


Examining the Educational Gap for Children with ADHD and Subthreshold ADHD

Journal of Attention Disorders
1–14
© The Author(s) 2020
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/1087054720972790
journals.sagepub.com/home/jad


Nardia Zendarski^{1,2} , Shuaijun Guo^{1,2}, Emma Sciberras^{1,2,3} ,
Daryl Efron^{1,2,6}, Jon Quach^{1,2}, Leanne Winter⁴, Matthew Bisset^{2,3} ,
Christel M. Middeldorp^{4,5}, and David Coghill^{1,2}

Abstract

Objective: The present study examined the impact of Attention Deficit Hyperactivity Disorder (ADHD) on core educational outcomes in two large community cohorts of Australian school children. **Method:** Academic (reading and numeracy) and non-academic (school engagement, attendance, peer victimization, and parental expectations) outcomes were compared between children with ADHD, subthreshold ADHD, and controls when children were in grade 5 (M age = 10.5). Data were drawn from the Longitudinal Study of Australian Children birth cohort (LSAC; $N = 3,540$) and the Children's Attention Project (CAP; $N = 356$). **Results:** Both subthreshold ADHD and ADHD groups had poorer outcomes on all measures, with medium effects sizes. Differences were not evident between subthreshold ADHD and ADHD groups. **Conclusions:** Educational outcomes examined in this study highlight the educational risk for upperprimary school children with ADHD or subthreshold ADHD, in comparison to their peers. Monitoring these outcomes is necessary to inform policy, practice, and intervention.

Keywords

ADHD, academic, achievement, education, engagement

Children with Attention-Deficit/Hyperactivity Disorder (ADHD) are at increased risk of poorer educational outcomes and lower educational attainment in comparison to children without ADHD (Arnold et al., 2015; Loe & Feldman, 2007). Even those children who are subthreshold for ADHD (i.e., meeting some but not full clinical criteria for ADHD) may experience poorer outcomes (Biederman et al., 2018). It is hypothesized that ADHD symptoms likely cause learning deficits and are directly related to academic underachievement (de Zeeuw et al., 2017). Large discrepancies in the achievement of children and adolescents with ADHD on tests of reading, writing, spelling and mathematics have been reported (Masseti et al., 2008; Silva et al., 2015; Zendarski et al., 2017b), as well as discrepancies across non-academic performance indicators including attendance, engagement with school and peer problems (Fleming et al., 2017; Loe & Feldman, 2007; Rushton et al., 2019). Poor educational outcomes for individuals with ADHD limit employment, income opportunities and contribute to the high costs of ADHD, costing approximately \$20 billion per year in Australia (Sciberras et al., 2020). Routine measurement of ADHD treatment outcomes needs to extend beyond the core symptoms of ADHD to prioritize

measurement of crucial functional areas in the school environment. Educational outcome measures should be routinely collected and integrated into the decision making process within clinical practice to help improve treatment outcomes. Similarly, these data are likely to be useful to inform teaching policy and practices for school children with ADHD (Adamo et al., 2015).

While there is a great deal of empirical research examining educational outcomes for children with ADHD in early childhood (Loe & Feldman, 2007; Washbrook et al., 2013)

¹The University of Melbourne, Melbourne, Australia

²Murdoch Children's Research Institute, Melbourne, Australia

³Deakin University, Geelong, Australia

⁴The University of Queensland, Brisbane, Australia

⁵Children's Health Queensland Hospital and Health Service, Brisbane Australia

⁶Department General Medicine, Royal Children's Hospital, Melbourne Australia

Corresponding Author:

Nardia Zendarski, Department of Paediatrics, The University of Melbourne, 5th Floor South building, Flemington Rd, Parkville 3052, Australia.

Email: nardia.zendarski@unimelb.edu.au

and adolescence (Loe & Feldman, 2007; Zendarski et al., 2017a), the immediate preadolescent period (i.e., 10–12 years of age) just prior to transition from primary to secondary education, has been less well studied. This is an important developmental period because children are beginning to create their own views about their academic abilities and potential, and performance in this period has been shown to be a strong predictor of future academic attainment and success. Research examining academic achievement for students with ADHD having transitioned to high school or middle school in the USA has found children with ADHD are already well behind their peers (Langberg et al., 2008; Zendarski et al., 2017a) suggesting intervening is necessary before the transition. There is however little known about school outcomes for children with ADHD and subthreshold ADHD during this educational period across both academic and non-academic domains of functioning.

Longitudinal outcome studies have highlighted ADHD symptoms in childhood to be important predictors of poor educational outcomes in later school years (Arnold et al., 2015; Massetti et al., 2008). ADHD symptom severity, particularly symptoms of inattention, in childhood and adolescence have been found to predict poorer long-term outcomes (Merrell et al., 2017; Rigoni et al., 2020) and evidence suggests ADHD medication use during childhood does not vastly improve long term educational outcomes (Langberg & Becker, 2012). Maintaining engagement with learning in these years is likely to be an important protective factor for students with ADHD and subthreshold ADHD as they enter high school (Dvorsky & Langberg, 2016). Research in community and population studies have also highlighted that many children who meet ADHD criteria may remain unrecognized (Efron et al., 2014; Rowland et al., 2015). It is also the case that important indicators of learning and engagement are not always routinely assessed and even when they are this information is often not available to clinicians treating ADHD. This period at the end of primary schooling may, therefore, represent a period of opportunity to help children with ADHD having difficulty at school to make academic gains and to strengthen their engagement with school, learning and their peers (Dvorsky & Langberg, 2016).

Further, there is evidence to suggest that children with significant ADHD symptoms who fall below the ADHD threshold criteria are also at greater educational risk (Biederman et al., 2018; Kirova et al., 2019). A systematic qualitative review by Kirova et al. (2019) examined the body of literature (24 studies) on the prevalence and morbidity of subthreshold ADHD. Population prevalence of subthreshold ADHD was estimated to be 17.7%. Overall, findings suggest that subthreshold ADHD is associated with increased functional deficits in school, social skills, and cognitive functioning, as well as high comorbidity. However, research comparing educational outcomes for

children with subthreshold ADHD symptoms remains limited and few studies compare outcomes between children with ADHD, subthreshold ADHD, and controls (Kirova et al., 2019).

One recent study using data from the Children's Attention Project, which is a source of data in the current paper, demonstrated that children with subthreshold ADHD had substantially poorer reading and math performance (assessed via a blinded direct assessment), as well as poorer teacher rated academic competence at age 10 than controls and academic performance was similarly lower to children meeting the full criteria for ADHD (Efron et al., 2020). Broader academic indicators, as outlined below, were not examined in this paper. However, given the results from our initial investigation we deem it important to consider children with subthreshold ADHD as well as those with full ADHD in this study.

Indicators of Academic and Non-academic Educational Outcomes

Learning encompasses the knowledge, skills, and abilities that children attain because of their involvement in education. Academic achievement is a key component of this, typically measured by achievement across important academic domains. Performance in reading and numeracy are primary indicators of children's academic proficiency and are often measured on standardized tests including the National Assessment Program—Literacy and Numeracy (NAPLAN) program in Australia (Department of Education and Training [DET], 2018). However, academic achievement is not the only domain of education success, for example, children's level of attendance, school engagement and emotional wellbeing (i.e., experience of peer victimization), also contribute to school success (Hughes, 2015). Research examining these broader measures, however, remains limited in preadolescent children with ADHD (Hancock et al., 2013; Loe & Feldman, 2007). Prior research indicates that higher parental expectations may be protective for children's later academic achievement (Yamamoto & Holloway, 2010). Parents who hold higher expectations for their child's education attainment may have higher involvement in their child's education at home and at school, which may also influence their child's own educational goals (Gubbins & Otero, 2020; Wilder, 2014).

