Early Pathways to School Learning

Lessons from the NT data linkage study

Summary Findings

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SUMMARY FINDINGS

1. Introduction

This document summarises selected findings from the Northern Territory (NT) Data Linkage Study which are reported in full detail in the research monograph *Early Pathways to School Learning: Lessons from the NT Data Linkage Study (Silburn et al. 2018) which is available online at* http://ccde.menzies.edu.au.

The study was undertaken as a collaboration between the Menzies School of Health Research, the NT departments of Health, Education and Territory Families, and the Aboriginal Medical Services Alliance Northern Territory (AMSANT). This was jointly funded by the NT Government and a National Health and Medical Research Council Partnership Grant (NHMRC No. 1091491) *"Improving the developmental outcomes of Northern Territory children: a data linkage study to inform policy and practice in health, family services and education".*

The study findings provide a comprehensive new source of population-level evidence regarding the early life determinants of NT children's development and school learning. The study involved the linkage and analysis of administrative information usually held separately by different government departments. These data follow children's history of contact with different services to provide a holistic, life course perspective on some of the key drivers of their early health, development, school learning and other outcomes. They have important policy value in being used to inform, prioritise, and coordinate government and community services to better enable all NT children to have the best possible start in life, and for Aboriginal and non-Aboriginal children to have more equitable developmental outcomes.

2. Methodology

The study design, analysis and reporting of findings have sought to address the concerns of Indigenous scholars and communities regarding cultural bias and adverse policy outcomes which can result from simplistic use of Indigenous administrative data.

The study population comprised all children born in the NT between 1994 and 2013 who had an administrative record in one or more of the datasets from which data were provided for record linkage and de-identified analysis. These datasets include NT Perinatal Trends 1994–2013; NT Immunisation 1994–2014; NT Hospital Inpatient Activity 1994–2014, NT Department of Education—Student Activity 2005–2014; National Assessment Program for Literacy and Numeracy (NAPLAN) 2008–2014; and Australian Early Development Census (AEDC) 2009/10 and 2012.

A single dichotomous variable was used to define Aboriginal status for data concerning Aboriginal and Torres Strait Islanders, given the relatively small number of NT residents who are Torres Strait Islanders and that most of these also identify as Aboriginal. In assembling and preparing the datasets for analysis, the research team gave particular attention to investigating how best to define Aboriginal status for each of the various analyses required in the study. Also, as variation in this may have been recorded at different times or between datasets, special steps were taken to reduce this potential source of bias which might lead to under-reporting. This involved investigating the consistency and completeness of Aboriginal status recording in each of the datasets, and then ranking them in order of their concordance with the NT Department of Health datasets, which had the most complete and consistent recording. These rankings were then used to create an 'algorithm' (i.e. rule) for defining the most consistent Aboriginal status variable to be used in the study's longitudinal analyses.

All statistical analyses were conducted using the statistical software STATA 14. The large study population and comprehensive scope of data available enabled these investigations to be informed by an eco-epidemiological, life span, human development conceptual framework.

3. Early life health and development

The study's description of changes in NT children's early life health and development over the period 1994–2013 provides epidemiological perspective on the study population and a baseline against which progress can be benchmarked. This also identified some important emerging service needs.

Live births and fertility rates: The overall rates of all NT live births increased between 2004 and 2013, but Aboriginal births showed a significant decreasing trend with an average of 1.7% fewer births each year. This decrease was most notable among Aboriginal mothers aged 20–34 years, who account for around two thirds of Aboriginal births. Importantly, teenage birth rates for Aboriginal and non-Aboriginal mothers have both shown encouraging decreasing trends (Figure 3.1). However, the decreasing total fertility rate (TFR) for Aboriginal women is of some concern. By 2013 it was the lowest on record, and close to the replacement rate of the average 2.1. This has important implications for population sustainability, and for projections of the NT's future population which are needed for planning services and social policy.

