Patterns in Psychostimulant Use for ADHD across Two Australian Jurisdictions (2000-2011)

Brenton J. Prosser, Robert C. Reid, and Matthew C. Lambert

Abstract—**Objective: The aim of this study is to compare archival data on psychostimulant prescriptions for youth aged birth to 18 years in two Australian jurisdictions since 2000. Methods: a person-based data set was used to assess: (i) growth in new prescriptions; (ii) male: female ratios; (iii) mean start age; (iv) mean durations of use. Results: A previous study of 7,489 youths in South Australia was compared with a study of 69,944 youths in New South Wales to find: (i) a steady increase in new prescriptions; (ii) a decline in male: female ratios; (iii) opposing trends in mean start ages; and (iv) convergence in mean durations of use around 2.0 years. Conclusions: Australia appears to be following the United States in trends of psychostimulant use for ADHD and more research is needed into specific patterns in duration of use, as well as if similar barriers to accessing multi-modal support are being experienced.**

Index Terms—**Attention deficit hyperactivity disorder, demographics, duration, psychostimulant use.**

I. Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is amongst the most commonly diagnosed childhood disorders in western nations. A key element in the recommended treatment of ADHD is psychostimulant medication. The effectiveness of this treatment for ADHD is well documented [1]-[3] and has been behind the marked increase in psychostimulant use for ADHD over the last twenty-five years [4]-[9]. The authors note a growing body of literature that explores the prevalence of ADHD diagnosis and psychostimulant treatment internationally [10]-[13]. However, there remains a lack of clear data in relation to the patterns in psychostimulant use within nations, a lack to which this paper aims to respond. While the authors also note that public controversy continues over ADHD diagnosis and psychostimulant treatment, the data used for this paper only refers to medication that had been prescribed for ADHD and provides no information on the suitability (or otherwise) of diagnostic processes. Hence, the scope of this paper is an examination of patterns in psychostimulant use in two Australian jurisdictions (including the growth in new prescriptions).

A significant challenge in identifying national patterns in psychostimulant use in Australia lies in the fact that individual jurisdictions have different authorisation requirements for prescribing and different systems for recording these authorisations [14]. Previous national studies have used international and federal records of narcotics control to report levels of psychostimulant consumption and to produce Australian estimates of prevalence [10], [15]. These have been limited in their capacity to analyse specific national patterns and trends. Other studies have examined data from single jurisdictions to consider prevalence, gender ratio and demographic variation [7], [16], [17]. These too have been limited, primarily in their capacity to present a national perspective. Notably, the last comparison of prescription patterns between jurisdictions [18] was inconclusive due to large gaps in the data and variations in how data was recorded. However it is the aim of this paper, by replicating the methodology of a previous study in South Australia [7] within the significantly larger New South Wales context, to provide a contemporary point of comparison.

The content of this paper can also be located within the broader context of a lack of international data on patterns of psychostimulant use for ADHD. Although it is agreed that the prevalence of ADHD grew significantly in western nations throughout the 1990s [10], [11], [15], [19]-[22], actual estimates of levels of ADHD diagnosis and drug treatment vary greatly. For instance, an international review of 39 studies found ADHD prevalence to be between 2% and 18% per cent [13], while one study has estimated world-wide prevalence to be 5.3% [12]. North American estimates of prevalence range between 5% and 23% [23],[24], with approximately 4.3% of these children thought to be treated with medication [8]. It has been estimated that in nations using the American Psychiatric Association's *Diagnostic and Statistical Manual*, the prevalence of ADHD diagnosis is between 2% and 9% [13]. In Australia, estimates of prevalence have ranged between 1.6% [18] and 11% [25], while a more recent estimate stated between 5% and 10% of young people [26]. Records of ADHD diagnosis are not collated or accessible in AustraliaMoH. Rather, levels of psychostimulant prescription to young people are used as an approximation.

For the reasons noted above, accurate national estimates of levels of ADHD diagnosis and psychostimulant use have been difficult to obtain in Australia. However in Western Australia, which has levels of medication use significantly higher than the rest of Australia [10], [16]), it has been reported that just under 2% of young people have been diagnosed with ADHD and prescribed medication [14]. In response, the paper will report on psychostimulant use for ADHD across two jurisdictions, which together, comprise a significant proportion of the Australian youth population.