Several socio-demographic factors are known to impact on the educational outcomes of school children in general. Family socioeconomic background, parent education, age or grade, indigenous status, attending a school with a low socioeconomic background or in a rural or remote area can have an impact on educational achievement (Lamb et al., 2015). In Australia, differences in education outcomes remain for Indigenous children even after controlling for socioeconomic status and remoteness (Guenther et al.,

2013). Importantly, we must continue to tease out the impact that ADHD has on children's ability to learn and achieve within foundational education settings to minimize the impact of ADHD on the educational outcomes of children over and above the impact of sex, socioeconomic circumstances, indigenous status and remoteness.

Present Study

The present study examined the impact of ADHD and sub-threshold ADHD on core educational outcomes in two large community cohorts of Australian school children. The study aimed to compare academic (reading and numeracy) and non-academic (school engagement, attendance, peer victimization, and parental expectations) performance measures between children with ADHD, subthreshold ADHD, and controls. It was hypothesized that compared to controls both ADHD and subthreshold ADHD would predict poorer educational outcomes, even when considering potentially confounding factors relating to the child, family, and school.

Method

Study Design and Settings

This paper draws on data from two longitudinal studies, the Longitudinal Study of Australian Children (LSAC) and the Children's Attention Project (CAP; Sciberras et al., 2013). The two samples, which differ in several respects, were included to test whether our findings would be replicated across independent samples. Replication is increasingly recognized as essential in psychological research (Stanley & Spence, 2014). Outcomes are examined when children are near their final years of primary school because this is an important developmental period and to ensure that findings were not confounded by the impact of transition to high school.

Longitudinal Study of Australian Children (LSAC). LSAC data were collected initially from a population-based birth cohort (B cohort) of Australian children born between March 2003 and February 2004 (Sanson et al., 2002). Subsequently, data are collected every 2 years, referred to as waves. All study procedures were approved by the Australian Institute of Family Studies (AIFS) Ethics Committee (AIFS 13-04) and informed written parental consent was obtained for each participating child at baseline. Consent to access the dataset for this study was obtained from AIFS. The study design is summarized below and more detailed information is provided elsewhere (Soloff et al., 2005).

In summary, LSAC used a two-stage clustered sampling design, stratified by state and by location (metropolitan and urban status) to recruit their sample. Children were randomly selected using the Medicare (publicly funded national

health insurance) database. Recruited families in the final sample were broadly representative of Australian children except for those living in remote areas. At each wave, data were collected from parents (97% biological mothers) through interviews conducted by trained research assistants in the family home, child self-report and teacher questionnaires and via data linkage. Comprehensive data is gathered on each participating child, including their experiences within families and communities, and experiences in education and aspects of children's development. Of the initial 5,107 babies enrolled, 74% were retained in wave 6 ($n=3,764$). Families retained were more likely to be English-speaking and parents were more highly educated (Norton & Monahan, 2015). In this study, we used Wave 6 outcome data, measured in 2014 with B-cohort children at age 10 to 11 years. Most children (83%) were in their sixth year of formal education (grade 5) with the remainder in grade 6. A small number of children ($n=224$) in the LSAC cohort were excluded from the analyses if they were reported to be in grades lower than 5 or in alternate educational settings, leaving a total sample size of 3,540 for this study.

Children's attention project (CAP). CAP is a community-based longitudinal cohort study examining developmental differences and outcomes in children with ADHD and sub-threshold ADHD compared to children without ADHD across childhood (Sciberras et al., 2013). Participating children were recruited through 43 Victorian schools in their second year of formal education (grade 1) in 2011 to 2012. In this study, we examined outcomes in wave 3 when participating children were in their sixth and seventh years of formal education (grades 5–6) during 2014 to 2015, aged 10 to 11 years. Of the 491 children enrolled at baseline, data were available for 75% were available at Wave 3, a further 10 children were excluded from the ADHD sub-threshold group due to their ADHD status being unclear, leaving a total sample of 356. Ethical approval was obtained from the Human Research Ethics Committees of The Royal Children's Hospital (#31056) and the Victorian Department of Education and Training (#2011_001095). Informed written parental consent was obtained for each participating child on study entry. The study design is summarized below. Detailed information about the study design is provided elsewhere (Sciberras et al., 2013).

Children who screened positive for ADHD by both parent and teacher report using an ADHD screener were matched to children who screened negative by both parent and teacher report, based on age and school, were invited into the study. Diagnostic interviews to confirm the presence or absence of ADHD were conducted face-to-face with parents by trained research staff, supervised by clinicians. Children were excluded if they had a severe medical condition, intellectual disability or where parents had very low English proficiency. CAP aims to chart the course of

Table 1. Description of Study Outcome Measures.

Outcomes	Measure	Description	Reporter	Identical measure between cohorts
Reading and Numeracy Achievement	National Assessment Program—Literacy and Numeracy (NAPLAN) –Grade 5 ^a	NAPLAN is an Australia-wide direct assessment of academic skills conducted in schools with all children in grades 3, 5, 7, and 9. NAPLAN measures students' academic skills, scores that range from 0 to 1,000. Reading tests focus on the reading of written English and understanding of the written text (ACARA, 2019). Numeracy tests focus on competency in numerical operations and problem-solving ability.	Linkage	Yes
Risk Status—Reading and Numeracy	At or Below National Minimum Standard (NMS)	Student achievement on NAPLAN tests is mapped on to achievement bands to help monitor skills proficiency. Six of the bands are used for reporting student performance at each year level. Grade 5 uses bands 3 to 8, with band 4 the minimum standard. Performance in bands 3 and 4 indicate students at academic risk and are likely to require additional targeted support (ACARA, 2019). Results are dichotomized to bands 3&4=at risk, bands 5 and above=not at risk.	Linkage	Yes
Peer victimization	Bullied by peers	Parents are asked if their child has experienced an incident of being bullied at school in the previous 12 months or current school year. Results are dichotomized to 1 = if Yes, 2 = if No (Gresham et al., 2010).	Parent	No ^b
Frequent absenteeism	School days absent	LSAC study designed question asking parents to record the number of school days the student has been absent in the last 4 weeks excluding school or public holidays. Results are dichotomized into 2 categories: 0 = absent 1 or less days, 1 = absent 2 or more days. CAP study designed question asking the teacher to report whether the child is frequently absent (Sciberras et al., 2013): 0 = if No, 1 = if Yes.	Parent/ Teacher	No ^c
Engagement	School Engagement Scale (SES)	Children's school engagement was measured using the school engagement scale, adapted from the Longitudinal Surveys of Australian Youth (LSAY) Attitudes Towards School Survey (LSAY, 2018) consisting of 11 items measured on a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree), including items such as "My school is a place where I feel happy" and "My school is a place where I like learning." The mean score is calculated for student engagement, ranging between 1 and 4.	Child	Yes
Educational aspirations	Parental expectations on their child's level of educational attainment	Parent report of their educational aspirations (level of educational attainment) for their child by choosing one of five categories presented from not completing secondary school to obtaining a doctoral degree. The CAP study excluded doctoral degrees. Results were dichotomized to indicate 0 = No University, 1 = University degree or above.	Parent	Yes

Note. ^aData were obtained directly from The Australian Curriculum, Assessment and Reporting Authority (ACARA), NAPLAN tests were conducted in either 2014 or 2015.

^bLSAC asks about whether the child has been victimized in the last 12 months or current school year, while the CAP study asked about the current school year.

^cThe LSAC and CAP studies vary regarding school absenteeism (parent vs. teacher report). Educational outcomes collected in Wave 6 LSAC, Wave 3 CAP, when children were aged 10 to 11 years.

children's ADHD symptoms over time and to identify risk and protective factors associated with different child trajectories. Data are collected on academic, social, cognitive, and mental health outcomes at each wave from multiple informants via parent and teacher surveys, direct child assessments and diagnostic interviews, as well as through data linkages to educational and health datasets.