Figure 3.1 Teenage births: NT 1994–2013

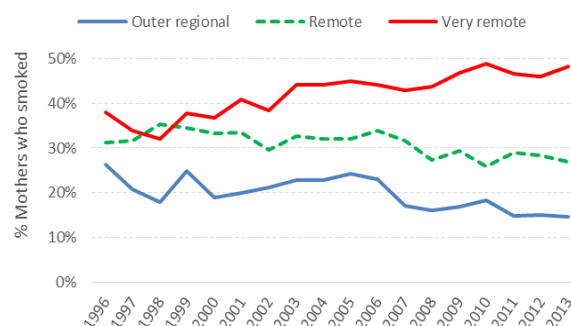**Figure 3.3 Smoking in pregnancy: NT 1994–2013**
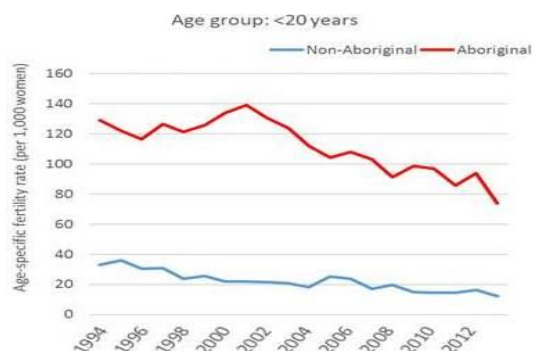
Alcohol use in pregnancy: Figure 3.2 shows the steady reduction in the proportion of women reporting alcohol consumption during pregnancy by region. Despite the overall reduction, the higher rates in remote and very remote areas reflect the relatively higher alcohol consumption of Aboriginal women in these areas. This poses increased risks for Fetal Alcohol Spectrum Disorders (FASD). Because alcohol can have a harmful effect before a woman knows she is pregnant, this is a further reason why alcohol control measures which reduce community rates of alcohol consumption are considered one of the most effective ways of reducing the risk of FASD. These measures should be implemented in conjunction with preventive health education programs, and routine screening of alcohol use in the health service contacts of all women of reproductive age.

Figure 3.2 Alcohol use in pregnancy: NT 1994–2013
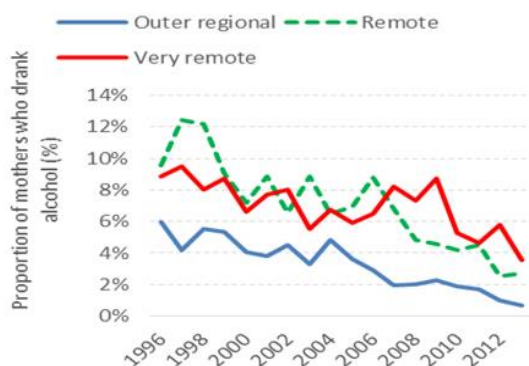
Smoking in pregnancy: While there has been an encouraging decrease in the overall proportion of women reporting they smoked during pregnancy, this is largely due to the improvements for those living in outer regional and remote areas. As can be seen in Figure 3.3, this is contrasted by the steadily increasing rates evident in very remote areas. Of particular concern is that by 2013 around 50% of NT Aboriginal mothers reported they smoked before and after 20 weeks gestation. Reducing these rates and improving community awareness of how smoking in pregnancy increases the risk of low birthweight and adverse childhood developmental and behavioural outcomes, should be key prevention priorities.

Antenatal care: The proportion of women accessing antenatal health care in their first trimester of pregnancy has steadily improved for both Aboriginal and non-Aboriginal women. Despite these increasing trends, it is of concern that up to 40% of Aboriginal mothers did not present for antenatal care in the first trimester, and that up to 30% of Aboriginal women attended less than the recommended seven antenatal visits during pregnancy.

Preterm birth: The rate of Aboriginal preterm births increased from 14.1% to 15.2% between 1996 and 2013, while the non-Aboriginal rate decreased from 7.1% to 6.7%.