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However, the data considered in this paper does not provide a basis for an estimate of prevalence of ADHD diagnosis.

It has been equally difficult to clearly ascertain the rate of new ADHD prescriptions both within and across nations. A growth rate of 12% per year in psychostimulant consumption for ADHD was recorded across ten countries between 1994 and 2000 [10], while the number of youth prescribed medication for ADHD doubled in the United States between 1995 and 2000 [19]. Europe has had relatively lower rates, but recent data from Sweden has identified a growth rate of 34% per year between 2006 and 2009 [27]. While rates in Germany and other European nations have also grown, they remain significantly lower than North American levels [11]. In Australia, new prescriptions of ADHD medications grew 26% per year between 1984 and 2000 [10] and by almost 73% between 2000 and 2011 [15]. This paper will report on the growth in new prescriptions in South Australia and New South Wales since 2000.

Another area that lacks clear data is which children are treated with psychostimulants and for what duration. International and Australian studies over the last decade point to a slow decline in the ratio of males to females being treated with psychostimulants for ADHD [11], [13], [16]. Although early studies suggested that most young people start treatment between seven and ten years of age [28]-[30], there is still limited information on international start age, duration and continuation into adolescence and adulthood [27]. North American studies have estimated duration of psychostimulant use ranging from 2.7 years [28] up to 8 years [21], while one Australian study found that over one quarter of children take medication for longer than 3 years [17]. Understanding the duration of medication use is important for clinical practice, however, there is limited information about the long term effects of psychostimulant treatment [28]. This present paper will seek to contribute to this information by reporting if the above trends have also been seen in the South Australian and New South Wales contexts.

Geographic variation, and particularly socio-economic status (SES), has been associated with patterns in psychostimulant use for ADHD [8], [11], [31]. While studies have found correlations with SES in some nations, this is not universally the case [13], [32], with the United States a notable exception [33]. Complicating matters is the connection between ethnicity and rating scales, SES and attitudes to psychostimulant use [34]-[36]. Federal policy may also contribute to different levels of psychostimulant use according to SES in different nations [37]-[39]. Hence, the differences between nations and between communities within nations require more examination to explore why some western nations report a correlation between SES and psychostimulant use, while others do not. Within Australia, significant regional variation has also been identified [16], [17], [40], which may be related to SES [7]. While this paper does not include specific consideration of SES or ethnicity, these are areas worthy of further research.

In a previous paper [7], we reported analysis of psychostimulant use in South Australia (SA) between 1990 and 2006. We found that patterns of psychostimulant use had closely paralleled United States trends, including a rapid initial growth and significant volatility in prescribing practices. We found over the sixteen year period that:

1) The male: female ratio declined from 5.4:1 to 4.3:1.
2) The average start age declined from 9.35 years to 8.84 years.
3) The average duration of treatment declined from 2.47 years to 2.05 years.
4) There was significant geographic variation in psychostimulant prescription.
5) There was a correlation between socio-economic status and the prescription rate per region.

In response, we called for increased attention to be given to patterns in psychostimulant treatment for ADHD in Australia.

Our response to this challenge can be found in this paper. Here, we reapply the previous methodology in the larger New South Wales (NSW) context to consider patterns in psychostimulant use between 2000 and 2011. This allows comparison with the SA data up until 2006. We hypothesize that the patterns previously found in the South Australian population will be confirmed in the NSW context during the same period. Hence, we again report on yearly prescription rates, demographic information and duration of use. Due to ethics approval and the release of final data not being finalized until 2 July 2013, it was not possible to include analysis of geographic variability (including by SES) by the due date for manuscript submission. However, as the above review demonstrates, international data on all of these areas is still emerging, and paper will still make an important contribution.

