescribing of stimulant medication for the treatment of ADHD in children and adolescents. The study firstly looks at the symptoms, diagnosis,

[a] In NSW in 1995, the Department of Education published the document *Talk, Time, Teamwork* to support teachers and schools in the management of students with ADHD. The document encourages a collaborative approach between teachers and doctors. It was distributed to all schools in NSW, and has been used in other regions of Australia and overseas.

aetiology and prevalence of ADHD. It examines the treatment options available for ADHD, with particular attention paid to the use of stimulant medication. The study also describes the restrictions that are in place in NSW for the prescribing of stimulant medication for the treatment of ADHD in children and adolescents. It then presents trends in the prescribing of stimulant medication in NSW over the last decade, and the characteristics of children and adolescents treated with stimulant medication in 2000. The study concludes with a discussion of these trends.

[b] The system was developed in conjunction with the Stimulants Subcommittee of the Medical Committee, a statutory committee established under section 30 of the *Poisons and Therapeutic Goods Act 1966*. The Stimulants Subcommittee, formally constituted in 1989, comprises experts (paediatric psychiatry and developmental and adolescent paediatrics) in the diagnosis and management of ADHD in children and young people. The Stimulants Subcommittee advises the Department on the development and revision of the stimulant prescribing criteria, policy issues relating to ADHD, and clinical issues affecting the prescribing of stimulants for individual children and adolescents.

2. Background

2.1 Diagnosis, symptoms and causes of ADHD

2.1.1 Diagnosis and symptoms

'Attention deficit hyperactivity disorder' is a term currently used to describe a number of broadly accepted symptoms and behavioural characteristics, core to which are the symptoms of inattention, hyperactivity, and impulsivity. Among the list of names previously applied to the disorder are 'minimal brain dysfunction', 'brain-injured child syndrome', 'hyperkinetic reaction of childhood', 'hyperactive child syndrome', and 'attention deficit disorder'. Over time not only has the name of the disorder evolved, but there has been a significant growth in the understanding of the disorder, as well as changes in the diagnosis and management of children with the disorder.

The behavioural characteristics of the disorder, described in more detail below, can be seen to some degree in most children at some time. To determine whether these are severe—and impairing enough to be clinically significant—a thorough assessment of the child by a skilled, knowledgable, and experienced clinician is required.

Assessment of the child involves a number of key elements. These include:

- a comprehensive interview with the child's adult caregivers, usually the parent(s);
- a developmental assessment to determine the child's developmental progress, which may lead to further assessment of vision, hearing, and language ability;
- school-related assessments, including reports of behaviour, learning, and attendance at school;
- behaviour rating scales completed by parents and teachers;
- assessment of coexisting mental disorders or comorbidities;
- a medical evaluation, to determine whether other factors may account for behaviour or learning difficulties, such as physical conditions;
- assessment of whether the symptoms are due to another mental disorder, such as anxiety disorder, or the result of stress or trauma,such as abuse.

The two most commonly used diagnostic systems for the diagnosis of ADHD are the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV),[9] and the *International Classification of Diseases Classification of Mental and Behavioural Disorders* (ICD-10).[10] In Australia, the National Health and Medical Research Council has recommended that the criteria established in DSM-IV should be the diagnostic criteria used for ADHD.[11]

The DSM-IV criteria emphasise several factors:

- the symptoms are not transient and must be present for at least six months;
- the symptoms are more frequent and severe than are typically observed in children of a comparable level of development;
- some of the symptoms that cause impairment must have been present before the age of seven years;
- the symptoms must be present in at least two settings, such as at home and at school;
- the symptoms must interfere with the child's social, academic, or occupational

functioning;

- the symptoms are not better explained by another disorder, such as anxiety disorder, schizophrenia, or autism.

The DSM-IV identifies three types of ADHD:

i) a combined type, where the child has symptoms of inattention, hyperactivity and impulsivity;

ii) an inattentive type, where the child predominantly has symptoms of inattention;

iii) a hyperactive-impulsive type, where the child predominantly has symptoms of hyperactivity and impulsivity.

According to the DSM-IV, a child with inattentive symptoms is commonly one who:

- fails to give attention to details or who makes careless mistakes; whose work is often messy and performed carelessly without considered thought;
- has difficulty sustaining attention in tasks and play activities, and who finds it hard to persist with a task until it is completed;
- often appears as if his or her mind is elsewhere or as if he or she is not listening or did not hear what has just been said;
- frequently shifts from one uncompleted task to another; he or she may begin a task, move on to another, then turn to another task without completing any one task;
- does not follow through on requests or instructions;
- often has difficulty organising tasks and activities;
- typically avoids tasks that require close concentration, such as homework, because they are found to be unpleasant and aversive;
- easily loses things that are needed for doing tasks or activities;
- is easily distracted by irrelevant stimuli; he or she attends to trivial noises, such as a car honking or a background conversation, that others would easily ignore;
- is often forgetful in daily activities—for example, missing appointments and forgetting to bring lunch;
- in social situations, may not follow details or rules of games, may not listen to others, or may not keep his or her mind on conversations.

Children who have symptoms of hyperactivity are commonly those who:

- fidget or squirm in their seat;
- fidget with objects, tap their hands, and shake their feet or legs excessively;
- leave their seat when they're expected not to, such as in a classroom or at the dining table;
- run about or climb excessively where it is inappropriate;
- have difficulty playing or engaging quietly in leisure activities, such as listening to a story;
- appear to be 'on the go', as if 'driven by a motor';
- talk excessively, and make excessive noises during quiet activities.

The child with impulsivity is typically one who:

- is impatient, has difficulty in delaying responses, blurts out answers before questions have been completed;

- has difficulty waiting his or her turn, grabs objects from others, and touches things he or she is not supposed to touch;
- excessively interrupts and intrudes on others, makes comments out of turn, and initiates conversations at inappropriate times.

2.1.2 Causes of ADHD

The cause or causes of ADHD are unknown. Some conditions such as fragile X syndrome, fetal alcohol syndrome, lead toxicity and very low birthweight, manifest symptoms of ADHD but these cases make up a very small proportion of children with ADHD.[12]

A variety of factors have been posited to play a causal role, including psychosocial factors, such as parent–child relationships and family dysfunction; and environmental factors, such as food additives and sugar intoxication. However, research in support of these claims has been very limited. They may affect the disorder but are unlikely to cause it.[12]

Recent studies suggest that ADHD is a disorder of the central nervous system. Barkley (1998) has described it as 'a developmental failure in the brain circuitry that underlies inhibition and self-control'.[13] He proposes that this loss of self-control impairs other brain functions that are crucial for maintaining attention. Brain imaging research has shown that the brains of children with ADHD tend to differ from those of children without the disorder, with specific areas being slightly smaller and less active.[14] It should be noted that these observations are research findings only and do not provide a diagnostic test for ADHD.

ADHD is highly hereditary.[15–17] Relatives of children with ADHD, for example, may be up to five times more likely to develop ADHD than relatives of children unaffected by the disorder, while a child who has a parent with ADHD may have a 50 percent chance of experiencing the disorder.[17,18–20] A shared environment by the family members may explain these findings in part, but studies involving twins and molecular genetics research indicates that the development of ADHD is probably genetically influenced.[21]

2.2 Prevalence of ADHD

ADHD does not appear to be culture-bound, or to be restricted to Western societies such as the United States, Europe, and Australia.[22,23] Its prevalence is not really known, but a number of studies, mainly overseas and in the United States in particular, have been conducted to determine its prevalence. The rate appears to vary according to the population involved and the diagnostic methods used. For example, it has been argued that physicians outside of the US tend to use more stringent criteria, and reserve the diagnosis for only obvious and severe cases. They may be reluctant to diagnose ADHD at all.[24]

According to the DSM-IV, between three and five per cent of children have ADHD. In their review, Goldman et al. (1998) found the prevalence of ADHD among children to range from 1.7 per cent to 16 per cent.[24] Early research in Australia reported the prevalence rate of hyperactivity to be as high as six per cent.[25]

In 1998, the National Survey of Mental Health and Wellbeing was conducted to determine the prevalence of mental health problems among Australian children and adolescents. It reported that 11.2 per cent of Australian children aged six to 17 years have ADHD. The prevalence of attention problems alone among children aged four to 17 years was found to be 6.1 per cent.[26] Due to the criteria used in this survey, the

estimate of ADHD prevalence is likely to be on the high side.[c]

The prevalence of ADHD differs according to various characteristics, such as the child's age and sex, and family or household characteristics.

Lavigne et al. (1996) examined the prevalence of ADHD in a large group of American (Chicago) children aged two to five years.[27] Two per cent of the children were identified as having ADHD. The Australian mental health survey reported that the rate of ADHD in children aged six to 12 years was about two times the rate for 13 to 17 year old children.[26]

It is well documented that ADHD is more prevalent among boys than among girls. The ratio of boys to girls is between 3:1 and 9:1, with the ratio decreasing with age. The Australian mental health survey of children found a somewhat smaller difference between the prevalence rate for boys and girls aged six to 17 years; the rate for boys (15.4 per cent) was just over two times the rate for girls (6.8 per cent).[26]

Part of the difference in the prevalence of ADHD between the sexes in research findings, and particularly clinic samples of children, may be referral bias; boys may be more likely to be referred for diagnosis because they exhibit more hyperactive–impulsive symptoms than girls.[14]

It has been suggested that girls are being under-diagnosed.[28] While some girls may display the more classic symptoms of hyperactivity and impulsivity, many may not. The differences between boys and girls who have ADHD are yet to be fully determined but it seems that—relative to boys with ADHD—girls with ADHD display greater intellectual impairment and lower levels of hyperactivity.[29] Several other subtypes of ADHD have been identified in very young girls. There is the shy and withdrawn type, who does not readily play with others, and tends to be distracted and forgetful. Then there is the dysphoric or mood disordered type who has prolonged temper tantrums and cannot be pleased, no matter what her parents try to do.[28]

A number of other psychiatric conditions commonly co-occur with ADHD. Up to 20 per cent of children with ADHD have mood disorders, 20 per cent have conduct disorders, and 40 per cent have oppositional defiant disorder. About seven per cent have tics or Tourette's syndrome, but up to 60 per cent of children with tics also have ADHD.[24,30] In preschool age children with ADHD, the prevalence of oppositional behaviour is very common.[27] The 1998 mental health survey of Australian children examined the prevalence of ADHD, conduct disorder, and depressive disorder. It found that 26 per cent of children with ADHD had either conduct or depressive disorder.[26]

The 1998 mental health survey of Australian children reported some interesting findings with respect to family–household characteristics. ADHD tended to be more prevalent in step–blended families and sole parent families than in families with original parents. ADHD was also more common in children who lived with parents that were not in paid employment, and in low-income households. The prevalence of ADHD in regions classified as metropolitan was about the same as that in non-metropolitan regions.[26]

Although regarded as a childhood disorder, ADHD is a disorder that persists into

[c] Although the survey used robust instruments for identifying emotional and behavioural problems, it did not include assessment by a clinician. Further, because the survey examined a limited number of mental health problems, it could not determine whether some children identified as having ADHD had other disorders that may have better explained their symptoms, such as anxiety in particular. Thus, a number of children identified in the survey as having ADHD may not have met the formal diagnostic criteria for ADHD described in DSM-IV. It should be noted that the prevalence rate of 11.2 per cent is a 'one year' estimate of prevalence, that is, an estimate of children who had ADHD during the year prior to the survey period.

adulthood. As many as 60 per cent of children developing the disorder go on to display symptoms as adults.[31]

2.3 Treatments for ADHD

Most of the research on the use of treatments for ADHD has been conducted with male Caucasian children. Relatively little is known about the treatment of ADHD in preschool children, adolescents, females, and minorities.[31]

Most treatments for ADHD fall into two general categories: psychosocial intervention and pharmacotherapy.

2.3.1 Psychosocial intervention

Research suggests there are two types of psychosocial intervention that are effective for treating ADHD in children: behavioural parent training and behavioural classroom interventions.[32]

Under a clinical behaviour therapy approach, parents undergo weekly group sessions over a period of weeks where they are taught behavioural techniques, such as time out, point systems, and contingent attention. Teachers are also trained by therapists in the use of classroom management strategies. The teachers may also use daily report cards on school performance, for which parents provide a consequence at home.

The more intensive these interventions are, the more effective they appear to be. In the contingency management approach, the strategies are implemented directly by the therapist, professional, or expert teacher rather than by the teacher or parent being trained by a therapist. The strategies are usually conducted in specialised treatment settings, such as special education classrooms and residential settings, where there is greater control over implementation. The difficulty with the contingency management approach is transporting it to other settings, including the home, school and peer settings.

Parent training in behavioural strategies need not be restricted to children of school age; such training may be useful for the management of ADHD in preschoolers.[33,34]

There are a number of psychosocial interventions that may be used in the management of ADHD, but there is little empirical research to support their use. These include individual therapy, play therapy and cognitive–behavioural treatments. Certain types of cognitive intervention, such as social skills training and problem-solving interventions, may be useful, but probably only when they are part of an intensive, multicomponent behavioural treatment package.[32]

The proven psychosocial interventions are not as effective in treating ADHD in children when compared with stimulant medication. When combined with medication, these interventions do appear to produce slightly better results than medication alone. Combining strategies, for example, may lead to lower dosages of medication,[35] and less intense behavioural treatment,[36] than if each approach is tried alone.

There are significant barriers to the effectiveness of psychosocial interventions. The success of their implementation depends heavily on the motivation and capabilities of the significant adults in the child's life. If key adults are unwilling or unable to implement the interventions, they will not be effective.[32] The benefits of psychosocial interventions also do not appear to extend beyond the time they are used; they need to be used on an ongoing basis.

2.3.2 Pharmacotherapy

The most common form of medication used to treat ADHD is stimulant medication. In Australia, this includes the drugs methylphenidate (Ritalin®, Attenta®, and dexamphetamine. The use of stimulant medication will be described in more detail later.

A number of non-stimulant drugs have proven useful in clinical practice for the treatment of ADHD in some children. Unlike stimulant medication, these drugs are not subject to monitoring and are not restricted to specialist prescribing. Although evidence is slowly gathering on their use in the treatment of ADHD, more research is needed to determine their effectiveness and safety.[31]

Tricyclic antidepressants and other antidepressants are generally used for children who are intolerant or unresponsive to stimulants, or who have particular concurrent disorders, such as depression, for which stimulants may be less appropriate. Because of their potential for cardiotoxicity, caution needs to be exercised when prescribing for children with suspected cardiovascular disorders. Generally, tricyclic antidepressants are considered a second-line medication treatment for ADHD.[31,37]

Clonidine (Catapres®) is an alpha-adrenergic agonist. In Australia it is approved for use in the treatment of hypertension, migraine, and menopausal flushing. The limited evidence available indicates that it has moderate effects on the symptoms of ADHD and may be particularly useful at reducing aggressive and defiant behaviours.[38,39] Having a sedating effect, it can also be useful for helping children where sleep disturbance is a major problem.[40] Increasingly, clonidine is being used as first-line pharmacotherapy for children with Tourette's syndrome.[41] There have been concerns raised about the safety of using it in combination with stimulant medication.[37,42] Overall, clonidine is not considered a first-line medication for the treatment of ADHD.[31,43]

Use of stimulants to treat ADHD

It has been well established that stimulant medication is very effective at treating ADHD, and it appears to be the most effective single treatment currently available.

The use of stimulant medication for the treatment of ADHD in children, however, has not been without controversy. The following are some of the concerns that have been raised:

- stimulants are abused by some adolescents and adults;
- children taking the medication may develop a substance-abuse problem;
- children who take the medication will come under pressure to divert their medication to others;
- stimulant use may adversely affect the developing brain;
- stimulants are being used to control behaviours in children at the expense of their genuine needs being met.