Measures

Table 1 provides a summary of the educational outcome measures used in this study. Measures were selected if they

were (1) identified in the literature as a valid indicator of student achievement or performance, (2) relevant to the upper-primary school period, and (3) available in both the LSAC and CAP datasets. Eight educational outcomes met these criteria: reading and numeracy achievement, student engagement, reading and numeracy risk status, frequent absenteeism, peer victimization, and parent educational expectations.

Comparison groups. Comparison groups were coded in the LSAC cohort based on parent report of ADHD diagnosis and symptom profiles on the five-item hyperactivity-inattention

(HI) subscale of the Strengths and Difficulties Questionnaire (SDQ; Goodman et al., 2000) at waves 3 to 6. Questions on the HI subscale ask respondents to rate hyperactive and inattentive behavior (e.g., “restless, overactive, cannot stay still for long”). The HI subscale has been validated as an adequate screening tool for ADHD in community settings (Goodman, 2001; Goodman et al., 2000) and is a strong predictor of ADHD diagnoses in clinical ($OR=10.20$, 95% CI [2.18–48.71], $p=.003$) and research ($OR=6.82$, 95% CI [1.95–23.84], $p=.003$) settings (Hall et al., 2019), with moderate sensitivity (42.5–63.3%) which may be improved by using multi-informant SDQs (Goodman et al., 2000; Hall et al., 2019). Children were coded as *ADHD* if their score on the HI subscale was at or above the 90th percentile (≥ 6) by either parent or teacher report at two consecutive waves or if they had a parent-reported ADHD diagnosis at any wave ($n=118$). Children who were at or above the 90th percentile on the HI subscale at any of the four waves by either parent or teacher report, but who did not meet the ADHD group criteria above, were coded as *subthreshold ADHD* and all other children were coded as *controls*.

In the CAP cohort, a two-stage screening (parent and teacher Conners 3 ADHD Index) and case-confirmation (Diagnostic Interview Schedule for Children, Version IV; [DISC-IV]) procedure (Sciberras et al., 2013) was used to group children as either *ADHD* (met full diagnostic criteria on the DISC-IV), *subthreshold ADHD* (screened positive but did not meet full diagnostic criteria on the DISC-IV), and *controls* (did not screen positive or meet diagnostic criteria) at enrolment into the study. The Conners 3 ADHD Index (Conners, 2008) is a 10 item brief screener used to identify possible ADHD. Items (e.g., restless, overactive) are rated on the frequency of occurrence from 1 (never/seldom) to 3 (very often/very frequent), with higher scores indicating greater symptom severity. This measure has been shown to have strong internal consistency (parent-report, $\alpha=0.92$) and test-retest reliability (Kao & Thomas, 2010). The ADHD module of the DISC-IV (Shaffer et al., 2000), is a structured diagnostic interview using ADHD criteria outlined in the Diagnostic and Statistical Manual for Mental Disorders-IV with good validity and reliability (Willcutt, 2012).

Demographics and control variables. The LSAC and CAP datasets provided child, family, and school demographic information including child sex, age, parental education level (tertiary education yes/no), and socioeconomic status (SES). The LSAC study also includes the child’s indigenous status (Aboriginal and Torres Strait Islander Heritage), ADHD medication use, for example Ritalin (methylphenidate), attending school location (metropolitan/regional), and school type (Catholic, independent or government). The school data are obtained from data linkage to the “My Schools” database, all other data are parent-reported.

Statistical Analyses

All analyses were conducted using Stata 15.1 (StataCorp, 2017). Participant characteristics and educational outcomes were first summarized using descriptive statistics. Univariate analysis (i.e., one-way test and chi-square test) were then conducted to examine the distribution of ADHD by participants’ socio-demographic and educational outcomes. Additionally, effect sizes (Hedges’ g and odds ratios) are reported calculated on unadjusted multiple regressions. Listwise deletion was used to handle missing data. Missing rates were between 5 and 19% on included variables, with highest rates for NAPLAN variables (see NAPLAN sensitivity analyses below). Multiple linear regression (continuous) and logistic regression (categorical) analysis were used to investigate the associations between each outcome and groups (ADHD, subthreshold ADHD, and controls). Data for each cohort were analyzed separately. Results report group differences between controls and each ADHD group.

LSAC regression models were adjusted for child sex, child Aboriginal or Torres Strait Islander status, child grade level, parent education level, metropolitan location and school type, and clustering by postcodes to reduce biased estimates. The CAP regression models were adjusted for child sex, child age and parent education level, and clustering by school. CAP participants were recruited from government-administered schools in metropolitan areas, so we chose not to control for school location or school type. Aboriginal or Torres Strait Islander status was not collected in the CAP study. ADHD medication use was largely associated with children classified as ADHD. LSAC only collected these data if ADHD diagnosis was indicated. Within the ADHD groups medication rates were low. As such we did not control for ADHD medication use.

NAPLAN sensitivity analyses. In each cohort, we were able to link to the individual-level NAPLAN results for children who sat the grade 5 assessments. The proportion of children across the ADHD, subthreshold ADHD, and control groups who are classified as either having an exemption or absent is consistent with national Australian data which indicates approximately 3% of children do not sit NAPLAN for these reasons. Therefore, the missing scores can be suggested to be missing at random as the data linkage process generally returns between 80 and 90% of children.

A sensitivity analysis was conducted to examine potential differences between the three groups in NAPLAN testing status, results are presented in supplementary Table 1. Overall, patterns of missing NAPLAN results were significantly different amongst the three LSAC groups, with the subthreshold ADHD group having more missing data compared to controls. Overall patterns of missing NAPLAN data were not significantly different between the three CAP groups.

Table 2. Sample Characteristics and Educational Outcomes.

	LSAC sample (N= 3,540)	CAP sample (N= 356)
	n (%) or mean \pm SD	n (%) or mean \pm SD
Socio-demographics		
Age	10.44 \pm 0.50	10.49 \pm 0.50
Male	1,799 (50.1)	218 (61.2)
Aboriginal or Torres Strait Islander	97 (2.7)	-
Grade 5	2,936 (82.9)	-
Metropolitan location	2,123 (60.2)	100
School type		
Government	2,200 (62.2)	-
Catholic	770 (21.7)	-
Independent	570 (16.1)	-
Parental level of education		
University degree or higher	1,374 (38.9)	141 (48.0)
Study groups		
Control	3,172 (89.6)	152 (42.7)
Subthreshold ADHD	188 (5.3)	69 (19.4)
ADHD	180 (5.1)	135 (37.9)
Key performance indicators (KPIs)		
NAPLAN reading	519.99 \pm 79.42	507.82 \pm 80.46
Below standard reading	366 (11.8)	51 (17.8)
NAPLAN numeracy	503.73 \pm 71.30	500.93 \pm 70.6
Below standard numeracy	417 (13.5)	42 (14.6)
Victimized by peers		
Frequently absent from school ^a	995 (28.7)	120 (38.5)
School engagement	887 (25.1)	29 (9.7)
School engagement	3.06 \pm 0.49	3.14 \pm 0.47
Parent school expectations—University	2,290 (67.6)	156 (46.7)

Note. SD = standard deviation; NAPLAN = national assessment program—literacy and numeracy; ADHD = attention deficit hyperactivity disorder.

^aParent report of child absence 2 or more days in the past month (LSAC) or teacher report of frequent absence (CAP).

Results

Sample Characteristics

Participants were 3,896 Australian school children in grades 5 to 6; 3,540 children for whom data were available at wave 6 in the LSAC cohort and 356 children for whom data were available at wave 3 of the CAP cohort. Within each cohort, three groups were compared. LSAC groups: ADHD ($n=180$), subthreshold ADHD ($n=188$), and controls ($n=3,172$). CAP groups: ADHD ($n=135$), subthreshold ADHD ($n=69$), and controls ($n=152$). Sample characteristics are summarized in Table 2.