II. Methods

The methods used in the previous South Australian study are documented in detail elsewhere [7], but a brief overview is necessary so that similarities and variations within this present study can be made clearly apparent. In line with the requirements of South Australian controlled substances legislation, medical practitioners are required to record prescriptions of 'drugs of dependence' with the South Australian Health Commission (SAHC). SA is a highly urbanized jurisdiction and the number of cases outside the metropolitan area is low, so data were only sought for prescriptions to those between birth and 18 years in the capital city of Adelaide. Data for 7,849 cases of psychostimulant prescription to individual persons were obtained for the period 1990 to 2006. This data included gender, date of birth, date of psychostimulant authorization, date of cessation and postcode. Postcode was used as a geographic marker because it covered a small and homogenous population grouping. The results of this study were reported according to prescriptions by age group, prescriptions by gender, prescription by start age, duration of treatment and prescription by geographic variation (including SES).

Several key features of the SA and NSW data sets need to be considered as part of reporting the methods for this present study. First, the total population of NSW is approximately six times larger than that of SA, which provides a much larger population for analysis. Second, NSW is a less urbanized jurisdiction, so while this data set focused on the Adelaide metropolitan area, the NSW data

set will consider all postcodes within that jurisdiction. Third, from 1994 the SAHC collection procedures assumed that once approval was given it continued until the age of eighteen years (unless the medical practitioner provided advice of cessation). For this reason only those who had been reported as ceased were included in the SA data, and although a new system in 2005 identified many inactive records, some cases that were no longer active were included active. The NSW data set records date of commencement for every prescription, and due to prescriptions being valid for 6 months (unless otherwise instructed by the prescriber), this provides an accurate estimate of duration of use. This will also provide opportunity for more detailed survival analysis in the future. Finally, both data sets involve individual and general approvals, which have different legislative requirements for reporting of commencement and cessation. This will be discussed in more detail in the limitations section.

Within NSW, data on psychostimulant prescription is recorded in the Pharmaceutical Drugs of Addiction System, which is maintained by Pharmaceutical Services Unit of the Legal and Regulatory Services Branch of the NSW Ministry of Health (MOH). Because psychostimulants are classified as "drugs of dependence" all medical practitioners in NSW are required to access either a general or individual authorization from the NSWMH to treat a patient with psychostimulants. (Discussed in the 'Limitations' section). Therefore, this data set represents all children from two to age 18 who have been authorized to receive psychostimulants (which is the maximum parameters of the NSW data set). Data was obtained for 69,944 persons with active prescriptions for the period 2000 to 2010. This allows for maximal statistical power. The methods previously used in the SA study were replicated with this NSW population.

The state of NSW is the major population center of Australia. As of 2010, the population of NSW was 7,221,468 persons which comprise over 20% of the total population of Australia. The state of NSW has one major metropolitan area, Sydney (population 4.6 million), while two smaller cities, Newcastle and Wollongong (combined population of approximately 700,000) are the fastest growth areas outside Greater Sydney. The remainder of the population is centered around approximately a dozen regional cities (populations 30,000 to 70,000), with the largest growth in the Port Macquarie region and the largest rural growth in the Yass Region (near the Australian Capital Territory) [41].

Data provided by the MOH include gender, date of birth, date psychostimulants were initially authorized (from which date of last authorization can be estimated)), and postcode. From these data we calculated the start age (date psychostimulants were authorized minus birthdate), duration of treatment (date of last authorization minus date psychostimulants were authorized), and the number of children beginning psychostimulant treatment per year.

III. Results

A. Results

1) Prescriptions by age group

The number of children prescribed psychostimulants increased steadily over the decade. Across all age ranges, there were 10.91 new cases per 1,000 youths prescribed in 2000, while over the next ten years levels fluctuated around 11.00 new cases per 1,000 youths prescribed. Interesting variations occurred between 2001 and 2010, with a peak of 11.93 cases in 2004 and a fall to 9.22 cases in 2007.

2) Start age and gender

The average start age for the entire group was 9.09 (*SD* = 3.17). The mean start age for youth who started treatment between 2001 and 2010 was 9.56 (*SD* = 3.28). There was a marked increase in the prescription of psychostimulants for older youth after 2001.

3) Duration of treatment

Treatment duration, for non-censored cases, ranged from .01 to 20.02 years with a mean duration of 3.42 years (*SD* = 2.95). Roughly 17% of the cases had treatment durations of 6 months or less. An additional 8.2% had durations up to 1 year in length. After an initial rise at 1.5 years (6,112 cases), there was an even decline in duration from 2 years (4,852 cases), to 3.5 years (3,667 cases), five years (2,471 cases), 10 years (638 cases), fifteen years (45 cases) and 20 years (1 case). There was a strong downward trend in treatment duration between 2000 and 2010.