To add further to the controversy, in recent times in the US, parents have allegedly been reported to local child protection offices for neglect after withholding their children's medication. Class-action lawsuits have also been filed in the US Federal Courts, which allege that the manufacturers of Ritalin® and the American Psychiatric Association have conspired to create and expand the market for Ritalin®.[44]

Efficacy and administration of stimulant treatment

In their review of the literature on stimulant treatment, Spencer et al. (1996) reported that treatment with stimulants improves abnormal behaviours of ADHD, as well as

self-esteem, social and family function.[31] It also reportedly improves a wide variety of cognitive abilities, increases school-based productivity, and improves performance in academic testing. The benefits from stimulant treatment are not restricted to school age children, but appear to be applicable to preschool age children as well.[33,45] Stimulants may also be effective for the treatment of ADHD symptoms in children who have mild to moderate mental retardation or developmental disability.[31,46]

A favourable response to stimulant medication does not confirm, nor refute, a diagnosis of ADHD. The effects produced by stimulant medication on behaviour and attention are not specific to people with ADHD; they also improve behaviour and attention in children without ADHD.[47,48]

About 70 per cent of children who are treated with one of the common stimulant medications will experience a significant reduction in hyperactivity or increase in attention. If one drug is not effective, the other usually is, so that as many as 90 per cent of children will respond positively to at least one of the stimulant medications available.[24,35]

Most of the published research on the effectiveness of stimulant medication comes from the US where methylphenidate is by far the most common stimulant drug prescribed. At this stage, no predictors of response to the stimulant drugs have been identified.[49] Which drug provides the better outcome, therefore, remains much of a clinical judgement for the practitioner. In a study of children from an Australian hospital, Efron and colleagues (1997) compared the effects of methylphenidate and dexamphetamine over a short period (two weeks on each drug) in children with ADHD.[50] They found that most children improved on either drug, but response to methylphenidate was slightly better than dexamphetamine.

Taken orally, stimulants are rapidly absorbed and cross the blood-brain barrier easily. Their effect on behaviours appears within 30 minutes, reaches a peak within one to three hours, and is gone by five hours.[14,51] Thus, to get sustained effects over the course of a day, dosing typically occurs more than once in a day.

In practice, the optimal dose is usually identified by starting with a low dose, then gradually increasing the dose (if required), paying particular attention to clinical effects and side effects. Once an effective and well-tolerated dose has been identified, the dose should be reviewed, and adjustments made, periodically by the clinician, with feedback from parents and teachers. Higher doses do not necessarily lead to better results, and some children may need to have their dose reduced over the course of treatment.[35]

Psychostimulant therapy does have its limitations. It does not cure or necessarily 'normalise' children with ADHD. A child with ADHD may possess additional disabilities that are not responsive to stimulant therapy and may require other intervention, such as educational remediation.[32] Medication may not be helpful in other areas of family life, such as parent–child interactions.[33] In addition to this, stimulant treatment is not helpful for a significant proportion of children (at least 10 per cent), and younger children tend to respond less well to stimulant treatment than older children.[31] The side effects and other adverse effects associated with stimulant therapy are discussed later.

As is the case with psychosocial interventions, the benefits derived from stimulant treatment are only available while the treatment is offered. The effectiveness of the treatment in the long-term has only recently begun to be assessed, but indications so far are that it is useful as a long-term treatment.[52–54]

Prevalence of stimulant treatment

According to research conducted overseas, particularly in the US but also in The Netherlands, the 1990s saw a significant increase in the prevalence of stimulant

prescribing.[55–59] Numerous reasons for this increase have been suggested, including increased duration of treatment; more girls, adolescents, and inattentive youths on medication; and an improved public image of the medication treatment.[56,59]

Safer and Malever (2000) recently examined the prevalence of medications administered in public schools (elementary, middle and high schools) in Maryland, US.[60] They estimated that 3.65 per cent of students were treated with medication for ADHD. The ratio of boys to girls was just under 4:1. In The Netherlands in 1999, the prevalence of stimulant usage among 0–19 year olds was reported to be 7.4 per 1,000 or just over 0.7 per cent. The ratio of males to females was 5.5:1. Children aged 5–9 years had the highest rate (13.9 per 1,000), followed by 10–14 year olds (10.0 per 1,000), 15–19 year olds (2.5 per 1,000) and then 0–4 year olds (2.3 per 1,000).[59]

Rates of prescribing appear to differ across regions.[58,60–62] Valentine et al. (1996), for example, found wide variation in the rate of use when they compared the states and territories of Australia in 1993.[61] Western Australia had the greatest rate followed by New South Wales. Several factors may account for such differences, including differences in socioeconomic status and ethnicity, availability of ADHD-specific treatment services, the knowledge and experience of the treating professionals, and attitudes toward the appropriateness of stimulant medication as a form of treatment for ADHD.

Adverse reactions and side-effects of stimulant treatment

The majority of children treated with stimulant medication will experience some adverse effects.[63] Most of the adverse effects are mild, short in duration, and generally disappear when the dose and timing of the medication is adjusted. The common side effects are insomnia, decreased appetite, stomachache, headache, and jitteriness. A small number of children will exhibit tics (motor or vocal).[24]

In practical terms, it can sometimes be difficult for parents and clinicians to clearly identify the side effects of medication; it is not uncommon for many of these 'side effects' to be present before medication is commenced. In one Australian study, more than half of the children with ADHD displayed irritability, anxiousness, proneness to crying, sadness–unhappiness, trouble sleeping, and day-dreams, before commencing medication.[63] On medication, many of these symptoms decreased in frequency and/or severity. Some genuine side effects did emerge; for methylphenidate there was appetite suppression, while for dexamphetamine there was appetite suppression and trouble sleeping. Four of the 125 children in the study (3.2 per cent) had to discontinue medication because the side effects were too adverse.

Appetite suppression, and its associated risk for delayed growth, has been a particular concern for children adversely affected by medication. It appears, however, that any delays these children may experience in the short-term do not appear to have a significant effect on final height as an adult. Further, there is evidence to suggest that growth delays experienced by children with ADHD may be a developmental artefact of the disorder.[31,64,65]

With respect to tics, it is thought that stimulant medication may precipitate their onset but does not cause them.[49] Gadow et al. (1999) conducted a long-term study of children with ADHD and multiple tic disorder.[66] The children, who had multiple tic disorder prior to psychostimulant therapy, were evaluated at six-month intervals for two years. Overall, methylphenidate did not exacerbate the children's motor or vocal tics. The authors did caution, however, that children should be carefully monitored to identify any drug-induced exacerbation of tics that may occur in individuals.

Stimulants may cause damage to the central nervous system, cardiovascular damage, and hypertension,[67] but these effects have been reported only in children taking doses

much higher than the therapeutic doses typically prescribed for children.[68]

Abuse of stimulants

Much of the concern surrounding the use of stimulants for the treatment of ADHD is their potential for abuse.

It has not been clearly established whether stimulant treatment increases the risk of drug abuse.[67] Weighing up the evidence, several experts are of the view that stimulant treatment does not increase the risk.[69] Further, some research suggests that treating children with ADHD with psychotropic medication (of which stimulants are the most common) actually reduces the risk of substance abuse disorder during adolescence.[5]

Overall there has been little evidence of the development of tolerance to the effects of stimulants on the symptoms of ADHD and little evidence of a need to increase the dose to get the same response.[68]

Perhaps the primary risk for drug abuse concerns peers. One study conducted in Wisconsin in the US reported that 16 per cent of children prescribed stimulants for the treatment of ADHD had been approached to sell, give, or trade their medication.[70] Interestingly, none of the children believed stimulants as prescribed could lead to abuse. Most recently, the US General Accounting Office concluded that diversion or abuse of stimulant medications is not a major problem in middle or high schools in the US.[71] From a survey of principals in these schools, they found that eight per cent knew of stimulants being diverted or abused at their school. Most principals reported knowing of only one incident in their school.

2.4 Restrictions on stimulant prescribing in NSW

The prescribing of the stimulants dexamphetamine and methylphenidate in NSW is subject to the *Poisons and Therapeutic Goods Act 1966* and its regulations.

To prescribe stimulants for the treatment of ADHD in children and adolescents in NSW,[d] a medical practitioner requires approval from the NSW Department of Health.[72]

There are two types of approval:

- general approval,
- individual patient approval.

2.4.1 General approval

General approval is only available to consultant paediatricians, and consultant psychiatrists who are members of the NSW Faculty of Child and Adolescent Psychiatry of the Royal Australian and New Zealand College of Psychiatrists ('Child Psychiatrists').

Doctors who have been granted general approval may prescribe stimulant medication to treat children with ADHD without the need to obtain individual Departmental approval for each child, providing certain 'routine prescribing' criteria are met. A child does not meet the routine prescribing criteria if one or more of the following apply:

- the DSM-IV criteria for ADHD are not fulfilled;
- the child is aged less than four years;
- the prescribed dose is 'high' (that is, >0.9mg/kg/day for dexamphetamine; >1.8mg/kg/day for methylphenidate);
- there are significant side effects;

- there is severe psychiatric comorbidity;
- there is pre-existing tic disorder.

Generally-approved doctors who prescribe for children who meet the routine prescribing criteria are required to notify the Department of their prescribing on a monthly basis. For each prescription written they must provide details of the child, including his or her name, date of birth, postcode, suburb or town of residence, the drug and daily dosage prescribed, and the date on which the prescription was written.

2.4.2 Individual patient approval

If a child falls outside the routine prescribing criteria, a generally-approved doctor is required to apply for individual patient approval before prescribing for that child. There is one exception for three years olds. If a child is aged three years and meets no other non-routine criterion, the doctor may initiate a trial of stimulant medication without prior approval. However, the doctor must apply within three months, providing clinical information about the case, for approval to continue prescribing.

Applications to prescribe for children outside routine prescribing criteria must be accompanied by a clinical report. The clinical report should include such information as the child's clinical history, assessments made or planned, the presence or absence of comorbid conditions, the family circumstances, and other treatments instituted or planned.

Cases involving children outside the routine prescribing criteria are referred to an expert committee for consideration.[e]

The Department does not grant any approval to treat children aged less than two years of age with stimulant medication. For children who are two years of age, doctors are required to obtain a second opinion from another appropriately experienced practitioner before approval is considered. Once approval is granted, the doctor initiating treatment for the two-year old and the specialist providing the second opinion must provide reports indicating that stimulant therapy is appropriate within three months of commencing treatment. Progress reports are required for all children aged less than four years.

Doctors other than paediatricians and child psychiatrists may apply to the Department to prescribe stimulant medication to children with ADHD on an individual patient basis. These doctors generally fall into the following groups:

- adult psychiatrists;
- advanced trainees in community paediatrics or child psychiatry;
- general practitioners, with paediatric training, working in rural or remote areas;
- general practitioners in a paediatrically-orientated practice.

Once approved as a prescriber, these doctors must seek individual Departmental approval for each child for whom they wish to prescribe stimulant medication. This individual patient approval is restricted to children who meet the routine prescribing criteria described earlier. These doctors cannot prescribe stimulants to children who fall outside the routine criteria; they must refer such children to a paediatrician or child

[d] Doctors who wish to prescribe stimulant medication for adults also require approval from the NSW Department of Health. Details are available in the publication *Attention Deficit Hyperactivity Disorder in Adults: Criteria for Issue of Authority Under the* Poisons and Therapeutic Goods Act 1966 *to Prescribe Dexamphetamine or Methylphenidate*, TG 190/2.

psychiatrist if prescription of stimulants is required.

Individual patient approval is granted in the form of an authority. Authorities are issued for various lengths of time, but no longer than 12 months.

Most prescribing that occurs in NSW does so under general approval. This system of approval has been in place since mid-1996. Prior to this, all approval for the prescribing of stimulants for the treatment of ADHD in children was by way of individual patient approval.

2.5 Aim of this study

The aim of this study is to describe NSW trends in the prescribing of stimulant medication for the treatment of ADHD in children and adolescents. There are five corresponding sections in Methods (Part 3) and Results (Part 4).

- Section 1 presents trends in the number of children with ADHD who commenced stimulant treatment for the first time, for the period 1990 to 2000.
- Section 2 shows the rate (per 1,000 population) of children with ADHD who were treated with stimulant medication as at 30 June, for the period 1990 to 2000.
- Section 3 examines the characteristics of children with ADHD who were treated with stimulant medication as at 1 December 2000.
- Section 4 presents the characteristics of children aged less than four years who were commenced on stimulant medication in the period 1 January 1999 to 30 June 2000, based on individual patient approvals to prescribe.
- Section 5 examines attrition from stimulant treatment using a cohort of children commenced on stimulant medication in 1997.

[e] This committee is the Stimulants Subcommittee of the Medical Committee. See Footnote b for more details.

3. Methods

3.1 Section 1: Trends in the number of children and adolescents treated with stimulant medication for the first time

The number of children treated with stimulant medication for the first time in each of the years 1990 to 2000 was determined and analysed by various characteristics of the child and the treatment.

Data on authorities issued and prescriptions written for stimulant medication for the treatment of ADHD in persons aged less than 18 years were extracted from the NSW Department of Health *Pharmaceutical Drugs of Addiction System* for the period 1 January 1990 to 31 December 2000.[f] Children treated with stimulant medication for the first time in each year were identified. The date on which treatment was deemed to have started was either the date on which the first authority was issued, or the date on which the first prescription was written, with respect to the child.

For each year in the period 1990 to 2000, the number of children commenced on stimulant medication for the first time was determined according to the following characteristics: age of child at commencement of stimulant treatment, sex of child, and drug used.

Children residing outside NSW were excluded from all analyses. Whether a child resided outside NSW was determined according to his or her address as at the time of data extraction.[g]

It should be noted that data over the period 1990 to 2000 are not strictly comparable. Data for the period 1990 to 1995 concern authorities (issued for individual patient approval) only, while the period 1996 to 2000 concern both authorities (issued for individual patient approval) and prescriptions (written under general approval).

3.2 Section 2: Trends in the rate of children and adolescents treated with stimulant medication

The prevalence of children treated with stimulant medication as at 30 June of each year in the period 1990 to 2000 was determined and analysed by various characteristics of the child and the treatment.

Data concerning authorities issued and prescriptions written for stimulant medication, for the treatment of ADHD in persons aged less than 18 years, that were valid as at 30 June were extracted from the NSW Department of Health's *Pharmaceutical Drugs of Addiction System* for each year in the period 1990 to 2000. An authority was deemed to be valid on 30 June of a given year if it was issued on or before this date and expired on or after this date. A prescription was deemed to be valid if it was written in the six-month period to 30 June of a given year, unless the child was aged three years at the date of the prescription, in which case it was deemed to be valid in the three-month period

[f] People were aged less than 18 years on the date on which the authority was issued or the prescription written.

[g] Data were extracted on 24 May 2001. It was necessary to use the address as at the time of the data extraction because historical information on address was not available.

to 30 June of that year.[h] A child was considered to have been treated with stimulant medication if he or she had a valid authority or prescription.

As at 30 June of each year in the period 1990 to 2000, the number of children treated with stimulant medication per 1,000 resident population of NSW aged two to 17 years was calculated using population data from the Australian Bureau of Statistics.[i] The rate of children treated with stimulant medication was determined according to the following characteristics: age of child, sex of child, and drug used.