LSAC sample characteristics. The average age of participants was 10.43 years ($SD=0.50$) and half were male. The children attended government (62%), Catholic (22%), and independent (16%) primary schools in metropolitan (60%) and regional areas (40%). Additional information on participant characteristic by each group are available in supplementary Table 2, which shows that groups vary across a range of factors including child sex, Aboriginal or Torres

Strait Islander status, medication use and parent education, but not on school type or location.

CAP sample characteristics. The average age of participants was 10.49 years ($SD=0.50$) and 61% were male and all attended government primary schools in metropolitan areas. Additional information on participant characteristics by group are available in supplementary Table 2, which shows groups vary regarding sex, medication use and parent education levels, with the subthreshold group having more females, while fewer parents in the ADHD groups had completed tertiary studies.

Group Differences in Educational Outcomes by Cohort

Educational outcomes by sample and group are presented in Table 3, which shows outcomes significantly differed between groups. Both the ADHD and subthreshold ADHD groups had poorer outcomes across all measures in comparison to controls as indicated in the corresponding F/χ^2

Table 3. Comparison of Children with ADHD Symptoms and Typical Children in Grade Five Across Eight Educational Outcomes (Unadjusted).

Educational outcomes	Control mean (SD)	Subthreshold ADHD mean (SD)	ADHD mean (SD)	$F\chi^2$	p	ES, C v S (Hedges' g)/ odds ratios	ES, C v A (Hedges' g)/ odds ratios	Summary difference ⁱ
LSAC sample ($n = 3,172$)		($n = 188$)	($n = 180$)					
NAPLAN reading ^a	524.77 (78.09)	480.42 (77.06)	471.44 (77.32)	54.94	<.001	0.57	0.68	C > S, A
NAPLAN numeracy ^b	507.12 (70.78)	473.14 (71.40)	470.83 (64.97)	34.56	<.001	0.48	0.52	C > S, A
School engagement ^c	3.09 (0.47)	2.84 (0.58)	2.80 (0.58)	46.33	<.001	0.53	0.59	C > S, A
At risk reading, n (%) ^d	281 (10.0)	42 (27.3)	43 (27.9)	82.34	<.001	3.36	3.47	C < S, A
At risk numeracy, n (%) ^e	327 (11.7)	42 (27.3)	48 (31.4)	74.36	<.001	2.81	3.43	C < S, A
Frequent absenteeism, n (%) ^f	771 (24.3)	59 (31.38)	57 (31.7)	9.12	.010	1.40	1.59	C < S, A
Victimized by peers, n (%) ^g	814 (26.3)	91 (50.8)	90 (50.8)	95.50	<.001	2.72	2.89	C < S, A
Parental expectations -University, n (%) ^h	2,163 (71.0)	74 (41.6)	53 (32.1)	166.26	<.001	0.29	0.19	C > S, A
CAP sample ($n = 152$)		($n = 69$)	($n = 135$)					
NAPLAN reading ^a	531.54 (74.74)	497.45 (78.2)	482.88 (80.76)	11.77	<.001	0.49	0.63	C > S, A
NAPLAN numeracy ^b	528.82 (64.18)	487.23 (66.87)	473.43 (66.88)	21.69	<.001	0.61	0.64	C > S, A
School engagement ^c	3.25 (0.43)	3.07 (0.46)	3.03 (0.41)	8.80	<.001	0.33	0.49	C > S, A
At risk reading, n (%) ^d	11 (8.46)	14 (25.45)	26 (25.74)	14.29	<.001	3.69	3.75	C < S, A
At risk numeracy, n (%) ^e	6 (4.65)	9 (16.01)	27 (26.21)	21.50	<.001	3.93	7.28	C < S, A
Frequent absenteeism, n (%) ^f	8 (6.15)	7 (10.45)	15 (13.51)	3.74	.154	1.75	2.38	C, S < A
Victimized by peers, n (%) ^g	31 (22.79)	29 (47.54)	60 (52.17)	25.37	<.001	2.84	3.69	C < S, A
Parental expectations -University, n (%) ^h	76 (52.41)	29 (46.77)	51 (40.16)	4.09	.129	0.80	0.61	C, S, A

Note. ADHD = attention deficit hyperactivity disorder; LSC = longitudinal study of Australian children; CAP = children's attention project; NAPLAN = national assessment program—literacy and numeracy; ES = effect size; C = controls; S = subthreshold ADHD; A = ADHD. Results show group differences and unadjusted effect sizes between controls (reference group) and each ADHD group. N 's varied between 3,107 and 3,540 for LSC with NAPLAN numeracy lowest, CAP sample between 286 and 339, with NAPLAN reading lowest. Hedges g effect sizes can be interpreted as small = 0.2, medium = 0.5 and large effect = 0.8.

^aNAPLAN Reading grade 5.

^bNAPLAN Numeracy grade 5.

^cSchool engagement scale.

^dAcademic risk, at or below national minimum standard (NMS) on grade 5 reading.

^eAcademic risk, at or below NMS on grade 5 numeracy test.

^fAbsent 2 or more days in the past month parent report (LSAC) or teacher report of frequent absence (CAP).

^gParent report of whether or not their child had been victimized at school this year.

^hParental expectation as to whether their child will attend university or not.

ⁱSummary of group comparisons, comma indicates no statistical difference between groups.

column. There were two exceptions; frequent absenteeism and parental expectations, which were not significantly different between the CAP groups.

Calculated effect sizes show a medium effect of ADHD or subthreshold ADHD on outcomes. For example, the largest effects in the LSAC sample were observed between the control group and the ADHD group on NAPLAN reading ($ES=0.68$) and engagement ($ES=0.59$). In the CAP sample, ADHD status had a medium negative effect on NAPLAN numeracy ($ES=0.63$) and increased risk of peer victimization ($OR=7.28$). There were no significant unadjusted differences between the subthreshold ADHD and ADHD groups in either cohort. Our analysis was sufficiently powered 0.87 and 0.97 respectively, to detect a medium effect size (0.4) with an alpha of 0.05 between the ADHD and subthreshold ADHD groups in CAP and LSAC.

Regression Results

Results for the adjusted multiple linear and logistic regressions are presented in Table 4. Of note, only one relationship was attenuated to non-significant (*LSAC*—frequent absenteeism) when adjusting for potential confounding variables. Overall, compared to controls, children in the ADHD and subthreshold ADHD groups in both samples performed significantly poorer on nearly all outcomes (13 of 16). For example, in the LSAC sample, the mean performance on the NAPLAN test of reading was 49.2 (95% $CI=[-61.65, -36.75]$) points lower for children in the ADHD group in comparison to control children (subthreshold ADHD group scores were 40.3 points lower than controls, 95% $CI=[-52.63, -27.96]$). In the CAP sample, the difference between the two groups was 46.82 (95% $CI=[-72.36, -21.28]$) points (subthreshold ADHD group scores were 31.25 points lower than controls, 95% $CI=[-60.83, -1.68]$). Also, compared to controls, children in the ADHD and subthreshold ADHD groups were less engaged in school, at increased risk of being below reading and numeracy benchmarks and at increased risk of being victimized. A key difference between cohorts was parent expectations. Significantly fewer parents in the ADHD ($OR=0.21$; 95% $CI=[0.14, 0.30]$) or subthreshold ADHD group ($OR=0.32$; 95% $CI=[0.24, 0.44]$) of the LSAC sample endorsed that they expected their child would attend university in comparison to parents of controls. There were no statistical differences in parental educational expectations between the controls and ADHD groups in the CAP sample and the odds of being frequently absent from school did not significantly differ between groups in either sample.