In addition to treatment duration and trends over time, we also identified gaps in treatment. Nearly 46% of the sample had at least one significant gap in treatment during the course of this study (i.e., *Gap* > 1 year). Children who started treatment at a younger age were more likely to have a gap – for example, a child stating treatment at age 8 was 26% more likely to have a gap compared to a child who started treatment at age 10. Future analysis will consider a range of matters, including variations in maximum possible treatment intervals, total duration across multiple treatment intervals and the significance of overall trends.

IV. Discussion

The purpose of this paper is to compare the above preliminary findings (derived using the same method) to patterns in psychostimulant use in SA between 2000 and 2006, as well as note subsequent developments in NSW. Table I presents an overview of these findings.

The present results show several similarities and some important differences between the SA and NSW populations.

The rate of new prescriptions grew steadily in both jurisdictions occurred between 2000 and 2004, which also aligns with a steady increase in the United States [42]. Hence, in broad terms, it can be claimed that these patterns of psychostimulant use parallel the United States experience.

However, it would appear that patterns in SA have been more volatile than those of NSW. While NSW has seen an increase in all years but three in the last decade, seven of sixteen years saw decline in SA. The first of the declines (1995-2000) is difficult to explain as it would be expected that rates would plateau or grow steadily after the initial rapid growth from a low base number of cases. Given, the smaller population of SA and the tendency in smaller Australian jurisdictions for a handful of prescribers to cover the majority of patients [7], [14], any change in these arrangements could have an impact, but essentially there is no known explanation. The second decline (2005-2006) has

a more plausible technical explanation. Until 1994, physicians in SA were required to request authorized prescriptions on an annual basis, but due to the significant growth throughout the 1990s, the policy was changed so that authorizations continued until 18 years of age. This resulted in some lapsed authorization being recorded as active. An improved data management system was introduced by the SAHC in 2005, which identified lapsed cases and deleted them. Although this had no effect on new prescriptions, it could influence SA duration data.

TABLE I: COMPARISON OF FINDINGS

Finding	SA 1990-2000	SA 2001-2006	NSW 2001-2010
New prescribe	Sharp increase (1990-1995) Steady decline (1995-2000)	Sharp increase (2000-2004) Sharp decline (2005-2006)	Brief decline (2002) Steady increase (2002-2004) Steady decline (2004-2006) Steady increase (2006-2010)
Male:female ratio	5.4:1	4.3:1	3.6:1
Mean start age (years)	9.35	8.84	9.56
Mean duration (years)	2.47	2.05	3.09 (2001-2006) 2.06 (2007-2010)

It is not immediately apparent why there was a brief decline in new prescriptions in NSW during 2002. Neither is it clear why there was a steady decline between 2004 and 2006. Interestingly, this second trend aligns with a sharp decline in new prescription in SA between 2005 and 2006. The MOH reports no major changes in data recording practices during these periods, so a number of other potential factors may have been at play, each of which is difficult to quantify. These include the influence of prominent media reports on parents and prescribers, the accessibility of diagnostic services, the availability of psychostimulant products, changing pricing structures and other potential influences Each of these are worthy of further examination in relation to these unexpected declines in new prescriptions.

A decline in male to female ratio was evident in both jurisdictions and was consistent with previous international research in this area [13]. The degree of decline in ratio in NSW and SA was equivalent over the period. It also aligned with previous findings that the number of girls commencing psychostimulants grew by 6.5 times in NSW between 1990 and 2000 [17], a trend that would seem to have continued over the following decade. While the ratio in NSW remained lower than SA, both were in the range of recent Western Australian estimates of 4.1:1 [16]. The consistency across these findings may well point to a national trend in gender ratios.