Children residing outside NSW were excluded from all analyses. Whether a child resided outside NSW was determined according to his or her address as at the time of data extraction.[j]

It should be noted that data over the period 1990 to 2000 are not strictly comparable. Data for the period 1990 to 1995 concern authorities only, while the period 1996 to 2000 concern both authorities and prescriptions.[k]

3.3 Section 3: Characteristics of children and adolescents treated with stimulant medication

The prevalence of children treated with stimulant medication as at 1 December 2000 was determined and analysed by various characteristics of the child and the treatment.

Data concerning children on stimulant medication for the treatment of ADHD as at 1 December 2000 were extracted using the method described in Section 2. A child was considered to have been treated with stimulant medication as at 1 December 2000 if he or she had a valid authority or prescription as at 1 December 2000. These data were analysed according to the following characteristics: age, sex, drug and dose, health area of residence, and treatment duration.

Age-specific rates per 1,000 resident population were calculated using population data from the Australian Bureau of Statistics.[l]

Rates for individual health areas were calculated using population data from the Australian Bureau of Statistics.[m] Health area of residence was based on the child's address as at the time of the data extraction.[n]

Data concerning dose are presented only for children who had a valid prescription. Comparable data for children for whom an authority was valid as at 1 December 2000 were not available.

Treatment duration was calculated as the number of days a child had continuously received stimulant treatment up until 1 December 2000. Where there was a break of no ~~more than 182 days ('six months') between consecutive valid authorities or prescriptions~~

[h] Under the *Poisons and Therapeutic Goods Act 1966*, prescriptions for stimulants (and all other Schedule 8 drugs) are valid for only six months from when written. The valid life of a prescription for three-year olds was restricted to three months because doctors may only prescribe to these children on a trial basis before obtaining an individual patient authority.

[i] Australian Bureau of Statistics. *Estimated Resident Population by Sex and Age, States and Territories of Australia*. Catalogue no. 3201.0.

[j] See footnote g

[k] As at 30 June 1996, the proportion of children treated with stimulant medication based on a valid authority was 95.9 per cent compared with 4.1 per cent with a valid prescription. The comparable proportions, respectively, for 30 June 2000 were 2.3 per cent and 97.7 per cent.

[l] Australian Bureau of Statistics. *Estimated Resident Population by Sex and Age, States and Territories of Australia*, Catalogue no. 3201.0; preliminary figures were used for 2000.

preceding 1 December 2000, a child was deemed to be continuously receiving treatment. (As described earlier, for children aged three years, a prescription was defined as being valid for a period of three months from the date it was written, while a prescription for a child aged four years or over was defined as being valid for a period of six months from the date it was written.) Treatment duration (in days) was calculated from the date of the first authority or prescription in the sequence of continuous treatment to 1 December 2000.

Children residing outside NSW were excluded from all analyses. Whether a child resided outside NSW was determined according to his or her address as at the time of data extraction.[o]

3.4 Section 4: Two- to three-year olds treated with stimulant medication

Children aged less than four years ('Two- to three-year olds') for whom an individual patient authority was issued for the first time in the period 1 January 1999 to 30 June 2000 were identified using the NSW Department of Health's *Pharmaceutical Drugs of Addiction System*. For the 57 children identified, the individual patient files containing application forms, clinical reports and other supporting evidence, were examined. Information was collated on the following variables: age, sex, presence of comorbid conditions, age of onset of ADHD symptoms, presence of familial ADHD, previous treatments used, effectiveness of stimulant medication, and side effects experienced.

3.5 Section 5: Attrition from stimulant treatment

Children aged three to 15 years who received their first *prescription* in the year 1997 were identified. To simplify the analysis, children for whom an individual patient authority had ever been issued were excluded. For each child, the date of the last prescription was determined by examining all prescriptions that had been notified to the Department of Health.[p] The time between the date of the first prescription and the last prescription for each child was then calculated to represent a measure of attrition from stimulant medication.

3.6 Caveats

For the purposes of this study, it is assumed that a child is being treated with stimulant medication if an authority for stimulant medication has been issued with respect to the child, or if a prescription for stimulant medication has been written for the child. It is also assumed that a child is on stimulant medication for the period over which an authority or prescription is valid. The extent to which these assumptions are valid is unknown.

[m] Australian Bureau of Statistics. *Estimated Resident Population by Sex and Age, 30 June 1998*, unpublished data provided by the Epidemiology and Surveillance Branch, NSW Department of Health.

[n] Data were extracted on 24 May 2001. Therefore, health area of residence was based on address as at 24 May 2001 and not 1 December 2000. Information concerning a child's address as at 1 December 2000 was not available.

[o] See footnote g.

An authority indicates a doctor's intention to prescribe stimulant medication for a particular child. When a doctor is issued with an individual patient authority, however, he or she may not necessarily proceed with writing a prescription for stimulant medication.

When a prescription has been written for a child, the prescription may not be filled. If the medication is dispensed, the child may not take the medication at all or may take the medication for only a short period of time (less than the period over which an authority or prescription is valid).

Therefore, a number of children may be counted as being on stimulant medication when in fact they are not. On the other hand, a number of children may not be included in the figures when they should be. An example of this is the child who continues to take medication beyond the period over which the authority or prescription is valid. The child may have surplus supplies of medication because he or she has spent some time off medication during the period over which the medication was prescribed.

These issues should be taken into consideration when interpreting the data contained in this study.

[p] All prescriptions that had been notified to the Department as at 4 June 2001 were considered. Due to delays in notification and recording, the *Pharmaceutical Drugs of Addiction System* as at 4 June 2001 would not have included all prescriptions written up to 4 June 2001. It included most notified prescriptions to February 2001.

4. Results

4.1 Section 1: Trends in the number of children and adolescents treated with stimulant medication for the first time

4.1.1 Overall trend

Figure 1 shows the number of children with ADHD who were commenced on stimulant medication for the first time in each year in the period 1990 to 2000. It can be seen that a significant increase occurred over this time, particularly in the period 1990 to 1994. The slight downward change from 1995 to 1996 may, at least in part, be due to the introduction of the general approval system. The number of children commenced on stimulant medication for the first time in 2000 was about five times the number for 1990.

4.1.2 Age at commencement

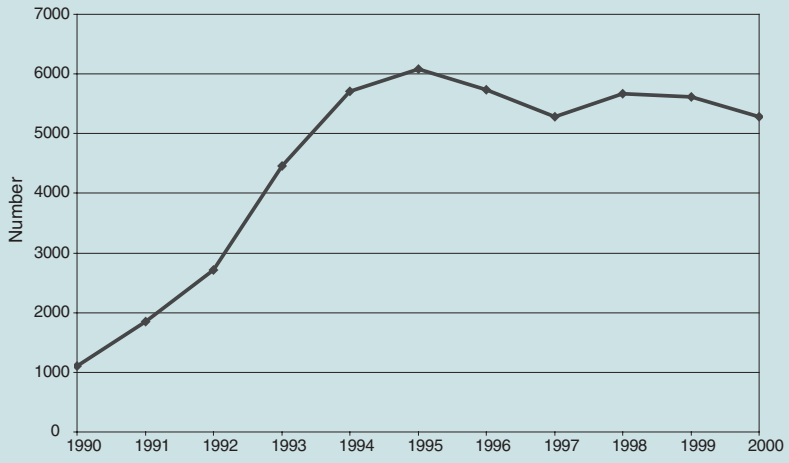
Figure 2 shows the number of children with ADHD who were commenced on stimulant medication for the first time in the period 1990 to 2000 according to the age of the child at commencement of stimulant treatment.

For all age groups there was an upward trend in the number of children commenced on stimulant medication for the first time in the period 1990 to 2000. For the largest group of children, 7–11 year olds, the number commenced on stimulant treatment for the first time in 2000 was 4.4 times higher than the number in 1990. The increase for children aged less than four years was similar at 4.8 times. These increases were similar to the overall average (4.8 times). For children in the age group 12–15 years, the increase (3.5 times) was slightly lower than the average.

The other age groups evidenced a somewhat greater increase, with children aged four years having the greatest increase at nine times. Most of the increase among children

FIGURE 1

Number of children with ADHD commenced on stimulant medication for the first time by year of commencement, 1990 to 2000



Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

aged less than four years was due to an increase in the number of three year olds starting stimulant treatment for the first time. For children aged 5–6 years the number started on stimulant medication for the first time in 2000 was seven times higher than the number in 1990. For children aged 16–17 years the increase was 7.6 times.

Although relatively young children and children in their late teens had the greatest increases from 1990 to 2000, the increase in the absolute number of children in these age groups was quite small. For example, the number of children aged less than four years who were commenced on stimulant treatment for the first time in 1990 was 18, while the comparable number for 2000 was 86. For 16–17 year olds the number went from 27 in 1990 to 205 in 2000.

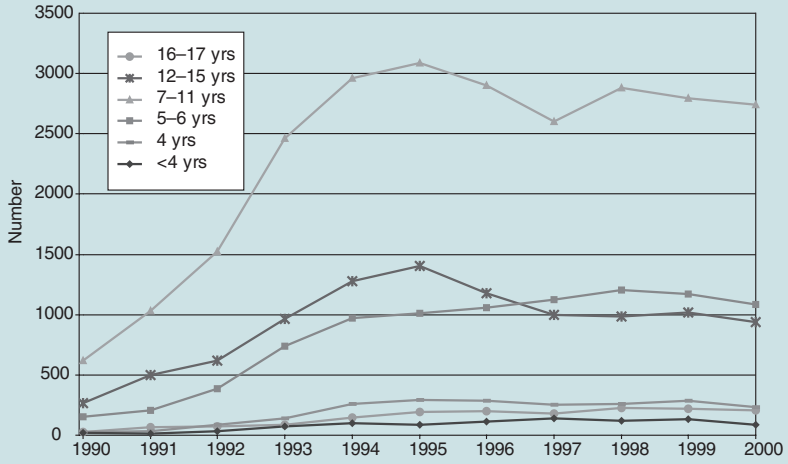
Figure 3 illustrates how the mix of children commenced on stimulant medication for the treatment of ADHD changed over the period 1990 to 2000. It shows the number of children who commenced stimulant treatment for the first time in the period 1990 to 2000 by age group, as a percentage of all children who started stimulant treatment for the first time. The age group 7–11 years is split into 7–8 year olds and 9–11 year olds because these groups had slightly different trends.

Over the period 1990 to 2000, very young children and older teenagers have consistently comprised a small proportion of all children commenced on stimulant medication for the first time. Their representation, however, over this time has gradually increased. Similarly, the representation of children aged 5–6 years among children commencing stimulant treatment for the first time has increased. Conversely, the proportion of children commenced on stimulant medication for the first time aged 9–15 years has gradually decreased.

There has been a slight downtrend in the average age of children who commenced stimulant treatment for the first time over the period 1990 to 2000. In 1990 the average age of children first started on stimulant medication was 9.4 years (SD = 3.0 years). In 2000 it was 8.8 years (SD = 3.3 years).

FIGURE 2

Number of children with ADHD commenced on stimulant medication for the first time, by age and year at commencement, 1990 to 2000



Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

4.1.3 Sex

Figure 4 shows the number of children with ADHD who were commenced on stimulant medication for the first time in each year in the period 1990 to 2000 by sex. Although the majority of children started on stimulant medication for the first time have been male, the growth in the number of females commenced on medication has been greater than the growth in the number of males. From 1990 to 2000, the number of girls commenced on stimulant medication increased by 6.5 times; the increase for boys was 4.4 times. Thus, there has been a slight downward trend in the proportion of children first commenced on stimulant medication who are male. In 1990 the proportion of children who were male was 84.1 per cent. In 1999 the figure was 78.5 per cent.

This downward trend in the proportion of children first started on stimulant medication who were male occurred across all age groups.

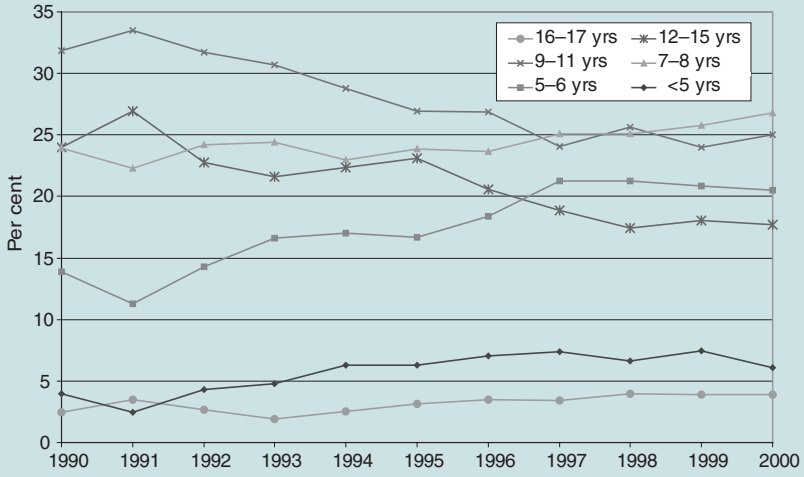
4.1.4 Drug

Figure 5 shows the number of children with ADHD who were commenced on stimulant medication for the first time in the period 1990 to 2000 according to the drug used for treatment. The initial drug used could not be determined for a large number of children in 1996 therefore data for 1996 are missing from Figure 5. For other years in the period 1994 to 2000, a small number of children are excluded for whom the initial drug used could not be determined.

Since 1993, a larger number of children started on stimulant medication for the first time have been initially treated with dexamphetamine rather than methylphenidate. In 2000, 56 per cent of children who started stimulant medication for the first time were commenced on dexamphetamine.

FIGURE 3

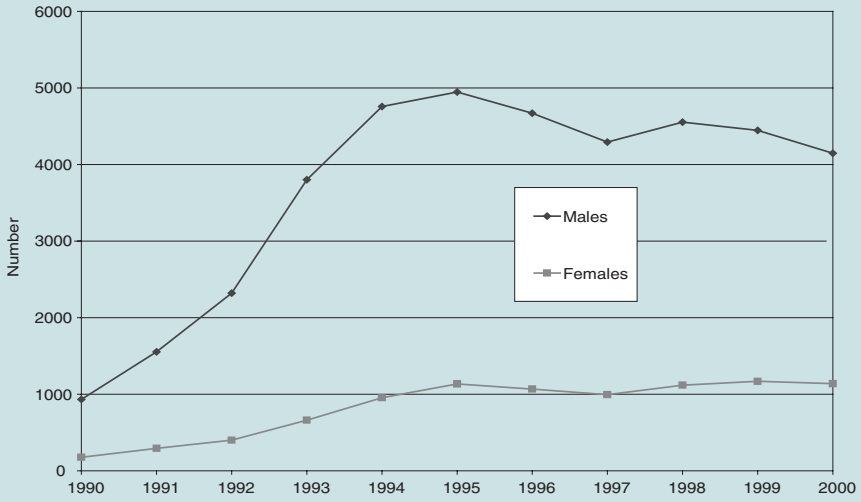
Per cent of children with ADHD commenced on stimulant medication for the first time, by age and year at commencement, 1990 to 2000



Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 4

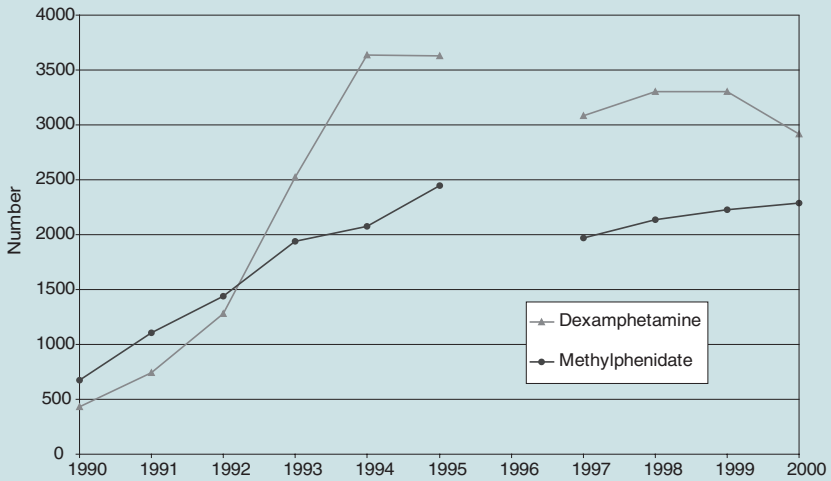
Number of children with ADHD commenced on stimulant medication for the first time by sex, 1990 to 2000



Note: Data for 1990 excludes one child whose sex was unknown.
Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 5

Number of children with ADHD commenced on stimulant medication for the first time, by drug and year at commencement, 1990 to 2000



Note: The initial drug used could not be determined for a large number of children first treated with stimulant medication in 1996, therefore data for 1996 are not shown. For the other years in the period 1994 to 2000, a small number of children are excluded for whom the initial drug used could not be determined.
Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

4.2 Section 2: Trends in the rate of children and adolescents treated with stimulant medication

4.2.1 Sex

Figure 6 shows the number of children with ADHD per 1,000 NSW resident population aged 2–17 years who were treated with stimulant medication as at 30 June of each year in the period 1990 to 2000. Separate trends for males, females, and all children are presented.