Discussion

This study compared educational outcomes for three groups of primary school children (ADHD, subthreshold ADHD,

and controls) using outcomes that are routinely available in education settings. As hypothesized, both children with ADHD and subthreshold ADHD had moderately poorer outcomes across most measurement domains. Although children in the ADHD groups had the poorest performance on outcomes, there was no significant difference in performance between these children and children in the subthreshold ADHD groups. An important aspect of these findings is their robust replication across two independent community-based samples that differ in several respects. This study highlights the potential clinical importance of monitoring educational outcomes and additional learning needs of children with ADHD and subthreshold ADHD during primary school.

Academic Achievement

Our findings suggest both children with ADHD and subthreshold ADHD have poorer academic outcomes (i.e., lower reading and numeracy achievement) compared to their non-ADHD peers, which is consistent with prior research (Efron et al., *pn press*; Fleming et al., 2017; Loe & Feldman, 2007; Silva et al., 2015). Based on the effect sizes for NAPLAN reading and numeracy, children with ADHD were approximately 8 months behind controls (Goss & Sonnemann, 2016), with children in the subthreshold groups similarly impacted. Additionally, a large proportion of children with ADHD and subthreshold ADHD were not progressing well against the national achievement benchmarks, with more than 25% of children with ADHD in the lowest two performance bands for their grade. Findings are consistent with those reported by Silva and colleagues who examined NAPLAN benchmarks in a large cohort of primary school children in Western Australia (Silva et al., 2015). Findings emphasize the importance of being able to identify and monitor children with ADHD, as well as subthreshold ADHD, to provide academic support and services when indicated.

Non-academic Domains

This study extended previous research by examining children's performance on a range of non-academic domains related to children's wellbeing and engagement with school. Children with ADHD and subthreshold ADHD in comparison to controls had poor outcomes (i.e. lowered student engagement and increased experience of peer victimization, and to a lesser extent attendance and parental expectations for their child's future educational attainment). For example, children in the ADHD groups reported feeling less engaged in school in comparison to controls, with medium effect sizes reported. Lowered engagement in children with ADHD has previously been associated with higher depressive symptoms, poor parental supervision, and increased

Table 4. Multiple Regression Analysis Showing the Associations Between Educational Outcomes and ADHD Groups (Adjusted).

Educational outcomes	LSAC sample ⁱ			CAP sample ^j		
	Control	Subthreshold ADHD β /OR, 95% CI	ADHD β /OR, 95% CI	Control	Subthreshold ADHD β /OR, 95% CI	ADHD β /OR, 95% CI
NAPLAN reading ^a	Ref	-40.30 (-52.63, -27.96)	-49.20 (-61.65, -36.75)	Ref	-31.25 (-60.83, -1.68)	-46.82 (-72.36, -21.28)
NAPLAN numeracy ^b	Ref	-36.62 (-48.26, 24.98)	-39.15 (-50.29, -28.01)	Ref	-35.46 (-63.07, -7.85)	-52.70 (-72.07, -33.34)
School engagement ^c	Ref	-0.20 (-0.29, -0.10)	-0.23 (-0.32, -0.14)	Ref	-0.22 (-0.34, -0.10)	-0.21 (-0.31, -0.11)
At risk reading ^d	Ref	3.11 (2.12, 4.55)	3.11 (2.07, 4.67)	Ref	3.74 (1.56, 8.90)	5.32 (2.16, 13.15)
At risk numeracy ^e	Ref	2.85 (1.97, 4.13)	3.57 (2.37, 5.38)	Ref	5.05 (1.61, 15.78)	7.89 (2.56, 24.30)
Frequent absenteeism ^f	Ref	1.19 (0.85, 1.66)	1.33 (0.95, 1.86)	Ref	1.72 (0.56, 5.32)	2.20 (0.97, 4.98)
Victimized by peers ^g	Ref	2.96 (2.16, 4.06)	2.86 (2.06, 3.98)	Ref	3.32 (1.64, 6.74)	3.61 (2.02, 6.41)
Parental expectations - University ^h	Ref	0.32 (0.24, 0.44)	0.21 (0.14, 0.30)	Ref	0.77 (0.39, 1.35)	0.73 (0.39, 1.34)

Note. ADHD = attention deficit hyperactivity disorder; β = beta weight; OR = odds ratio; CI = confidence interval; LSAC = longitudinal study of Australian children; CAP = children's attention project; NAPLAN = national assessment program—literacy and numeracy. N's varied between 3,084 and 3,526 for LSAC with NAPLAN numeracy lowest, CAP sample between 280 and 243, with NAPLAN reading lowest. Results show adjusted comparisons between controls (reference group) and each ADHD group. Bold denotes a significant difference between the reference and comparison group.

^aNAPLAN reading grade 5.

^bNAPLAN numeracy grade 5.

^cChild self-report of school engagement.

^dAcademic risk, at or below national minimum standard (NMS) on grade 5 reading.

^eAcademic risk, at or below NMS on grade 5 numeracy test.

^fAbsent 2 or more days in the past month parent report (LSAC) or teacher report of frequent absence (CAP).

^gParent report of whether or not their child had been victimized at school this year.

^hParental expectation as to whether their child will attend university or not.

ⁱLSAC adjusted for child sex, Indigenous status, Grade 5, parental education, school type and location, and clustering effect of postcode.

^jCAP adjusted for child age, sex, parental education, and the clustering effect of schools.

student-teacher conflict in children and adolescents with ADHD (Rushton et al., 2019; Zendarski et al., 2017b). Similarly, children in the ADHD groups were three to four times more likely to be victimized by their peers at school, supporting previous findings and concerns raised about the impact of peer victimization on children with ADHD's wellbeing and mental health (Rushton et al., 2019; Zendarski et al., 2017b). Engagement and peer victimization are potentially modifiable factors and targeted intervention could help improve these children's school experience, and consequently build their resilience, leading to improved educational outcomes (Dvorsky & Langberg, 2016).

Subthreshold ADHD

This study makes an important contribution to the literature on the level of educational impairment experienced by children with subthreshold ADHD. Although current research findings suggest subthreshold ADHD symptoms are associated with functional impairment and of clinical importance (Kirova et al., 2019), there is limited research examining the impact of subthreshold symptoms on children's academic and non-academic performance in upper primary school. Our data, replicated in two large prospective studies, show ADHD and subthreshold ADHD groups were similarly impacted on all outcome measures. Results suggest that, regardless of whether a child reaches the diagnostic threshold, ADHD symptoms have the potential to impact children's achievement and performance at school. This finding is similar to our recent paper examining academic functioning in children with full syndrome and subthreshold ADHD (Efron et al., 2020) but extends this prior research by focusing on a broader range of educational indicators including national standardized academic assessments. We also show subthreshold ADHD groups have a higher representation of females and higher socioeconomic advantage (i.e., higher parent education) compared with ADHD groups. Both sex and socioeconomic advantage have previously been shown to be characteristic of subthreshold ADHD groups in comparison to ADHD groups (Kirova et al., 2019). Without targeted intervention and support, both groups of children remain particularly vulnerable as they transition to secondary school (Dvorsky & Langberg, 2016).

Strengths and Limitations

In this study, we were able to replicate findings in two large non-clinical samples of Australian primary school children. LSAC is broadly representative of Australian children and families and the proportion of children categorized as ADHD (using the SDQ HI scale) was within the expected range (3–7%) for ADHD in community samples (Lawrence, 2016; Willcutt, 2012). The CAP study used a rigorous case

classification and matching process to categorize children into the three groups. A unified set of outcome measures, including data linkage to NAPLAN grade 5 results, were used across both studies. Even though there were differences in methodology between the two studies, the results were replicated across the two samples, which suggests that they were robust to these differences. A novel component of this study was to compare a broad range of important educational outcomes between children with ADHD and children with subthreshold symptoms in upper primary school. Further, we used multi-informant measures including parent, teacher, and self-report in the non-academic domains. Cumulatively, these factors improve the generalizability of findings.