Duration of psychostimulant medication use between NSW and SA appears to be converging at approximately 2 years. However, over 25% of those prescribed psychostimulants for ADHD ceased using that medication within one year. Given that research shows that up to 10% of children do not respond to psychostimulant treatment [43], [44], part of this may be the result of children who were non-responsive to medication and were removed from treatment after a single prescription. It may also be that the some families did not find psychostimulant treatment to be as effective as other supports within a multi-modal approach. Other factors could include the affordability of medication, possible negative stigma around taking psychostimulants or complexities with comorbid conditions.

It is important to note that this study also accounted for gaps in the treatment of ADHD with psychostimulants (which the SA data did not). Nearly 46% of the NSW sample had at least one significant gap in treatment during the course of this study. These gaps may result from families ceasing medication after the initial prescription, but returning due to difficulties being experienced as their child enters adolescence. These gaps may also result from the practice of 'drug holidays'. When children routinely take short breaks from treatment (weekends and school breaks), there can be delay in the need for a new prescription to be issued. Another possible explanation for these gaps is the time taken to arrange changes between medications or to newly introduced medications. Hence, the date, the nature and the length of these gaps will be important features of future survival analysis within this data set, as well as gaining an accurate picture of patterns in duration.

V. LIMITATIONS

The preliminary data presented in this general paper must be interpreted cautiously. First, the data supplied by both the SAHC and the MOH does not record if the script is filled once issued. Second, methyphenidate and dexamphetamine are also approved for the treatment of narcolepsy. Because the prevalence of narcolepsy is estimated at 4 to 10 cases per 10,000 [45], all but a fraction of cases in the SA data set should be for individuals with ADHD, while the NSW data does not include narcolepsy. Third, after 1995, the SA data assumes that once an authorization has been issued, it is valid until 18 years of age (unless the medical practitioner notifies otherwise). This may result in low levels of reporting of cessation. Together these four factors may result in the data recording more cases of using psychostimulants, or using psychostimulants longer, than actually eventuated. However, they are consequences of previous and current techniques of MOH and SAHC data collection that we cannot redress, which makes this data set the most accurate available.

Further, there are three features that limit the direct comparison of SA and NSW data. First, the MOH requirement is that medical practitioners report their prescribing on a monthly basis, but this is not always adhered to, which the MOH advises may result in some under reporting. Second, the SAHC data set does not record cases of those who cease psychostimulant use within one month of authorization, but while rare, the MOH data set does. An third feature of the NSW context is that of general and individual approvals. General approvals are available to consultant pediatricians and consultant psychiatrists who are

member of the Royal Australian and New Zealand College of Psychiatrists. These medical practitioners do not need to gain individual approval for prescription as long as they follow a set of routine prescribing criteria. The maximum duration of a general approval is six months. All other medical practitioners who wish to prescribe, or for prescriptions for children less than four years of age, must seek individual approval.

VI. Implications

This data on general patterns of psychostimulant use for ADHD in two Australian jurisdictions show that there continues to be a steady increase in new prescriptions. This would suggest that some Australian jurisdictions continue to follow North American trends in ADHD treatment. This highlights the need for examination to see if barriers to treatment that have been identified in that context are also experienced in Australia. Such barriers include cultural influences on prevalence and/or prescription, geographic variations in access to non-pharmaceutical support and the impact of low SES on accessing medical treatment [13]. Further examination of barriers to access to treatment will better inform clinical practice.

Means start age and average duration continue to be areas requiring further research. Commencing medication treatment early and continuing for long durations may be concerning given that recent Australian research suggests extended use of psychostimulant treatment may stunt growth and delay adolescence [46]. Alternatively, starting treatment later and with numerous gaps in treatment presents the possibility that young people experience the majority of the growing up years without any form of support [7]. Hence, further examination of specific patterns of duration by start age will better inform clinical practice and highlight if greater efforts are needed to make multi-modal supports more accessible.

VII. Conclusion

The international data on patterns in psychostimulant use for ADHD (including prescription by gender, new cases, start age and duration) is still emerging. By making a longitudinal comparison between two Australian jurisdictions this paper makes an important contribution. In doing so, it also points to the importance of further research into duration, geographic variation and socio-economic links to patterns in psychostimulant use for ADHD.

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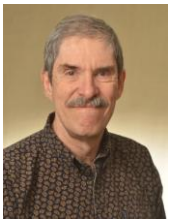

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