It can be seen that there was a sharp increase in the rate of children on stimulant medication after 1993. From 1996 to 2000 the rate has been fairly stable. It should be noted that a change in the approval system to prescribe stimulant medication occurred in NSW in 1996.

Overall, from 1990 to 2000, there was a nine-fold increase in the rate of children treated with stimulant medication for ADHD. The increase for girls (10.8 times) was slightly greater than the increase evidenced for boys (8.8 times).

4.2.2 Age

Figure 7 shows the number of children with ADHD per 1,000 NSW resident population who were treated with stimulant medication as at 30 June of each year in the period 1990 to 2000 by age.

It can be seen that all age groups experienced an increase over the period 1990 to 2000. For two groups of children the increase in the rate from 1990 to 2000 was higher than the average increase (9.1 times); children in the age group 5–6 years (increase of 10.8 times) and children in the age group 16–17 years (increase of 14 times). For children in the age group 7–11 years, the rate increased 8.9 times from 1990 to 2000. For children in the age group 12–15 years the rate increased 8.1 times, while for children aged less than five years the increase in the rate was 7.5 times.

Although not shown here, the trends for male and female children were generally similar to the trend for all children. A notable exception was for female children aged 16–17 years. For this group, the rate from 1990 to 2000 increased about 27 times, going from a rate of 0.1 to a rate of 2.7 (per 1,000 females aged 16–17 years).

The average age of children on stimulant medication as at 30 June was fairly stable over the period 1990 to 2000, at around 11 years of age.

4.2.3 Drug

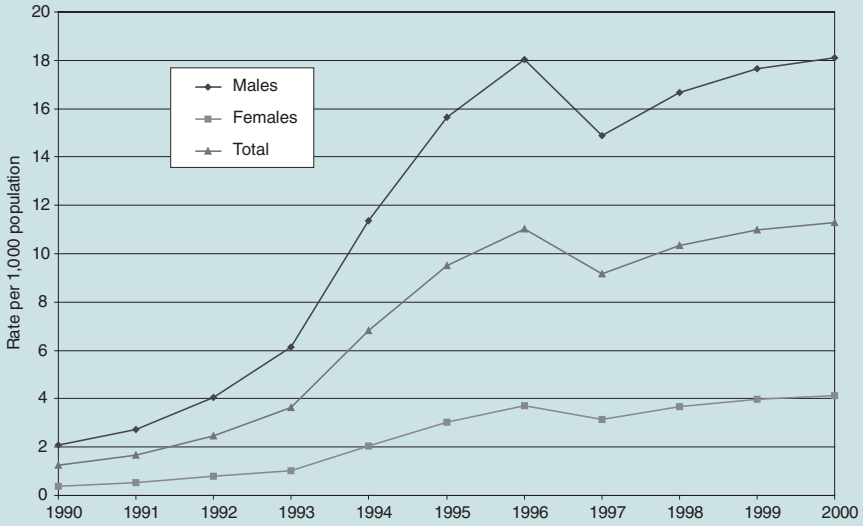
Figure 8 shows the number of children with ADHD per 1,000 NSW resident population aged 2–17 years who were treated with stimulant medication as at 30 June of each year in the period 1990 to 2000 by drug used for treatment. The drug used could not be determined for a large number of children in 1996 therefore data for 1996 are missing from Figure 8. For other years in the period 1995 to 2000, a small number of children are excluded for whom the drug used could not be determined.

From 1990 to 1993, slightly more children on stimulant medication were on methylphenidate than were on dexamphetamine. For most other years in the period 1990 to 2000, the number of children on dexamphetamine was about the same as the number on methylphenidate.

Although not shown here, the trends for male and female children were similar to the

FIGURE 6

Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD by sex and year, 30 June, 1990 to 2000

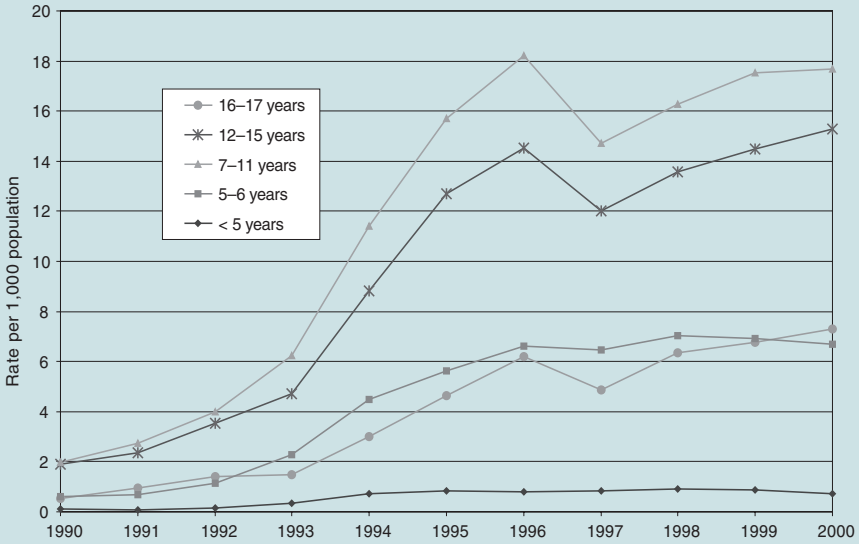


Notes: NSW resident population based on Australian Bureau of Statistics preliminary estimates of population as at 30 June 2000 (Catalogue no. 3201.0).
The total for 1990 includes one person whose sex was unknown.

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 7

Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD by age and year, 30 June, 1990 to 2000

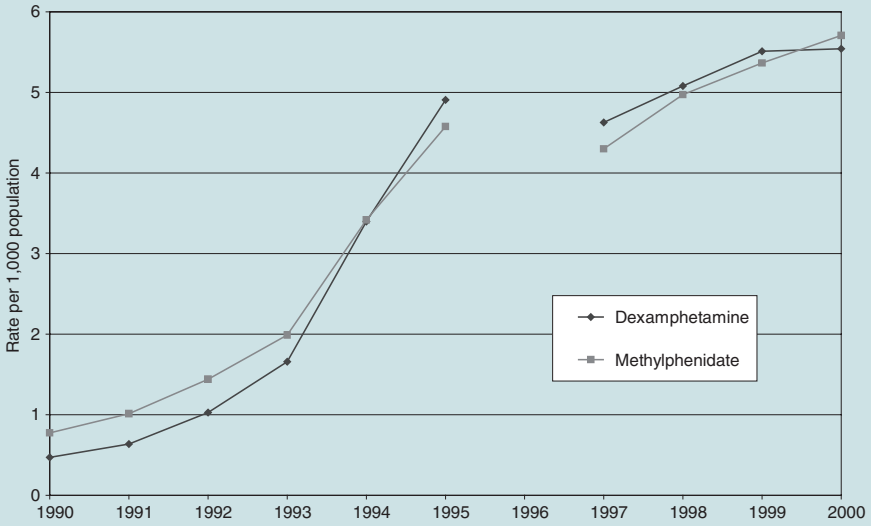


Note: NSW resident population based on Australian Bureau of Statistics estimates of population as at 30 June (Catalogue no. 3201.0).

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 8

Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD by drug and year, 30 June, 1990 to 2000



Note: The drug used could not be determined for a large number of children treated with stimulant medication as at 30 June 1996, therefore data for 1996 are not shown. For the other years in the period 1995 to 2000, a small number of children are excluded for whom the drug used could not be determined.
NSW resident population based on Australian Bureau of Statistics estimates of population as at 30 June (Catalogue no. 3201.0)

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

trend for all children.

4.3 Section 3: Characteristics of children and adolescents treated with stimulant medication

4.3.1 Age and Sex

Table 1 shows the age and sex breakdown of children who were being treated with stimulant medication for ADHD as at 1 December 2000. It also shows the ratio of male children to female children.

From Table 1 it can be seen that the age distribution for boys was similar to that for girls. For almost every age group, boys outnumbered girls by between four and five times. Among three-year olds, boys outnumbered girls almost eight to one.

The average age of children on stimulant medication as at 1 December 2000 was 10.8 years (SD = 3.1 years).

Table 2 shows the number and rate of children treated with stimulant medication for ADHD as at 1 December 2000 by sex. The rate is based on the estimated number of children in NSW in each age group as at 30 June 2000. The ratio of the male rate to the female rate is also shown in Table 2.

From Table 2 it can be seen that about 11 in 1,000 children, or just over one per cent of children, in NSW were being treated with stimulant medication for ADHD as at 1 December 2000. The rate was highest for children in the age group 9–11 years (19.3 per 1,000 resident population), followed by those in the age group 7–8 years (15.5 per 1,000 resident population). Children aged less than four years had the lowest rate at 0.2 per 1,000 resident population, followed by four year olds (1.7 per 1,000 resident population).

The rate for boys was about four times the rate for girls. As noted earlier, the largest discrepancy between the sexes was among children aged less than four years. In this age group the rate for boys was more than seven times the rate for girls.

Figure 9 shows the rate of children treated with stimulant medication for ADHD as at 1

TABLE 1

Number and percentage of children treated with stimulant medication for ADHD as at 1 December 2000 by age and sex

Age	Males		Females		Total		Ratio M / F
	No.	%	No.	%	No.	%	
2 yrs	0	0.0	0	0.0	0	0.0	-
3 yrs	23	0.2	3	0.1	26	0.2	7.7
4 yrs	120	0.9	28	1.0	148	0.9	4.3
5–6 yrs	951	7.3	236	8.1	1,187	7.5	4.0
7–8 yrs	2,267	17.4	498	17.1	2,765	17.4	4.6
9–11 yrs	4,201	32.3	964	33.0	5,165	32.4	4.4
12–15 yrs	4,452	34.2	937	32.1	5,389	33.8	4.8
16–17 yrs	993	7.6	254	8.7	1,247	7.8	3.9
Total	13,007	100	2,920	100	15,927	100	4.5

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

TABLE 2

Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD as at 1 December 2000 by age and sex

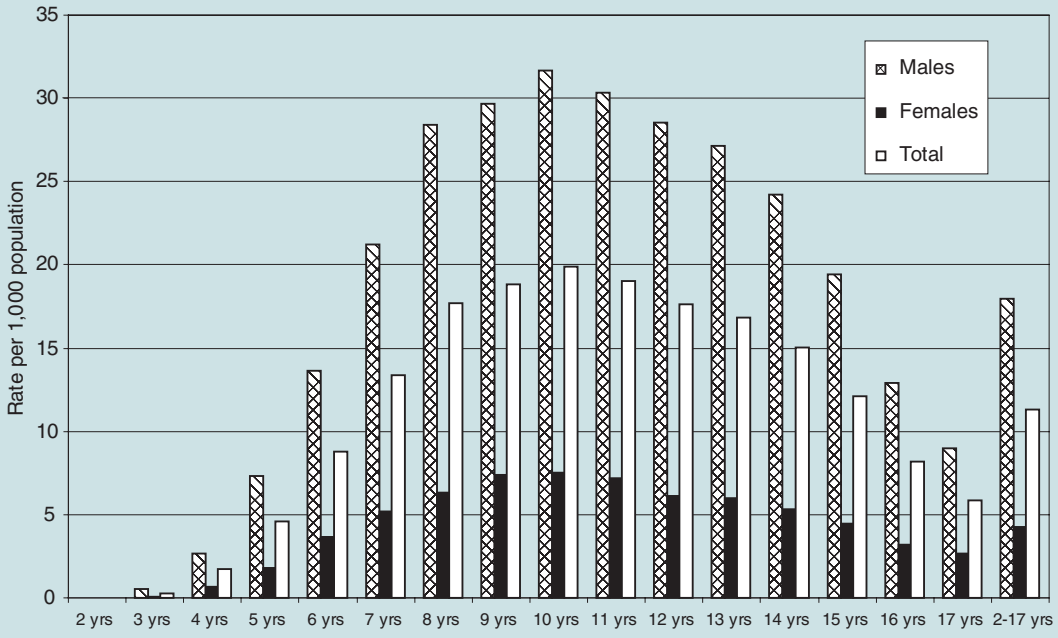
Age	Males	Females	Total	Ratio M / F
< 4 yrs	0.3	0.04	0.2	7.3
4 yrs	2.7	0.7	1.7	4.1
5–6 yrs	10.5	2.7	6.7	3.8
7–8 yrs	24.8	5.8	15.5	4.3
9–11 yrs	30.6	7.4	19.3	4.1
12–15 yrs	24.8	5.5	15.4	4.5
16–17 yrs	10.9	2.9	7.0	3.7
Total	18.0	4.2	11.3	4.2

Note: NSW resident population based on Australian Bureau of Statistics preliminary estimates of population as at 30 June 2000 (Catalogue no. 3201.0).

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 9

Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD as at 1 December 2000 by single year of age and sex



Note: NSW resident population based on Australian Bureau of Statistics preliminary estimates of population as at 30 June 2000 (Catalogue no. 3201.0).

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

December 2000 by single year of age and sex. The rates for males and females overall (that is, all persons aged 2–17 years) are also shown in Figure 9.

For both boys and girls aged from seven to 15 years, the rate on stimulant medication was higher than the average. At a rate of 31.7 per 1,000 resident population, the rate for boys aged 10 years was about 1.8 times greater than the average for boys. The rate for girls of this age (7.5 per 1,000 resident population) was also 1.8 times the average for girls.

4.3.2 Age and drug

Figure 10 shows the percentage of children who were being treated with stimulant medication for ADHD as at 1 December 2000 according to the child's age and drug. It shows that a slightly higher proportion of children on stimulant treatment as at 1 December 2000 were on methylphenidate (52.0 per cent) than dexamphetamine (48.0 per cent).

These proportions differed slightly according to the child's age. The smallest proportion on methylphenidate (42.9 per cent) were children aged four years, while the highest proportion of children on methylphenidate (53.7 per cent) were 9–11 year olds.