There are several limitations to note. The LSAC sample included children across Australia from different school settings and areas. In contrast, the CAP sample was recruited from government schools in metropolitan areas only. To limit potential bias associated with the type of school attended and area, we included school type and location as confounders in the regression analysis for LSAC data. While standardized tests such as NAPLAN are useful benchmark tests, more regular literacy and numeracy testing in classroom is necessary to identify children who are behind and to monitor children who do not sit NAPLAN testing. Diagnostic testing may also be necessary to understand children's individual strengths and weakness across cognitive domains. This study did not consider the impact of specific comorbid conditions that can impact on school functioning, including externalizing and internalizing comorbidities, autism spectrum disorder, specific learning disorders and lowered IQ which may account for some of the variations in results (Barnard-Brak et al., 2011). However, many studies have found that ADHD remains a significant predictor of academic outcomes even after controlling for these factors (Kent et al., 2011; Zendarski et al., 2017a).

Practice Implications

Our findings that ADHD symptoms, threshold or subthreshold, are associated with poorer educational outcomes in upper primary school have important implications for practice. A strong primary school foundation in literacy and numeracy underpins a child's future educational success and outcomes in both these domains remain a key part of educational targets for schools and policy makers. Our findings further substantiate the impact of ADHD symptoms on children's academic achievement. Despite this, there remains no definitive policy or procedures in relation to the education of students with ADHD within Australian primary schools. Additionally, less than half the children with ADHD have been diagnosed (Efron et al., 2014; Sayal et al., 2018), and children with subthreshold ADHD are likely to go unrecognized as a cohort of children at risk.

Although subthreshold ADHD may represent a milder phenotype in comparison to children full syndrome ADHD (Kirova et al., 2019), these children are also likely to be experiencing school difficulties in their upper primary school years. ADHD symptom thresholds for diagnosis may be less meaningful in the context of educational outcomes and children with elevated symptoms who fail to meet such thresholds remain at considerable risk. Greater emphasis should be placed on identifying primary school children with impairing levels of inattentive and or hyperactive-impulsive behaviors in the classroom irrespective of whether they meet criteria for a diagnosis. There remain numerous challenges to being able to identify children at risk of ADHD in upper primary school. Information on school achievement and performance may be hard to obtain, particularly if these children are excluded from testing, are frequently absent or move schools. Referral pathways between educators and health professionals may be unclear, and some parents may be reluctant to seek professional help for their child (Sayal et al., 2018).

Further obtaining access to funding for special educational services and supports remains challenging for children identified with ADHD in Australia, as the diagnosis itself is insufficient to meet criteria to obtain access to funding programs for students with disabilities and services (i.e., learning support teacher). Access to Individual Education Plans (IEPs) and Student Support Groups (SSGs) are at the discretion of individual school principals and often requires strong advocacy from parents. In Australia, only 4% of children have diagnoses that qualify them to access services, whilst 18% identified with emerging needs do not qualify (O'Connor et al., 2020). However, the Australian National Consistent Collection of Data (NCCD) is beginning to address this gap by having schools examine the type of adjustments that they make in the classroom for students based on student's functional needs, as opposed to clinical diagnosis criteria. Some Australian states are also using this model to determine school funding, potentially enabling a closer match between student needs and school resources (Garvey et al., 2020).

Targeted academic intervention, as well as programs to assist children with ADHD in childhood to manage the increased academic demands of upper-primary school that is, organizational and homework skills programs (Langberg et al., 2011), are moderately effective in improving academic outcomes. Behavioral modification approaches such as the Daily Report Card, where daily behavioral goals (i.e., complete homework) are created for the child using tangible rewards and parental involvement can be effective in improving motivation and decreasing unhelpful behaviors. These interventions can be implemented effectively by school staff with minimal resources and cost (DuPaul et al.,

2012). However, there is a paucity of information on accommodations, services, and interventions being accessed by children with ADHD in primary schools (Sayal et al., 2018). There remains a pressing need for education and health professionals to continue to collaborate on policies and programs aimed at addressing educational disadvantage for children with impairing ADHD symptoms before they transition to secondary school.

Conclusion

Results from two large cohorts of children in upper-primary school show children with ADHD and subthreshold ADHD languish behind their peers on a broad range of academic and non-academic educational outcomes. Early identification of educational difficulties, along with an integrated approach to policy and intervention, is needed to drive change. Developing a consistent set of educational outcomes measures could provide a mechanism to monitor the effectiveness of these programs. With better collaboration between health and education, measures could be obtained through existing data sources routinely collected in health and education settings.

Acknowledgments

The authors gratefully acknowledge the participating families and teachers of the LSAC and CAP studies, as well as the research team who have collected and maintained the data.


Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was commissioned by the Australian ADHD Professionals Association (AADPA) and funded through the Australian Government under the Department of Health Mental Health program awarded to AADPA. This Children's Attention Project was funded by the Australian National Health and Medical Research Council (project grant no. 1008522). A/Prof Efron was supported by a Clinician Scientist Fellowship from the Murdoch Children's Research Institute (MCRI). MCRI is supported by the Victorian Government's Operational Infrastructure Support program. A/Prof Sciberras was funded by a National Health and Medical Research Council Career Development Fellowship (1110688) and a veski Inspiring Women's Fellowship.

ORCID iDs

Nardia Zendarski  <https://orcid.org/0000-0002-4498-0202>

Emma Sciberras  <https://orcid.org/0000-0003-2812-303X>

Matthew Bisset  <https://orcid.org/0000-0001-8757-4215>

Supplemental Material

Supplemental material for this article is available online.