4.3.3 Age and dose

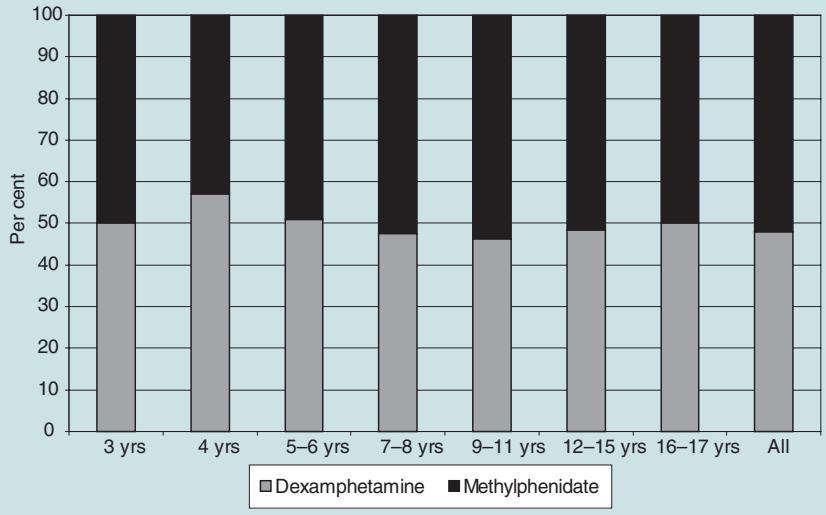
Figure 11 shows the average daily dose (in tablets) for children treated with stimulant medication for ADHD as at 1 December 2000, according to the child's age and the drug. Children for whom the daily number of tablets prescribed could not be determined are excluded from Figure 11.

The average dose for methylphenidate was slightly less or the same as that for dexamphetamine, across all age groups. Figure 11 shows a positive association between age and dose; the greater the age, the higher the average daily dose (in tablets).

Figure 12 shows the percentage of children treated with stimulant medication for ADHD as at 1 December 2000, according to the child's age and the daily number of

FIGURE 10

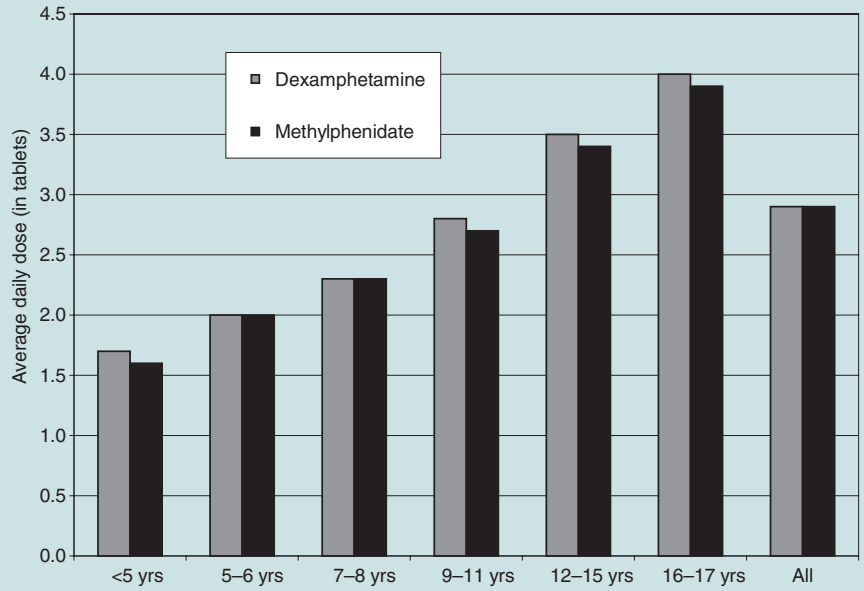
Per cent of children treated with stimulant medication for ADHD as at 1 December 2000 by age and drug



Note: Excludes 50 children for whom the drug of treatment could not be determined.
Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 11

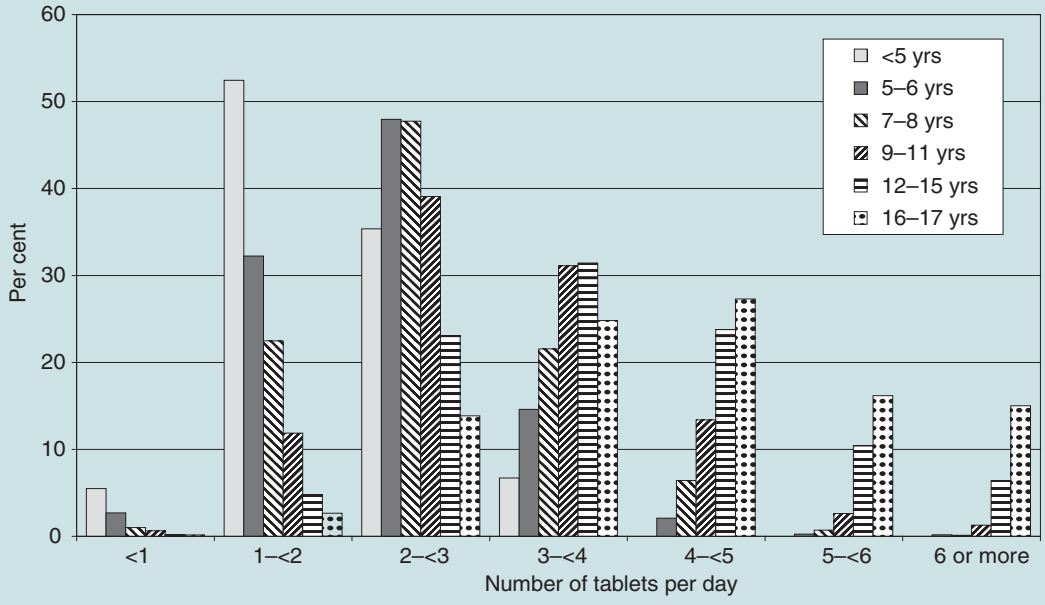
Average daily dose (in tablets) for children treated with stimulant medication for ADHD as at 1 December 2000 by age and drug



Note: Excludes 380 children for whom the daily dose could not be determined.
Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 12

Per cent of children treated with stimulant medication for ADHD as at 1 December 2000 by age and daily dose



Note: Excludes 380 children for whom the daily dose could not be determined.
Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

tablets prescribed.

The relative frequency distributions for dexamphetamine and methylphenidate were very similar, hence data on the two drugs were combined. Children for whom the daily number of tablets prescribed could not be determined are excluded from Figure 12.

The positive association previously shown between age and dose is evident in Figure 12. A relatively high proportion of young children were on low doses, while older children were on higher doses. For example, the vast majority of children aged less than five years (93.3 per cent) were taking fewer than three tablets per day. In comparison, 83.3 per cent of those aged 16–17 years were taking three or more tablets per day.

4.3.4 Health area of residence

Figure 13 shows the rate (per 1,000 resident population) of children treated with stimulant medication for ADHD for each health area of residence as at 1 December 2000 by sex. The rate is based on the estimated number of children aged two to 17 years residing in each health area as at 30 June 1998.

The health areas that had the highest rate of children treated with stimulant medication for ADHD were, respectively, the Hunter, Central Coast, Mid North Coast, Macquarie, and Wentworth areas. Areas with the lowest rate, respectively, were the Far West, Central Sydney, South Western Sydney, Northern Rivers, and New England areas.

Figures 14 to 17 show the rate (per 1,000 resident population) of children treated with stimulant medication for ADHD for each health area of residence as at 1 December 2000 for the following age groups, respectively: 5–6 years, 7–11 years, 12–15 years and 16–17 years. The rates are based on the estimated number of children in each respective age group residing in each health area as at 30 June 1998. Areas are ordered according to the overall rate of treatment.

It can be seen that the differences in rates of treatment across areas seen in Figure 13 are generally reflected in Figures 14 to 17. The areas which had the highest rates of treatment overall had the highest rates of treatment in each age group. Children who had the highest rates of stimulant treatment were boys in the age groups 7–11 years and 12–15 years who resided in the Hunter area. Almost one in 20 boys aged 7–11 years in the Hunter area were treated with stimulant medication for ADHD as at 1 December 2000. About one in 25 boys aged 12 to 15 years who resided in the Hunter area were treated with stimulant medication for ADHD as at 1 December 2000. These rates were 1.6 to 1.7 times the State average for these children.

Relative to the State average, the rate of treatment in the Northern Sydney area of boys and girls aged 16–17 years was high. About one in 53 boys aged 16–17 years (or 18.9 per 1,000 resident population) in the Northern Sydney area were treated with stimulant medication as at 1 December 2000. This rate is about 1.7 times the State average (11.1 per 1,000 resident population). For girls aged 16–17 years, the rate in the Northern Sydney area (5.0 per 1,000 resident population) was 1.7 times the State average (3.0 per 1,000 resident population).

4.3.5 Duration of stimulant treatment

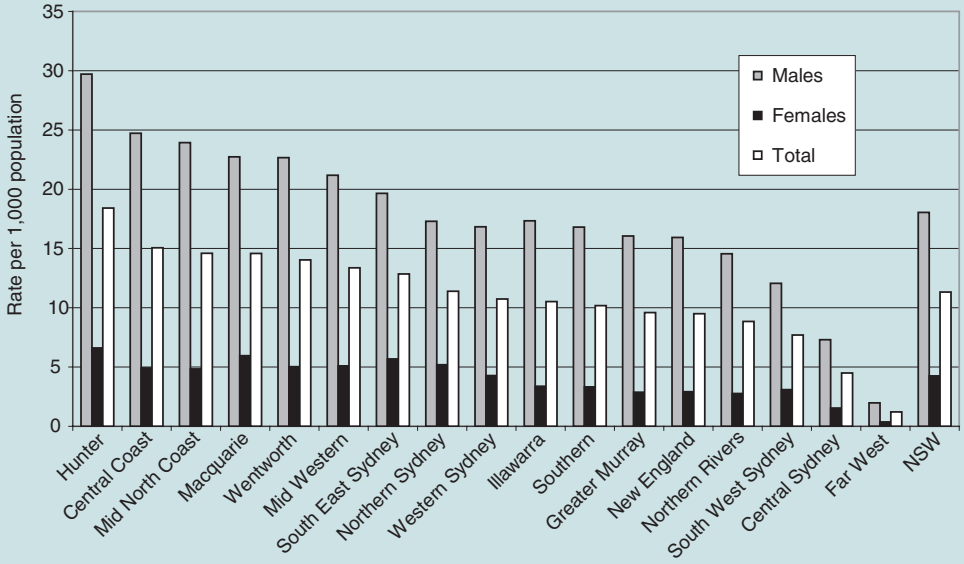
Table 3 shows the continuous length of time on stimulant medication for children being treated with stimulants for ADHD as at 1 December 2000 by age.

Overall, about 40 per cent of children on stimulant medication as at 1 December 2000 had been on medication for up to a year. Just over three per cent (533 children) had been continuously on stimulant medication for more than seven years. The longest duration of continuous treatment was 12 years. Two children fell into this category; one commenced medication at about age five years, and the other commenced when he was aged about two-and-a-half years.

From Table 3 it can be seen that time in treatment generally varied according to the

FIGURE 13

Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD as at 1 December 2000 by health area of residence and sex

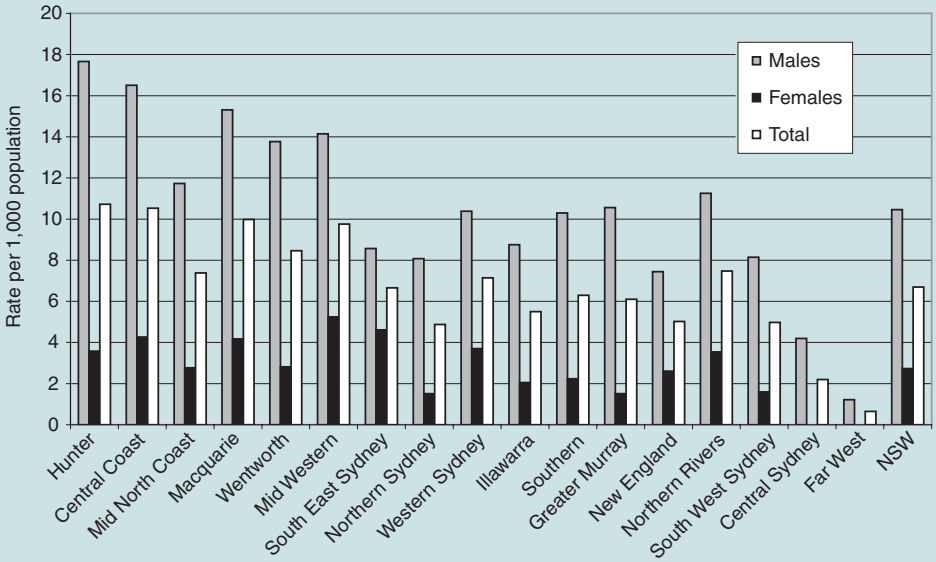


Notes: Excludes two children for whom health area of residence could not be determined.
Resident population based on Australian Bureau of Statistics estimates of population as at 30 June 1998 (unpublished data).

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 14

Rate per 1,000 NSW resident population of children aged 5–6 years treated with stimulant medication for ADHD as at 1 December 2000 by health area of residence and sex

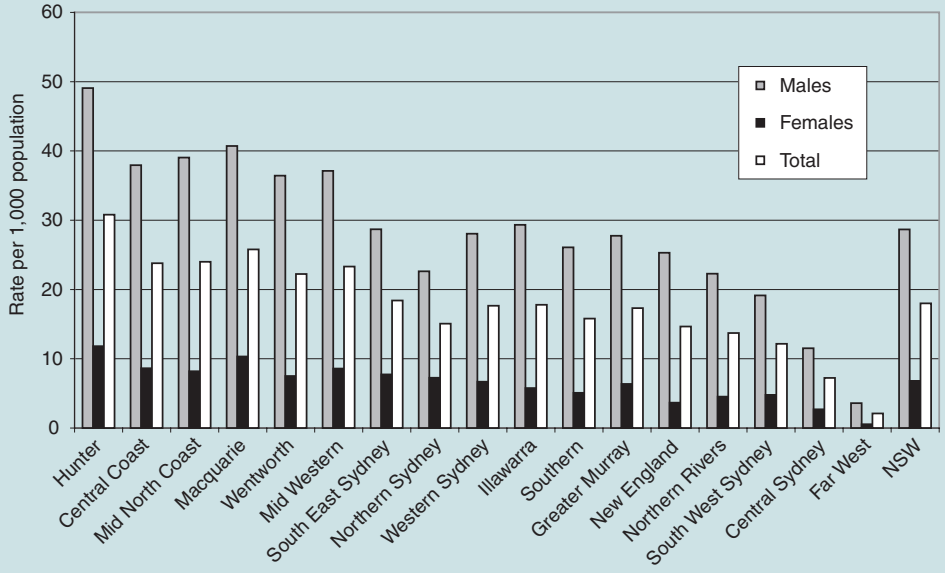


Notes: Resident population based on Australian Bureau of Statistics estimates of population as at 30 June 1998 (unpublished data).

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 15

Rate per 1,000 NSW resident population of children aged 7–11 years treated with stimulant medication for ADHD as at 1 December 2000 by health area of residence and sex

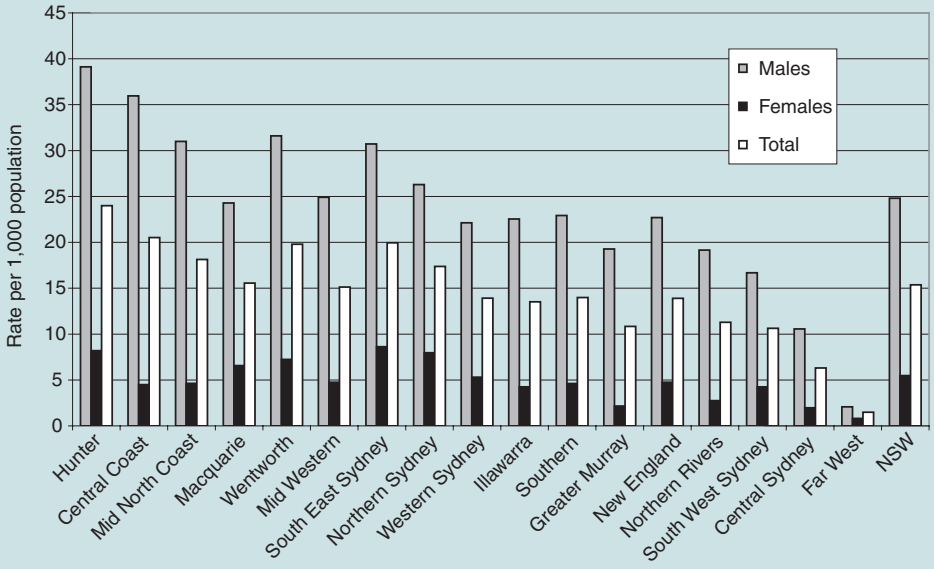


Notes: Resident population based on Australian Bureau of Statistics estimates of population as at 30 June 1998 (unpublished data).

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 16

Rate per 1,000 NSW resident population of children aged 12–15 years treated with stimulant medication for ADHD as at 1 December 2000 by health area of residence and sex

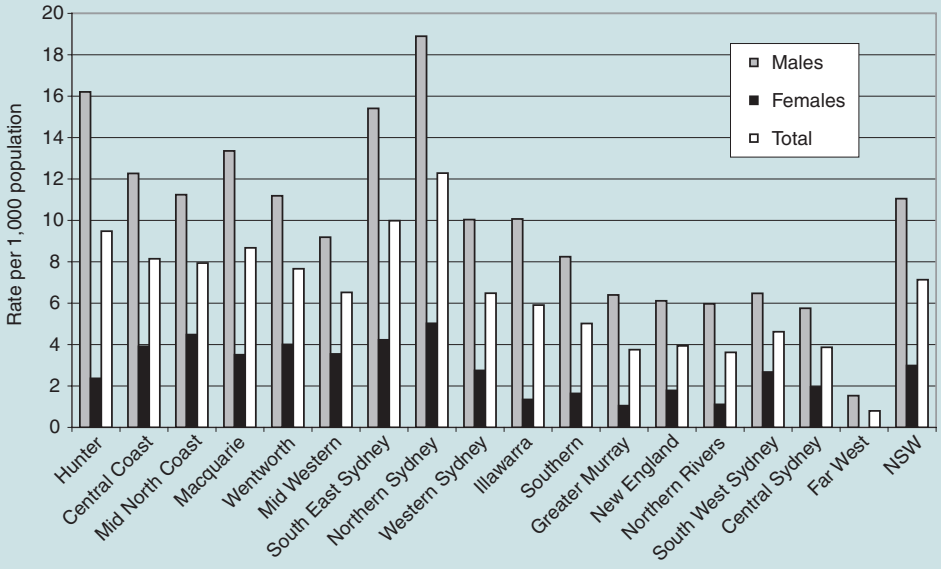


Notes: Resident population based on Australian Bureau of Statistics estimates of population as at 30 June 1998 (unpublished data).

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 17

Rate per 1,000 NSW resident population of children aged 16–17 years treated with stimulant medication for ADHD as at 1 December 2000 by health area of residence and sex



Notes: Resident population based on Australian Bureau of Statistics estimates of population as at 30 June 1998 (unpublished data).

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

age of the child. A higher proportion of older children were on medication for longer periods than younger children. For example, as at 1 December 2000, 40.4 per cent of children aged 16–17 years had been on medication for more than three years, while the comparable proportion of 7–8 year olds was 9.2 per cent.

TABLE 3

Number and percentage of children treated with stimulant medication for ADHD as at 1 December 2000 by age and duration of continuous treatment

Treatment duration (years)	Age													
	< 5 yrs		5–6 yrs		7–8 yrs		9–11 yrs		12–15 yrs		16–17 yrs		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
≤ 1	154	88.5	825	69.5	1,346	48.7	1,862	36.1	1,736	32.2	422	33.8	6,345	39.8
> 1–2	19	10.9	268	22.6	750	27.1	1,095	21.2	928	17.2	181	14.5	3,241	20.3
> 2–3	1	0.6	78	6.6	415	15.0	875	16.9	705	13.1	140	11.2	2,214	13.9
> 3–5	0	0.0	16	1.3	242	8.8	967	18.7	861	16.0	162	13.0	2,248	14.1
> 5–7	0	0.0	0	0.0	12	0.4	346	6.7	817	15.2	171	13.7	1,346	8.5
> 7–9	0	0.0	0	0.0	0	0.0	20	0.4	321	6.0	125	10.0	466	2.9
> 9	0	0.0	0	0.0	0	0.0	0	0.0	21	0.4	46	3.7	67	0.4
Total	174	100	1,187	100	2,765	100	5,165	100	5,389	100	1,247	100	15,927	100

4.4 Section 4: Two- to three-year olds treated with stimulant medication

In the period 1 January 1999 to 30 June 2000, individual patient authorities were issued for the first time in respect of 58 children aged less than four years. One of these children did not go on to take medication. Of the remaining 57 children, 48 were aged three years and nine were aged two years. The characteristics of these children are shown in Table 4. It should be noted that the characteristics presented in Table 4 are based on information supplied in medical reports by doctors treating the children. The actual prevalence of some characteristics may be higher than that indicated in Table 4. A child's failure to be included in the prevalence rate may not be because the child did not possess the characteristic but simply because the doctor did not provide the information in the medical report.

The majority of the children aged 2–3 years for whom an individual patient authority was first issued during the 18-month period 1 January 1999 to 30 June 2000 were male (86.0 per cent). A notable proportion of these young children (29.8 per cent) were reported as having some type of developmental delay, usually involving speech. In 15 cases (26.3 per cent) a relation of the child (for example: sister, brother, uncle) was reported to have ADHD. For most of the children, the age of onset of ADHD symptoms was reported. Among the three-year olds, age of onset of ADHD most commonly occurred before the age of two years.

TABLE 4

Characteristics of children aged 2–3 years Initial authorities issued for stimulant medication for ADHD, 1 January 1999 to 30 June 2000

Characteristics	Two-year olds *n* = 9 (%)	Three-year olds *n* = 48 (%)
Male	8 (88.9)	41 (85.4)
Developmental delay	4 (44.4)	13 (27.1)
Familial ADHD	5 (55.6)	10 (20.8)
Age of onset	< 12 months, *n* = 3 (33.3) 12–24 months, *n* = 4 (44.4) not reported, *n* = 2 (22.2)	< 2 years, *n* = 27 (56.3) ≥ 2 years, *n* = 18 (37.5) not reported, *n* = 3 (6.3)
Dietary control	3 (33.3)	4 (8.3)
Behavioural–early intervention	3 (33.3)	13 (27.1)
Other medication, (for example, clonidine)	6 (66.7)	18 (37.5)
Side effects from stimulant medication	none, *n* = 3 (33.3) at least one, *n* = 3 (33.3) not reported, *n* = 3 (33.3)	none, *n* = 9 (18.8) at least one, *n* = 19 (39.6) not reported, *n* = 20 (41.7)
Effect of stimulant medication	improvement, *n* = 6 (66.7) no improvement, *n* = 1 (11.1) not reported, *n* = 2 (22.2)	substantial improvement, *n* = 33 (68.8) some improvement, *n* = 2 (4.2) no improvement, *n* = 1 (2.1) not reported, *n* = 12 (25.0)

Source: Pharmaceutical Services Branch, NSW Department of Health.

Various treatments other than stimulant medication were reported. In about 28 per cent of cases some type of behavioural intervention or early intervention was attempted. A small proportion (12.3 per cent) had undergone some type of treatment involving diet. Non-stimulant medication was relatively common, with 42.1 per cent of the 2–3 year olds having used this. The most common medication used was clonidine. In almost all cases, these other treatments were not helpful.

Almost four out of every ten children experienced a side effect of the stimulant medication. The most commonly reported concerned appetite, followed by emotional problems. Other side effects included sleeping problems, obsessive behaviours, stomach pain, rebound effects of the drug, thirst and headache.

For the majority of the children (71.9 per cent), stimulant treatment resulted in improvements in behaviour. Some children did not appear to respond positively to the medication, although there were no reports of behaviour worsening as a result of stimulant treatment.

Some individual cases are described below.

Case 1: 'Michael', aged 2 years and 8 months

Michael has a history of active, wilful and sometimes destructive behaviour. His mother reports that he has been very difficult from birth. She says she cannot take him anywhere and that no-one is prepared to mind him. He touches everything within sight, appears to have no fear, and does not learn from experience about what is dangerous, painful or forbidden. She says his play is not constructive and that he hurts other children. Michael does not respond to requests. Standard procedures such as timeout have not been effective; he destroys his surroundings.

Michael lives with his mother, who is separated from Michael's father. Michael's father was said to be very similar in temperament in early childhood, and as an adult has trouble concentrating. Michael has an older brother (from a different father) who is quiet and easygoing.

After unsuccessful family and individual counselling, treatment with dexamphetamine is commenced. Progress reports at one and three-months after commencing medication indicate that Michael's behaviour has considerably improved. His mother reports that he has become a pleasure to take shopping and that he can play constructively for long periods of time. The relationship between Michael and his mother has improved, as has her handling of his behaviour. Michael's grandparents and day carers have noticed the improvement. He continues to be fairly boisterous.

Treatment with dexamphetamine is discontinued after three months. Michael continues to do well at home and at day care. His mother is cheerful and enjoying the relationship with her son.

Case 2: 'Phillip', aged 2 years and 8 months

Phillip was noticed by his mother to have a very bad temper at eight months of age. By age 12 months it was clear that he was extremely hyperactive. A neighbour had offered to look after him on three occasions, but each time needed to return the boy to his mother because he was uncontrollable. He has been taken out of preschool because of antisocial behaviour. Phillip has a younger sister whom he hits and kicks.

Phillip's doctor describes his visit to his office as a 'disaster'. Phillip did not stay with multiple toys for more than two minutes and ripped up a number of books. He did not take notice of his mother's instructions.

Phillip's mother has language-based problems in reading and spelling, as well as two

cousins with ADHD. Phillip's father claims to have had difficulties with concentration and organisation at school, and in adolescence had some symptoms of conduct disorder.

Various interventions, including a restrictive diet, parenting skills training and behaviour management, have been tried without benefit. Phillip is prescribed dexamphetamine. According to a progress report seven weeks into treatment, Phillip's parents have noticed a dramatic improvement in his behaviour. He is much less hyperactive, and much more attentive and responsive to their instructions. In the initial stages of treatment he is quite teary on a few occasions but this side effect resolves itself. His appetite is also initially affected but returns to normal.

A progress report at three months into treatment states that the effects of the medication in the dose given are reduced. Phillip's behaviour is perhaps marginally better than it was before stimulant medication was commenced. Phillip's mother continues to try behaviour modification strategies, such as timeout, but Phillip remains defiant, smashing toys and furniture. She is becoming overwhelmed by his behaviour. A change in dosing is suggested, as well as a dose of clonidine.

At almost three-and-a-half years of age, Phillip is attending preschool a few days a week, but his behaviour at home is extremely difficult. Occasionally when he wakes in the middle of the night he goes about the house wreaking havoc. A period of residential observation is suggested to the parents. A higher dose of stimulant medication, or use of other medications are considered.

Case 3: 'Kylie', aged 2 years and 7 months

Kylie has always been an active child. She finds it difficult to sit still and is unable to watch television. Kylie displays oppositional behaviour towards her mother. She has temper tantrums when she doesn't get her own way and is violent towards her younger brother. She is a poor and restless sleeper, often not getting to sleep until 11.00 p.m. in the evening.

Developmentally, Kylie is progressing normally. There do not appear to be any dietary triggers to her behaviour; her mother avoids giving her cordial and lollies.

Three of Kylie's cousins are being treated for ADHD. Her older sister does not pose any behavioural or educational problems. Her younger brother is copying her behaviour and this concerns Kylie's mother. Kylie's father has no difficulty with reading but her mother does occasionally. Because of his work, Kylie's father spends significant time away from home. Her mother is becoming increasingly negative toward Kylie because of her hyperactivity, disruptiveness and lack of response to parental intervention.

Dexamphetamine is prescribed. According to a progress report two months into treatment, Kylie is responding well. There has been a significant improvement in her level of activity, irritability, and communication at home and preschool. She is much better able to stay on task. Some days she does not require medication. Her mother finds her much easier to discipline. Kylie is not experiencing any side effects.

Eight months after medication is commenced, the improvements are maintained. When there is lessened stimuli in Kylie's environment she does not require medication. Her mother is anxious not to overuse medication.

Case 4: 'Harry', aged 3 years and 7 months

Harry is a boy who is continually on the go. He is prone to tantrums and often shows aggression (hitting, kicking, biting) towards his parents and younger sister. His parents

fear taking him out in public because he hits out and yells at strangers. He has been having night terrors most nights for over a year. Harry gets very upset when his routine is disturbed.

He is described by his preschool as a complex and difficult child to manage. He tends to be a loner at preschool. He tantrums at preschool and his mother has had to collect him on a few occasions.

Harry is not toilet trained. He has moderately severe language delay, as well as immature play and social skills.

Harry's parents find his behaviour upsetting. They are finding him hard to cope with. Harry's grandparents are concerned for him and his family. They mind Harry occasionally, as a form of respite care for his parents.

According to Harry's grandmother, his mother was overactive as a child. Harry's father indicates he had delayed speech development as a child.

Harry has been involved with an early intervention program but this was discontinued recently. He has not been able to be assessed by a speech therapist because of his disruptive behaviour.

Dexamphetamine is prescribed with positive results. A progress report at four weeks indicates he is less active and seems to concentrate better at tasks. His aggressive behaviours have diminished and he is playing more co-operatively with his sister. His tantrums have also diminished and he is more compliant with instructions.

On medication, his sleep pattern has generally changed for the better, although he occasionally does not get to sleep until after 11.00 p.m. He has lost some weight since beginning medication, and developed some mild obsessional behaviour about cleanliness.

Re-commencement of the early intervention program is recommended, as well as ongoing speech therapy.

After two months on medication, Harry's positive response to medication is maintained. He is experiencing no significant side effects.

Case 5: 'Daniel', aged 3 years and 8 months

Daniel is a large boy who is constantly on the move until late into the night. He has no patience to play with a toy or watch a cartoon. He is oppositional and defiant and will throw a tantrum if he cannot get his own way.

The carers at his preschool have difficulty coping with him. He is extremely energetic. He displays aggressive and impulsive behaviour; he hits out, swears and spits at carers and other children. He is exceptionally strong and can be a danger to others as he tips over and throws furniture.

Daniel has been assessed as having delayed language.

Daniel lives with his mother. She indicates no family history of ADHD or learning difficulties.

Daniel is commenced on dexamphetamine. He responds well in the first month but in the second month the effects appear to wear off rapidly. He is more quiet and tractable on medication.

According to a progress report about six months into treatment, Daniel is described as being extremely hyperactive and impossible to manage without medication.

Eleven months after commencing medication, Daniel has made significant progress. Behavioural strategies and counselling for both Daniel and his mother are being used. Daniel is attending a school and improving his academic and social abilities. He is not experiencing any side effects from the medication.