References

- ACARA. (2019). *NAP, National assessment program*. Australian Curriculum, Assessment and Reporting Authority (ACARA). <https://reports.acara.edu.au/Home/Participation>
- Adamo, N., Seth, S., & Coghill, D. (2015). Pharmacological treatment of attention-deficit/hyperactivity disorder: assessing outcomes. *Expert Review of Clinical Pharmacology*, 8(4), 383-397. <https://doi.org/10.1586/17512433.2015.1050379>
- Arnold, L. E., Hodgkins, P., Kahle, J., Madhoo, M., & Kewley, G. (2015). Long-term outcomes of ADHD: Academic achievement and performance. *Journal of Attention Disorders*. Advanceonlinepublication. <https://doi.org/10.1177/1087054714566076>
- Barnard-Brak, L., Sulak, T. N., & Fearon, D. D. (2011). Coexisting disorders and academic achievement among children with ADHD. *Journal of Attention Disorders*, 15(6), 506-515. <https://doi.org/https://doi.org/10.1177/1087054710369667>
- Biederman, J., Fitzgerald, M., Kirova, A. -M., Woodworth, K., Biederman, I., & Faraone, S. (2018). Further evidence of morbidity and dysfunction associated with subsyndromal ADHD in clinically referred children. *The Journal of Clinical Psychiatry*, 79(5), 17m11870. <https://doi.org/10.4088/JCP.17m11870>
- Conners, C. K. (2008). *Conners* (3rd ed.). Multi-Health Systems. https://doi.org/10.1007/978-0-387-79948-3_1534
- de Zeeuw, E. L., van Beijsterveldt, C. E. M., Ehli, E. A., de Geus, E. J. C., & Boomsma, D. I. (2017). Attention deficit hyperactivity disorder symptoms and low educational achievement: Evidence supporting a causal hypothesis. *Behavior Genetics*, 47(3), 278-289. <https://doi.org/10.1007/s10519-017-9836-4>
- Department of Education and Training. (2018). *Through growth to achievement: The report of the review to achieve educational excellence in Australian schools*. Department of Education and Training. <https://docs.education.gov.au/node/50516>
- DuPaul, G. J., Eckert, T. L., & Vilaro, B. (2012). The effects of school-based interventions for attention deficit hyperactivity disorder: A meta-analysis 1996-2010. *School Psychology Review*, 41(4), 387-412. <https://doi.org/10.1080/02796015.2012.12087496>
- Dvorsky, M. R., & Langberg, J. M. (2016). A review of factors that promote resilience in youth with ADHD and ADHD symptoms. *Clinical Child and Family Psychology Review*, 19(4), 368-391. <https://doi.org/10.1007/s10567-016-0216-z>
- Efron, D., Nicholson, J. M., Anderson, V., Silk, T., Ukoumunne, O. C., Gulenc, A., Hazell, P., Jongeling, B., & Sciberras, E. (2020). ADHD at age 7 and functional impairments at age 10. *Pediatrics*, 146(5), e20201061. <https://doi.org/10.1542/peds.2020-1061>
- Efron, D., Sciberras, E., Anderson, V., Hazell, P., Ukoumunne, O. C., Jongeling, B., Schilpzand, E. J., Bisset, M., & Nicholson, J. M. (2014). Functional status in children with ADHD at age 6-8: A controlled community study. *Pediatrics*, 134(4), e992-e1000. <https://doi.org/10.1542/peds.2014-1027>
- Fleming, M., Fitton, C. A., Steiner, M. F. C., McLay, J. S., Clark, D., King, A., Mackay, D. F., & Pell, J. P. (2017). Educational and health outcomes of children treated for attention-deficit/hyperactivity disorder. *JAMA Pediatrics*, 171(7), e170691-e170691. <https://doi.org/10.1001/jamapediatrics.2017.0691>
- Garvey, W., O'Connor, M., Quach, J., & Goldfeld, S. (2020). Better support for children with additional health and developmental needs in school settings: Perspectives of education experts. *Child Care Health Development*, 46(4), 522-529. <https://doi.org/10.1111/cch.12766>
- Goodman, R. (2001). Psychometric properties of the strengths and difficulties questionnaire. *Journal of the American Academy of Child and Adolescent Psychiatry*, 40(11), 1337-1345. <https://doi.org/10.1097/00004583-200111000-00015>
- Goodman, R., Ford, T., Simmons, H., Gatward, R., & Meltzer, H. (2000). Using the strengths and difficulties questionnaire (SDQ) to screen for child psychiatric disorders in a community sample. *British Journal of Psychiatry*, 177, 534-539. <https://doi.org/10.1192/bjp.177.6.534>
- Goss, P., & Sonnemann, J. (2016). *Widening gaps: What NAPLAN tells us about student progress*. Grattan Institute. <https://grattan.edu.au/report/widening-gaps/>
- Gresham, F. M., Elliott, S. N., & Kettler, R. J. (2010). Base rates of social skills acquisition/performance deficits, strengths, and problem behaviors: An analysis of the social skills improvement system—rating scales. *Psychological Assessment*, 22(4), 809-815. <https://doi.org/10.1037/a0020255>
- Gubbins, V., & Otero, G. (2020). Determinants of parental involvement in primary school: Evidence from Chile. *Educational Review*, 72(2), 137-156. <https://doi.org/10.1080/00131911.2018.1487386>
- Guenther, J., Bat, M., & Osborne, S. (2013). Red dirt thinking on educational disadvantage. *The Australian Journal of Indigenous Education*, 42(2), 100-110. <https://doi.org/10.1017/jie.2013.18>
- Hall, C. L., Guo, B., Valentine, A. Z., Groom, M. J., Daley, D., Sayal, K., & Hollis, C. (2019). The validity of the strengths and difficulties questionnaire (SDQ) for children with ADHD symptoms. *Plos One*, 14(6), e0218518. <https://doi.org/10.1371/journal.pone.0218518>
- Hancock, K. J., Shepherd, C. C. J., Lawrence, D., & Zubrick, S. R. (2013). *Student attendance and educational outcomes: Every day counts*. Report for the Department of Education, Employment and Workplace Relations.
- Hughes, K. (2015). *Impact of student engagement on achievement and well-being*. <https://doi.org/10.13140/RG.2.1.2536.3684>
- Kao, G. S., & Thomas, H. M. (2010). Test review: C. Keith Conners, Conners 3rd edition Toronto, Ontario, Canada: Multi-health systems, 2008. *Journal of Psychoeducational Assessment*, 28(6), 598-602. <https://doi.org/10.1177/0734282909360011>
- Kent, K. M., Pelham, W. E., Jr., Molina, B. S. G., Sibley, M. H., Waschbusch, D. A., Yu, J., Gnagy, E. M., Biswas, A., Babinski, D. E., & Karch, K. M. (2011). The academic experience of male high school students with ADHD. *Journal of Abnormal Child Psychology*, 39(3), 451-462. <https://doi.org/10.1007/s10802-010-9472-4>
- Kirova, A. M., Kelberman, C., Storch, B., DiSalvo, M., Woodworth, K. Y., Faraone, S. V., & Biederman, J. (2019). Are subsyndromal manifestations of attention deficit hyperactivity disorder morbid in children? A systematic qualitative review of