Case 6: 'Peter', aged 3 years and 1 month

Peter is a relentlessly over active boy who has tempter tantrums when limits are set on him. He pulls his hair out. He is more settled with one-to-one attention. He has been very active since he began walking at age 10 months. He likes to climb and has climbed over six-foot fences. On one occasion he set fires in his home. His speech is slightly immature for his age.

At preschool he has difficulty settling to play and forming relationships because he moves so quickly from one thing to the next. He is not particularly aggressive. He is affectionate with the carers.

Peter's father is described as being very similar to Peter at a similar age. He went on to have problems with academic failure, conduct disorder, and substance abuse. Peter no longer has contact with his father. Peter has an older sister being treated with stimulant medication for ADHD.

Peter's mother has been prone to depression and anxiety. She is getting significant benefit from attending a parenting course. She receives regular respite care through a charity organisation.

Methylphenidate is prescribed for Peter. According to a progress report around four-and-a-half months into treatment, Peter has shown moderate but significant improvement in his impulsivity and ability to focus. His behaviour is also settled at preschool. His speech also appears to have improved. He has experienced some appetite suppression on medication, but has no other side effects.

4.5 Section 5: Attrition from stimulant treatment

Table 5 examines attrition from stimulant treatment. It shows the number of children in 1997 who started on stimulant medication for the first time when aged three to 15 years, according to the time between the first and last prescription. The table does not include any children for whom an individual patient authority had ever been issued.

Table 5 shows that about 19 per cent of children aged 3–15 years who started on stimulant medication in 1997 did not continue medication after their first prescription. This proportion was roughly the same for children commenced on dexamphetamine (19.9 per cent) and for children commenced on methylphenidate (18.1 per cent). For over one-third of the children, the time between the first and last prescription was no more than 12 months.

The pattern seen in Table 5 was similar for most children. However, as shown in Figure 18, it was quite different for some.

Figure 18 shows the percentage of children who discontinued stimulant treatment after one prescription, by age, for children aged 3–15 years who first started treatment in 1997.

For children aged five, six and seven years, the proportion who discontinued treatment with stimulant medication after the first prescription was 14.4 per cent, 13.1 per cent and 14.8 per cent, respectively. In contrast, for children aged 14 and 15 years, the percentage who discontinued treatment with stimulant medication after the first prescription was 35.9 per cent and 39.8 per cent, respectively.

TABLE 5

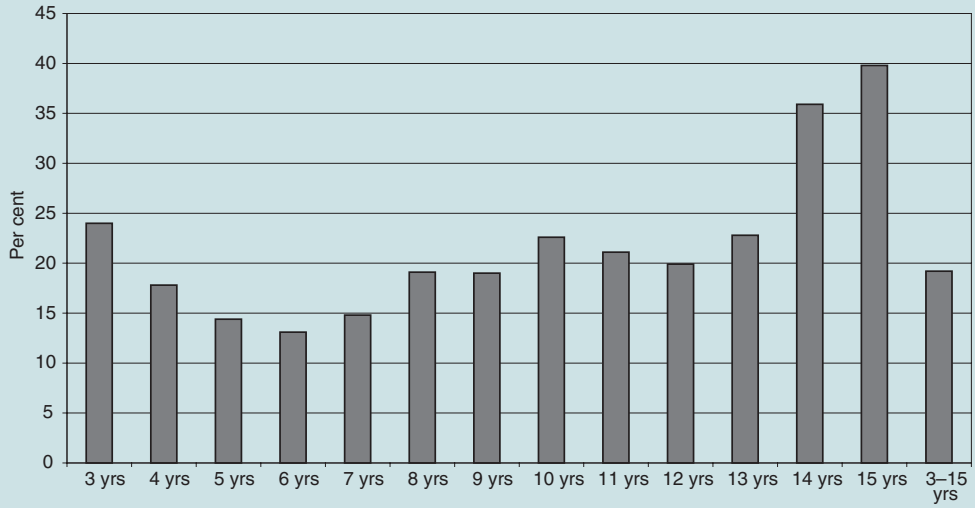
Number of children first started on stimulant medication in 1997 when aged 3–15 years by time between first and last prescription

Time between first and last prescription	Number	Per cent	Cumulative per cent
0 months (that is, first prescription = last prescription)	908	19.2	19.2
≤1 month	55	1.2	20.4
>1–6 months	300	6.4	26.7
>6–12 months	368	7.8	34.5
>12 months	3,091	65.5	100
Total	4,722		

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

FIGURE 18

Per cent of children (aged 3–15 years who were first treated in 1997) who discontinued treatment after one prescription, by age



Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

5. Discussion

This study has presented trends in the prescribing of stimulant medication for the treatment of ADHD in children and adolescents in NSW. Where comparisons are available, the patterns are generally consistent with overseas patterns of prescribing.

Over the last decade there has been a significant increase in the prescribing of stimulant medication for the treatment of ADHD in children in NSW. This finding is consistent with what is known to have occurred elsewhere. For example, analysing data on the number of office-based visits to physicians in the US, Robison et al. (1999) found a 2.9-fold increase in the rate of patients aged 5–18 years diagnosed with ADHD who were prescribed stimulant medication from 1990 to 1995.[57] Similarly, Zito et al. (2000) reported a three-fold increase in stimulant treatment for preschoolers during the early 1990s in regions of the US.[58] In The Netherlands, Schirm et al. (2001) reported a five-fold increase in the use of stimulant medication among 0–19 years from 1995 to 1999.[59]

The sharpest increases in NSW occurred in the mid-1990s. There are many factors that may have contributed to this, including: an increased public and clinician awareness and acceptance of ADHD as a disorder; a broadening of the diagnostic criteria for ADHD; a greater knowledge of the course of the disorder; an increase in the availability of ADHD-specific services, particularly paediatric and child psychiatric services; an increase in knowledge about the use and effectiveness of stimulant medication; fewer interruptions in treatment because of reduced concerns about growth retardation; lengthier periods of treatment; and an increase in the use of stimulant medication for the treatment of adults. In NSW specifically, this period saw a greater emphasis on professional collaboration between clinicians and educators. The publication *Talk, Time, Teamwork*, which facilitates and supports the work of teachers and doctors in the management of ADHD, was developed and distributed to schools across NSW in 1995.[73]

Results of this study suggest that current rates of prescribing of stimulant medication in NSW are not cause for alarm. At the end of 2000, approximately one per cent of children were being treated with stimulant medication for ADHD. This is somewhat lower than the US, where is it estimated that three per cent of children are treated with stimulants.[56,60] Moreover, if it is accepted that the prevalence of ADHD in Australia is around 11 per cent,[26] it can be argued that children in NSW are being undertreated;[q] only one in every 10 children with ADHD is undergoing what is known to be the single most effective form of treatment for ADHD.

In NSW, the prevalence of stimulant treatment is greatest among school-age children, particularly in the ages eight to 13 years. This is not surprising given that it is usually soon after a child commences formal schooling that the presence of ADHD becomes apparent. Indeed, results from this study indicate that the number of children aged five to eight years commenced on stimulant medication for the first time has increased over the last decade relative to other children.

The rate of treatment of very young children, or preschoolers, appears to be low in NSW. As at 1 December 2000, fewer than one in 1,490 children aged less than five years was on stimulant medication in NSW. Over the last decade, the growth in the number of preschoolers treated with stimulant medication has been less than the average growth in the number of children overall on stimulant medication.

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[q] As indicated earlier, the prevalence rate is likely to be over inclusive.The National Survey of Mental Health and Wellbeing, from which it was obtained, did not strictly apply DSM-IV criteria; children with ADHD-type symptoms due to anxiety disorder or abuse, for example, may have been included in the prevalance rate.

Concerns have been expressed about preschoolers being treated with psychotropic medication for a number of reasons: the medications are not approved for use in the very young; there are very few controlled data showing whether they are effective in this age group; psychiatric diagnoses in preschoolers generally lack validity and reliability—clinicians must rely on parental reports and it is difficult to establish whether the behaviours are outside the range of age-appropriate behaviours; there is little knowledge and considerable apprehension about the long-term effect of psychotropics on the developing brain; and there are scarce data about the pharmacokinetic and pharmacodynamic characteristics of these drugs in the very young.[74]

In NSW, a number of requirements are imposed on clinicians to ensure that prescribing of stimulant medication for very young children with ADHD is appropriate. These include requirements to submit written applications supported by clinical reports, to provide written progress reports, and, in cases where the child is aged two years, requirements to obtain a second opinion on the appropriateness of stimulant medication.

The present examination of individual patient approvals granted by the Department in the 18-month period to June 2000 indicates that stimulant medication is effective, at least to some extent, for a significant proportion of two- to three-year olds (Table 4). It should be noted that the data presented here on two- to three-year olds are not necessarily representative of all two- to three-year olds commenced on stimulants. In this study, details of a large number of three-year olds who were commenced on stimulant medication were not available for analysis. This was mainly because the child turned four years of age during the medication trial period and therefore an individual application was not required, or because medication was not continued after a trial period and no information was provided by the clinician regarding the effectiveness of the medication during the trial.

In about 39 per cent of the cases involving two- to three-year olds that were examined in the present study, side effects were reported. The most commonly reported were appetite and emotional problems. About 21 per cent evidenced no side effects, indicating that perhaps as high as 79 per cent of these children may have had side effects. Once again, caution should be used as these figures may not be representative of all two- to three-year olds. However, this rate of side effects is fairly consistent with the published literature, where some side effects have been reported in 80 per cent of children.[63] Generally the side effects children experience are mild and temporary.

The level of use of non-stimulant medication among two- to three-year olds that was found in this study is of concern. Although non-stimulant medications such as clonidine are reported to be useful in the management of some ADHD-related behaviours, the safety and efficacy of these drugs in very young children are yet to be demonstrated.[33,74]

The use of psychotropic medication in very young children is not uncommon. In regions in the US, Zito et al. (2000) reported a large increase in the use of non-stimulant medication in the early 1990s for the treatment of ADHD in preschoolers.[58] The increase in the use of clonidine was particularly large. The use of antidepressants also increased.

Rappley et al. (1999) examined claims for outpatient and pharmacy services in Michigan, US, involving children with ADHD aged three years or younger.[75] They found that 57 per cent of these children had received psychotropic medication. Twenty-two different psychotropic medications had been used with the group. Methylphenidate was the most common medication used, followed by clonidine, and dexamphetamine. Over a third of the children were treated simultaneously with two or three medications. Preliminary findings from a recent survey of Australian paediatricians and child psychiatrists indicate

that 'off-label' prescribing (that is, prescribing for conditions for which the medication does not have marketing approval) for children in Australia is widespread.[76]

In Australia, medications other than stimulants that may be used to treat ADHD, such as antidepressants and clonidine, are not formally monitored and are not restricted to specialist prescribing. The mechanisms that are in place to monitor the use of stimulants have no jurisdiction over these other medications.[11] The decision to prescribe the medication, therefore, rests solely with the clinician.

In the present study, the age distribution of children on stimulant medication was found to be similar for boys and girls (Tables 1 and 2). However, in almost all age groups, boys outnumbered girls by about four to one. This gender disparity is a common finding in ADHD research. It is thought that some of the disparity occurs because boys are more likely than girls to be referred for treatment due to their higher rates of disruptive behaviour.[29] The data presented in this study lend some support to this notion, especially in the case of very young children. Among the two- to three-year olds, males outnumbered females more than seven to one. It is among this age group that oppositional defiant behaviours, for example, are highly prevalent with ADHD and are more commonly displayed by boys than by girls.[27] It is clearly recognised that children who display aggressive and defiant behaviour at a very early age have generally poor long-term outcomes, therefore it is important to detect and treat these children as early as possible.[77]

Although boys outnumber girls in treatment rates, the growth in the number of girls commenced on stimulant treatment in the last decade has been greater than the growth in the number of boys. The increase from 1990 to 2000 in the number of girls commenced on medication was 1.3 times the average increase in children commenced on medication. An increase in the number and proportion of girls on medication has been observed overseas.[55,59] As a greater understanding and acceptance of ADHD has occurred over time, a greater number of girls may have been recognised as having the disorder and referred for treatment. The disproportionate growth in girls on psychostimulant therapy is likely to continue in the future if it is accepted that the prevalence rate of ADHD for girls in Australia is about half of that for boys.[26]

This study has reported some interesting findings with respect to the drug used in psychostimulant therapy for ADHD. In the very early 1990s, more children who commenced stimulant treatment in NSW were started on methylphenidate (Figure 5). This most likely reflects US practice where methylphenidate was, and still is, the most common stimulant prescribed. From 1993, however, more NSW children were commenced on dexamphetamine than methylphenidate. The fact that more children are commenced on dexamphetamine is probably, at least in part, due to economic reasons. Over the last decade, dexamphetamine has been available on the Pharmaceutical Benefits Scheme whereas methylphenidate has not been, making dexamphetamine a considerably less expensive product for the family.[r]

While more children may be commenced on dexamphetamine, roughly the same number of children at any one time are treated with methylphenidate as are treated with dexamphetamine (Figure 8). This may mean that a higher proportion of children commenced on dexamphetamine drop out of treatment compared with those commenced on methylphenidate. A more likely explanation is that a proportion of children commenced on dexamphetamine are switched from dexamphetamine to methylphenidate. It is well documented that some individuals find one stimulant drug to be more effective than another.[35,50]

Regional differences in the rate of psychostimulant therapy have been observed elsewhere, and this was the case for NSW. The rate of children on stimulant medication

at the end of 2000 varied considerably according to the health area involved. The region with the highest rate (Hunter Health area) had a rate almost 15 times the region with the lowest rate (Far West Health area). Differences between the other health areas were less marked, with rates ranging from 4.5 per 1,000 people aged 2–17 years in the Central Sydney area, to 15.1 per 1,000 people aged 2–17 years in the Central Coast area.

Without further investigation it is not possible to conclusively say what factor or factors contributed to these differences. However, a number of factors were likely to be involved. One of these factors concerns the availability of treatment services. For example, in the Far West area, a region characterised by geographical remoteness, access to ADHD-specific services is very limited. Other factors that may have contributed to differences in regional treatment rates include the prevalence of ADHD symptoms and variations in practice patterns concerning diagnostic criteria and methods; the clinician's approach to the treatment of ADHD, and more particularly his or her philosophy toward the use of psychostimulant therapy; socioeconomic factors; and parental and familial attitudes toward health services and treatment strategies.

The regional differences found in this study for older children provide some support for the involvement of socioeconomic factors. For children in the age group 16–17 years, the regional distribution of rates of treatment was quite dissimilar to that seen for the other age groups (Figure 17 versus Figures 14–16). For 16–17 year olds, Northern Sydney area and South East Sydney area had the highest rates of treatment. These areas are characterised by relatively high income, low unemployment, and high levels of education.[78] One could speculate that significant impairment among older adolescents in these regions is related to high expectations of academic achievement and potential. This may be particularly relevant if the inattentive type of ADHD, associated with higher level language and processing difficulties, is disproportionately prevalent among these older adolescents.

It has been shown in this study that psychostimulant therapy is a long-term strategy for managing ADHD for a significant number of children with the disorder. As at 1 December 2000, about one in four children with ADHD undergoing psychostimulant therapy in NSW had been receiving this treatment for more than three years. This is not surprising given that ADHD is a chronic disorder.

However, for an equally significant proportion of children with ADHD, psychostimulant therapy is not an option that is pursued beyond a short period. Data presented here indicate that about 20 per cent of children who start stimulant treatment discontinue treatment after their first prescription (Table 5). This is consistent with the fact that stimulants are not an effective treatment for at least 10 per cent of children with ADHD.

For older children, short-term attrition from stimulant treatment appeared to be somewhat greater than that for younger children (Figure 18). Almost 40 per cent of 14 and 15 year olds dropped out of treatment after their first prescription. There are a number of possible explanations for this.

It is possible that the older children found stimulant medication less effective than children of other ages. Other family influences such as quality of family functioning and family socioeconomic adversity may have also played a role. Factors more likely to have been involved include the child's dislike and fear of taking medication, the child's age at initiation of treatment, and the presence of comorbid conditions, especially oppositional defiant disorder and conduct disorder.

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[r] The cost of methylphenidate can be as much as four times the cost of dexamphetamine.

Generally, the treatment of adolescents is regarded as more difficult. They may choose not to continue treatment because taking the medication gives them a sense of inadequacy, or because they feel somehow that their parents are trying to control their behaviour.[79] They may judge the medication to be of little benefit, despite the views of others. For example, while parents may perceive the effects of medication to be favourable, children taking the medication do not always agree.[80] Older children are more likely to discontinue medication than younger children because, at this age, they are more autonomous and less influenced by their parents, who would usually decide on treatment options. Children with comorbid oppositional defiant disorder are also more likely to discontinue medication than other children with ADHD; children who are defiant are less likely to comply with requests to take medication.[81]

While the focus of this study has been on the use of stimulant medication, it is important to recognise that stimulants are only one option available for the management of ADHD. There is little doubt from published research that stimulants are very effective for many children at improving many of the symptoms of ADHD. Psychostimulant therapy, however, is also effective only while it is being used. Individual children will have different responses, with very few exhibiting gains across-the-board. Many children receiving stimulants may still retain more behaviour problems than normal children, and some children will not be helped by medication at all.

The consensus among experts is that stimulant medication should be used in conjunction with non-medication interventions. By temporarily controlling symptoms, stimulants help people to pay more attention and help them to better organise themselves. In this way, they facilitate the use of other kinds of strategies or treatments that can improve academic performance, social integration and family harmony. Compared with medication treatment alone, a combined treatment approach can lead to a greater number of children being successfully treated,[54] and lower dosages of medication being required.[35] The combined approach may also be more effective for treating children with multiple comorbid disorders.[82]

In Australia, the National Health and Medical Research Council (NHMRC) (1997) has recommended that treatment for ADHD should be 'multimodal and involve consideration of simultaneous medication use, behaviour management, family counselling and support, educational management, and specific development issues' relevant to the child involved (page 38).[11] They also recommend that 'specific and individualised treatment plans should be formulated for each child with ADHD and their family' (ibid.). These and other recommendations of the NHMRC are incorporated into criteria used by clinicians in NSW for the diagnosis and management of ADHD in children and adolescents.[72]

The decision to treat a child with ADHD with stimulant medication largely rests with the child's parent(s) on the advice of the treating clinician. They must weigh up the likely benefits, such as alleviation of core symptoms, and probable reduced risk of later academic and social problems, against the potential hazards, including likely, but probably minor, side effects and indeterminate long-term effects.

To facilitate this decision, clinicians must ensure that comprehensive assessment and diagnostic procedures are used. They must fully explain to parents, as well as children where appropriate, the nature of stimulant treatment. The importance of regularly reviewing the child and the management strategies in place must be recognised. If strategies are to be used to their full potential, they must be adjusted as needed, and steps taken to ensure that parents and children are complying with instructions.

A major challenge for health authorities is ensuring that statutory obligations are met with respect to the prescribing of stimulant medication, without impeding the

delivery of an appropriate and effective form of treatment for ADHD. This study has demonstrated that the regulatory and monitoring system in place in NSW supports and encourages stimulant prescribing that is in accord with modern, appropriate and effective management of ADHD.

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6.1 Useful internet resources

NSW Department of Health

www.health.nsw.gov.au/public-health/psb/adhd

Commonwealth of Australia Department of Health and Aged Care

www.health.gov.au/hsdd/mentalhe/index.htm

National Institute of Mental Health (U.S.)

www.nimh.nih.gov/publicat/index.cfm

Australian Network for Promotion, Prevention and Early Intervention for Mental Health (AUSEINET)

http://auseinet.flinders.edu.au/index.php

Children and Adults with Attention-Deficit/Hyperactivity Disorder (CHADD; US non-profit organisation representing and supporting children and adults with ADHD)

www.chadd.org

National Health and Medical Research Council

www.nhmrc.gov.au/index.htm

For the NHMRC report on ADHD go to:

www.health.gov.au:80/nhmrc/publications/adhd/contents.htm

7. Appendix

Data for Figures 1 and 2: Number of children with ADHD commenced on stimulant medication for the first time by age and year at commencement, 1990 to 2000

Year	<4 yrs	4 yrs	5–6 yrs	7–11 yrs	12–15 yrs	16–17 yrs	2–17 yrs
1990	18	26	154	618	267	27	1,110
1991	12	34	208	1,030	498	65	1,847
1992	30	88	388	1,522	620	72	2,720
1993	72	141	741	2,460	965	85	4,464
1994	101	258	973	2,958	1,276	146	5,712
1995	88	295	1,014	3,087	1,407	190	6,081
1996	115	288	1,055	2,900	1,179	201	5,738
1997	138	251	1,124	2,599	998	179	5,289
1998	120	257	1,205	2,878	988	223	5,671
1999	133	286	1,170	2,795	1,015	217	5,616
2000	86	234	1,085	2,740	936	205	5,286

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figure 3: Per cent of children with ADHD commenced on stimulant medication for the first time, by age and year at commencement, 1990 to 2000

Year yrs	<5 yrs	5–6 yrs	7–8 yrs	9–11 yrs	12–15 yrs	16–17
1990	4.0	13.9	23.9	31.8	24.0	2.4
1991	2.5	11.3	22.3	33.5	27.0	3.5
1992	4.3	14.3	24.2	31.7	22.8	2.6
1993	4.8	16.6	24.4	30.7	21.6	1.9
1994	6.3	17.0	23.0	28.8	22.3	2.6
1995	6.3	16.7	23.8	26.9	23.1	3.1
1996	7.0	18.4	23.7	26.9	20.5	3.5
1997	7.4	21.3	25.1	24.1	18.9	3.4
1998	6.7	21.2	25.1	25.7	17.4	3.9
1999	7.5	20.8	25.8	24.0	18.1	3.9
2000	6.1	20.5	26.8	25.0	17.7	3.9

Data for Figure 4: Number of children with ADHD commenced on stimulant medication for the first time by sex, 1990 to 2000

Year	Males	Females
1990	933	176
1991	1,554	293
1992	2,320	400
1993	3,802	662
1994	4,757	955
1995	4,947	1,134
1996	4,671	1,067
1997	4,294	995
1998	4,553	1,118
1999	4,447	1,169
2000	4,147	1,139

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figure 5: Number of children with ADHD commenced on stimulant medication for the first time, by year and drug at commencement, 1990 to 2000

Year	Dexamphetamine	Methylphenidate	Total
1990	435	675	1,110
1991	740	1,107	1,847
1992	1,280	1,440	2,720
1993	2,523	1,941	4,464
1994	3,633	2,078	5,711
1995	3,632	2,447	6,079
1996			
1997	3,080	1,966	5,046
1998	3,301	2,135	5,436
1999	3,306	2,227	5,533
2000	2,915	2,289	5,204

Note: The drug used could not be determined for a large number of children first treated with stimulant medication in1996, therefore data for 1996 are not shown. For the other years in the period 1994 to 2000, a small number of children are excluded for whom the initial drug used could not be determined.

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figure 6: Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD by sex and year, 30 June, 1990 to 2000

Year	Males	Females	Total
1990	2.1	0.4	1.2
1991	2.7	0.5	1.7
1992	4.1	0.8	2.5
1993	6.1	1.0	3.6
1994	11.4	2.0	6.8
1995	15.6	3.0	9.5
1996	18.0	3.7	11.0
1997	14.9	3.1	9.2
1998	16.7	3.7	10.3
1999	17.6	4.0	11.0
2000	18.1	4.1	11.3

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figure 7: Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD by age and year, 30 June, 1990 to 2000

Year years	<5 years	5–6 years	7–11 years	12–15 years	16–17
1990	0.1	0.6	2.0	1.9	0.5
1991	0.1	0.7	2.7	2.4	1.0
1992	0.1	1.1	4.0	3.6	1.4
1993	0.4	2.3	6.2	4.7	1.5
1994	0.7	4.5	11.4	8.8	3.0
1995	0.8	5.6	15.7	12.7	4.7
1996	0.8	6.6	18.2	14.5	6.2
1997	0.8	6.5	14.7	12.0	4.9
1998	0.9	7.0	16.3	13.6	6.4
1999	0.9	6.9	17.5	14.5	6.8

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figure 8: Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD by drug and year, 30 June, 1990 to 2000

Year	Dexamphetamine	Methylphenidate
1990	0.5	0.8
1991	0.6	1.0
1992	1.0	1.4
1993	1.7	2.0
1994	3.4	3.4
1995	4.9	4.6
1996		
1997	4.6	4.3
1998	5.1	5.0
1999	5.5	5.4
2000	5.5	5.7

Note: The drug used could not be determined for a large number of children treated with stimulant medication as at 30 June 1996, therefore data for 1996 are not shown. For the other years in the period 1995 to 2000, a small number of children are excluded for whom the drug used could not be determined.

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figure 9: Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD as at 1 December 2000 by single year of age and sex

Age (Years)	Males	Females	Total
2	0.0	0.0	0.0
3	0.5	0.1	0.3
4	2.7	0.7	1.7
5	7.3	1.8	4.6
6	13.7	3.7	8.8
7	21.2	5.2	13.4
8	28.4	6.3	17.7
9	29.7	7.4	18.8
10	31.7	7.5	19.9
11	30.4	7.2	19.0
12	28.6	6.1	17.6
13	27.2	6.0	16.8
14	24.2	5.3	15.0
15	19.4	4.5	12.1
16	12.9	3.2	8.2
17	9.0	2.6	5.9
2–17	18.0	4.2	11.3

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figure 10: Per cent of children treated with stimulant medication for ADHD as at 1 December 2000 by age and drug

Age (Years)	Dexamphetamine	Methylphenidate
2	0.0	0.0
3	50.0	50.0
4	57.1	42.9
5–6	50.9	49.1
7–8	47.6	52.4
9–11	46.3	53.7
12–15	48.3	51.7
16–17	50.2	49.8
2–17	48.0	52.0

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figure 11: Average daily dose (in tablets) for children treated with stimulant medication for ADHD as at 1 December 2000 by age and drug

	Average daily dose (in tablets)	
Age	Dexamphetamine	Methylphenidate
<5	1.7	1.6
5–6	2.0	2.0
7–8	2.3	2.3
9–11	2.8	2.7
12–15	3.5	3.4
16–17	4.0	3.9
All	2.9	2.9

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figure 12: Per cent of children treated with stimulant medication for ADHD as at 1 December 2000 by age and daily dose

Number of tablets per day yrs	<5 yrs	5–6 yrs	7–8 yrs	9–11 yrs	12–15 yrs	16–17
<1	5.5	2.7	1.0	0.6	0.2	0.2
1–<2	52.4	32.2	22.5	11.9	4.8	2.7
2–<3	35.4	48.0	47.7	39.1	23.0	13.9
3–<4	6.7	14.6	21.6	31.1	31.4	24.8
4–<5	0.0	2.1	6.4	13.4	23.8	27.3
5–<6	0.0	0.3	0.7	2.6	10.4	16.2
6 or more	0.0	0.2	0.1	1.3	6.4	15.0

Data for Figure 13: Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD as at 1 December 2000 by health area of residence and sex

Health area of residence	Males	Females	Total
Hunter	29.7	6.6	18.4
Central Coast	24.7	4.9	15.1
Mid North Coast	23.9	4.8	14.6
Macquarie	22.7	6.0	14.6
Wentworth	22.7	5.0	14.0
Mid Western	21.2	5.1	13.4
South East Sydney	19.7	5.7	12.9
Northern Sydney	17.3	5.2	11.4
Western Sydney	16.8	4.3	10.8
Illawarra	17.3	3.4	10.5
Southern	16.8	3.3	10.2
Greater Murray	16.1	2.9	9.6
New England	15.9	2.9	9.5
Northern Rivers	14.6	2.8	8.8
South West Sydney	12.1	3.1	7.7
Central Sydney	7.3	1.5	4.5
Far West	2.0	0.4	1.2
NSW	18.0	4.3	11.3

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figures 14–17: Rate per 1,000 NSW resident population of children treated with stimulant medication for ADHD as at 1 December 2000 by health area of residence, age and sex

Health area of residence	5–6 years			7–11 years			12–15 years			16–17 years		
	Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total
Hunter	17.7	3.6	10.7	49.1	11.8	30.8	39.1	8.2	24.0	16.2	2.4	9.5
Central Coast	16.5	4.3	10.5	38.0	8.6	23.8	36.0	4.5	20.5	12.3	3.9	8.1
Mid North Coast	11.7	2.8	7.4	39.0	8.2	24.0	31.0	4.6	18.1	11.2	4.5	7.9
Macquarie	15.3	4.2	10.0	40.7	10.3	25.8	24.3	6.6	15.6	13.4	3.5	8.7
Wentworth	13.8	2.8	8.5	36.4	7.5	22.2	31.6	7.2	19.8	11.2	4.0	7.7
Mid Western	14.1	5.2	9.8	37.1	8.6	23.3	24.9	4.7	15.1	9.2	3.6	6.5
South East Sydney	8.6	4.6	6.7	28.7	7.7	18.4	30.7	8.6	20.0	15.4	4.2	10.0
Northern Sydney	8.1	1.5	4.9	22.6	7.3	15.1	26.3	8.0	17.4	18.9	5.0	12.3
Western Sydney	10.4	3.7	7.1	28.0	6.7	17.7	22.1	5.3	13.9	10.0	2.8	6.5
Illawarra	8.8	2.1	5.5	29.3	5.8	17.8	22.5	4.2	13.5	10.1	1.4	5.9
Southern	10.3	2.2	6.3	26.1	5.1	15.8	22.9	4.6	14.0	8.2	1.6	5.0
Greater Murray	10.6	1.5	6.1	27.8	6.4	17.3	19.3	2.2	10.8	6.4	1.0	3.8
New England	7.4	2.6	5.0	25.3	3.7	14.6	22.7	4.8	13.9	6.1	1.8	3.9
Northern Rivers	11.3	3.5	7.5	22.3	4.5	13.7	19.2	2.7	11.3	6.0	1.1	3.6
South West Sydney	8.1	1.6	5.0	19.1	4.8	12.2	16.7	4.3	10.6	6.5	2.7	4.6
Central Sydney	4.2	0.0	2.2	11.5	2.7	7.2	10.6	2.0	6.3	5.8	2.0	3.9
Far West	1.2	0.0	0.6	3.6	0.5	2.1	2.1	0.8	1.5	1.5	0.0	0.8
NSW	10.5	2.7	6.7	28.7	6.8	18.0	24.8	5.5	15.4	11.1	3.0	7.1

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

Data for Figure 18: Per cent of children (aged 3–15 years who were first treated in 1997) who discontinued treatment after one prescription, by age

Age (Years)	Per cent
3	24.0
4	17.8
5	14.4
6	13.1
7	14.8
8	19.1
9	19.0
10	22.6
11	21.1
12	19.9
13	22.8
14	35.9
15	39.8
3–15	19.2

Source: *Pharmaceutical Drugs of Addiction System*, Pharmaceutical Services Branch, NSW Department of Health.

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