- the literature with meta-analysis. *Psychiatry Research*, 274, 75–90. <https://doi.org/10.1016/j.psychres.2019.02.003>
- Lamb, S., Jackson, J., Walstab, A., & Huo, S. (2015). *Educational opportunity in Australia 2015: Who succeeds and who misses out*. <https://apo.org.au/node/58167>
- Langberg, J. M., & Becker, S. P. (2012). Does long-term medication use improve the academic outcomes of youth with attention-deficit/hyperactivity disorder? *Clinical Child and Family Psychology Review*, 15(3), 215–233. <https://doi.org/10.1007/s10567-012-0117-8>
- Langberg, J. M., Epstein, J. N., Altaye, M., Molina, B. S. G., Arnold, L. E., & Vitiello, B. (2008). The transition to middle school is associated with changes in the developmental trajectory of ADHD symptomatology in young adolescents with ADHD. *Journal of Clinical Child and Adolescent Psychology*, 37(3), 651–663. <https://doi.org/10.1080/15374410802148095>
- Langberg, J. M., Molina, B. S. G., Arnold, L. E., Epstein, J. N., Altaye, M., Hinshaw, S. P., Swanson, J. M., Wigal, T., & Hechtman, L. (2011). Patterns and predictors of adolescent academic achievement and performance in a sample of children with attention-deficit/hyperactivity disorder. *Journal of Clinical Child and Adolescent Psychology*, 40(4), 519–531. <https://doi.org/10.1080/15374416.2011.581620>
- Lawrence, D. (2016). Key findings from the second Australian child and adolescent survey of mental health and wellbeing. *Australian and New Zealand Journal of Psychiatry*. Advance online publication. <https://doi.org/10.1177/0004867415617836>
- Loe, I. M., & Feldman, H. M. (2007). Academic and educational outcomes of children with ADHD. *Ambulatory Pediatrics*, 7(1 Suppl), 82–90. <https://doi.org/10.1016/j.ambp.2006.05.005>
- LSAY. (2018). *Longitudinal surveys of Australian Youth (2018)*. About LSAY. <https://www.lsay.edu.au/aboutlsay>
- Massetti, G. M., Lahey, B. B., Pelham, W. E., Loney, J., Ehrhardt, A., Lee, S. S., & Kipp, H. (2008). Academic achievement over 8 years among children who met modified criteria for attention-deficit/hyperactivity disorder at 4–6 years of age. *Journal of Abnormal Child Psychology*, 36(3), 399–410. <https://doi.org/10.1007/s10802-007-9186-4>
- Merrell, C., Sayal, K., Tymms, P., & Kasim, A. (2017). A longitudinal study of the association between inattention, hyperactivity and impulsivity and children's academic attainment at age 11. *Learning and Individual Differences*, 53, 156–161. <https://doi.org/10.1016/j.lindif.2016.04.003>
- Norton, A., & Monahan, K. (2015). *The longitudinal study of Australian children: LSAC technical Paper No. 15. Wave 6 weighting and non-response*. <https://growingupinaustralia.gov.au/sites/default/files/tp15.pdf>
- O'Connor, M., Chong, S., Quach, J., & Goldfeld, S. (2020). Learning outcomes of children with teacher-identified emerging health and developmental needs. *Child Care Health Development*, 46(2), 223–231. <https://doi.org/10.1111/cch.12737>
- Rigoni, M., Blevins, L. Z., Rettew, D. C., & Kasehagen, L. (2020). Symptom level associations between attention-deficit hyperactivity disorder and school performance. *Clinical Pediatrics*. Advance online publication. <https://doi.org/10.1177/0009922820924692>
- Rowland, A. S., Skipper, B. J., Umbach, D. M., Rabiner, D. L., Campbell, R. A., Naftel, A. J., & Sandler, D. P. (2015). The prevalence of ADHD in a population-based sample. *Journal of Attention Disorders*, 19(9), 741–754. <https://doi.org/10.1177/1087054713513799>
- Rushton, S., Giallo, R., & Efron, D. (2019). ADHD and emotional engagement with school in the primary years: Investigating the role of student-teacher relationships. *British Journal of Educational Psychology*. Advance online publication. <https://doi.org/10.1111/bjep.12316>
- Sanson, A. V., Nicholson, J., Ungerer, J., Zubrick, S., Wilson, K., Ainley, J., Berthelsen, D., Bittman, M., Broom, D., Harrison, L., Sawyer, M., Silburn, S., Strazdins, L., Vimpani, G., Wake, M., & Rodgers, B. (2002). *Introducing the longitudinal study of Australian children*. Australian Institute of Family Studies.
- Sayal, K., Prasad, V., Daley, D., Ford, T., & Coghill, D. (2018). ADHD in children and young people: Prevalence, care pathways, and service provision. *The Lancet Psychiatry*, 5(2), 175–186. [https://doi.org/10.1016/S2215-0366\(17\)30167-0](https://doi.org/10.1016/S2215-0366(17)30167-0)
- Sciberras, E., Efron, D., Schilpzand, E. J., Anderson, V., Jongeling, B., Hazell, P., Ukoumunne, O. C., & Nicholson, J. M. (2013). The children's attention project: A community-based longitudinal study of children with ADHD and non-ADHD controls. *BMC Psychiatry*, 13(1), 18. <https://doi.org/10.1186/1471-244X-13-18>
- Sciberras, E., Streatfeild, J., Ceccato, T., Pezzullo, L., Scott, J. G., Middeldorp, C., Hutchins, P., Paterson, R., Bellgrove, M., & Coghill, D. (2020). Social and economic costs of attention-deficit/hyperactivity disorder across the lifespan. *Journal of Attention Disorders*. Advance online publication. <https://doi.org/10.1177/1087054720961828>
- Shaffer, D., Fisher, P., Lucas, C. P., Dulcan, M. K., & Schwab-Stone, M. E. (2000). NIMH diagnostic interview schedule for children version IV (NIMH DISC-IV): Description, differences from previous versions, and reliability of some common diagnoses. *Journal of the American Academy of Child & Adolescent Psychiatry*, 39(1), 28–38.
- Silva, D., Colvin, L., Glauert, R., Stanley, F., Srinivasjois, R., & Bower, C. (2015). Literacy and numeracy underachievement in boys and girls with ADHD. *Journal of Attention Disorders*. Advance online publication. <https://doi.org/10.1177/1087054715596575>
- Soloff, C., Lawrence, D., & Johnstone, R. (2005). *LSAC technical paper no. 1: Sample design*. <https://growingupinaustralia.gov.au/sites/default/files/tp1.pdf>
- Stanley, D. J., & Spence, J. R. (2014). Expectations for replications: Are yours realistic? *Perspectives on Psychological Science*, 9(3), 305–318. <https://doi.org/10.1177/1745691614528518>
- StataCorp. (2017). *Stata statistical software: Release 15*. StataCorp.
- Washbrook, E., Propper, C., & Sayal, K. (2013). Pre-school hyperactivity/attention problems and educational outcomes in adolescence: Prospective longitudinal study. *British Journal of Psychiatry*, 203(4), 265–271. <https://doi.org/10.1192/bjp.bp.112.123562>
- Wilder, S. (2014). Effects of parental involvement on academic achievement: A meta-synthesis. *Educational Review*, 66(3), 377–397. <https://doi.org/10.1080/00131911.2013.780009>
- Willcutt, E. G. (2012). The prevalence of DSM-IV attention-deficit/hyperactivity disorder: A meta-analytic review. *Neurotherapeutics*, 9(3), 490–499. <https://doi.org/10.1007/s13311-012-0135-8>
- Yamamoto, Y., & Holloway, S. D. (2010). Parental expectations and children's academic performance in sociocultural context.

Educational Psychology Review, 22(3), 189–214. <https://doi.org/10.1007/s10648-010-9121-z>

Zendarski, N., Sciberras, E., Mensah, F., & Hiscock, H. (2017a).

Academic achievement and risk factors for adolescents with attention-deficit hyperactivity disorder in middle school and early high school. *Journal of Developmental & Behavioral Pediatrics*, 38(6), 358–368. <https://doi.org/10.1097/dbp.0000000000000460>

Zendarski, N., Sciberras, E., Mensah, F., & Hiscock, H. (2017b).

Early high school engagement in students with attention/deficit hyperactivity Disorder. *British Journal of Educational Psychology*, 87(2), 127–145. <https://doi.org/10.1111/bjep.12140>

Author Biographies

Nardia Zendarski is a research fellow at the Department of Paediatrics, the University of Melbourne and is an honorary researcher at the Murdoch Children's Research Institute. She is involved in research investigating ways to improve outcomes for children with ADHD.

Shuaijun Guo is a postdoctoral fellow for the Policy and Equity Group at the Murdoch Children's Research Institute and is an honorary researcher at the Department of Paediatrics, the University of Melbourne. His research experience and interest focus on health literacy and health inequities in children and adolescents.

Emma Sciberras works in the School of Psychology at Deakin University. She leads a research program focused on understanding developmental trajectories for children with ADHD and developing interventions that can improve outcomes for children with ADHD. She is also an honorary research fellow at the Murdoch Children's Research Institute and a clinical psychologist.

Daryl Efron is a consultant paediatrician at the Royal Children's Hospital, Melbourne, and Clinician Scientist Fellow at Murdoch

Children's Research Institute. His research interests include longitudinal outcomes in ADHD, psychopharmacology and models of care for children with development and mental health disorders.

Jon Quach is a senior lecturer within the Melbourne Graduate School of Education at the University of Melbourne, and is co-director of the Centre for Program Evaluation. His research focuses on the interface between health and education systems, aiming to understand how to leverage the two systems to better support the development and mental health outcomes of young children.

Leanne Winter: Is a research fellow for the Australian ADHD Professionals Association (AADPA) and a research project coordinator at the Child Health Research Centre, the University of Queensland. Her research interests include improving outcomes for children with mental health challenges, parenting and child behaviour.

Matthew Bisset is a research fellow at the School of Psychology, Deakin University, an associate researcher at Murdoch Children's Research Institute and psychologist at The Royal Children's Hospital. His research and clinical work focuses on improving mental health outcomes for young people.

Christel M. Middeldorp is a professor of child and youth psychiatry, a conjoint position at the Child Health Research Centre, The University of Queensland, and the Child and Youth Mental Health Service, Children's Health Queensland Hospital and Health Service. Her research focuses on factors associated with outcome of children with mental disorders, including neurodevelopmental disorders, and the development of targeted treatment to improve their outcomes.

David Coghill is the Financial Markets Foundation Chair of Developmental Mental Health in the Departments of Paediatrics and Psychiatry at the University of Melbourne. He is a child and adolescent psychiatrist with a strong research interest in ADHD and related disorders.