Low birthweight: Rates of low birthweight (LBW) among Aboriginal and non-Aboriginal babies showed little change over the study period. However, for births to mothers in very remote areas, the rates of LBW showed a significant increasing trend with rates averaging 5.8% higher than Aboriginal babies in outer regional areas.

Perinatal mortality: Between 1994 and 2013 the annual perinatal mortality rate of Aboriginal babies reduced from 33.5 to 24.9 per 1,000 births, while non-Aboriginal mortality reduced from 12.6 to 10.0 per 1,000 births.

Hospitalisations: Over the study period, the rates of all-episode hospitalisations of children aged 0–4 years were 2.4 to 3.0 times higher for Aboriginal children than for non-Aboriginal children. The Aboriginal rate fell from 568 per 1,000 in 2001 to an all-time low of 432 per 1,000 in 2006, but then increased again reaching 518 per 1,000 by 2013. Hospital admission for more serious illnesses requiring intensive care decreased significantly for Aboriginal children, falling from 6 per 1,000 in 2001 to 2.5 per 1,000 in 2013.

Figure 3.4 Injury hospitalisations: NT 2001-2013

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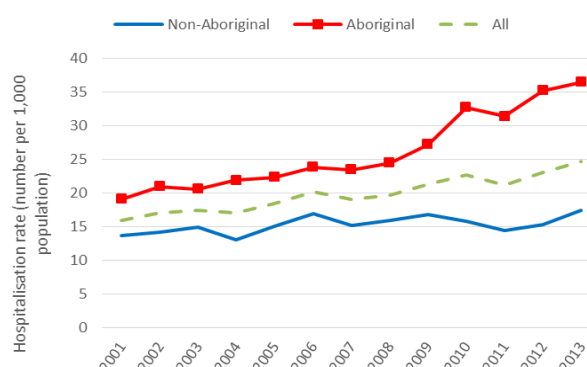
Hospitalisations for injuries increased for Aboriginal children from 19.1 to 36.5 per 1,000 between 2001 and 2013, and non-Aboriginal rates also increased from 14.2 to 17.5 per 1,000 over the same period (Figure 3.4).

Hospital admissions for acute lower respiratory infections (ALRI) among Aboriginal children aged 0–4 years decreased from 136 per 1,000 in 2001 to 100 per 1,000 by 2013, while the rates for non-Aboriginal children were relatively constant around 18.5 per 1,000 over the same period.

Early childhood development: The AEDC assessment of NT Aboriginal children commencing school in 2012 showed encouraging improvements on the equivalent 2009 AEDC developmental assessments. These improvements were most notable for Aboriginal children in very remote areas and were also the largest recorded for all states and territories. Non-Aboriginal children showed little change between their 2009 and 2012 AEDC assessments. Despite these improvements, the high proportion of Aboriginal children in remote and very remote areas assessed as being 'developmental vulnerable' on two or more AEDC domains are of particular concern. Without special learning and language support, these children are at high risk of not making a successful transition into school learning.

4. Early life factors associated with childhood development

Regression modelling was undertaken to investigate which early life factors were most strongly associated with children's developmental outcomes assessed in the 2009 and 2012 AEDC; and how these associations differed for Aboriginal and non-Aboriginal children, and between different geographical areas of the NT.

The initial regression modelling with the whole study cohort included Aboriginal status as one of the covariates. This found that Aboriginal status had no significant independent effect as a predictor of AEDC developmental vulnerability on one or more AEDC domains once the effects of the other covariates were taken into account. In other words, the main influences predicting children's developmental outcome were their experiences of early life health and sociodemographic factors—regardless of their Aboriginal or non-Aboriginal status.

Figure 4.1 shows findings from the regression modelling conducted separately for Aboriginal and non-Aboriginal children to identify the predictive factors most strongly associated with children being developmentally on-track. The bars in the chart indicate the increased likelihood (adjusted odds ratio) associated with each factor.

In a similar fashion, Figure 4.2 describes the increased likelihood of children being developmentally vulnerable on one or more AEDC domains for each of the predictive factors having a significant independent association with this AEDC outcome.

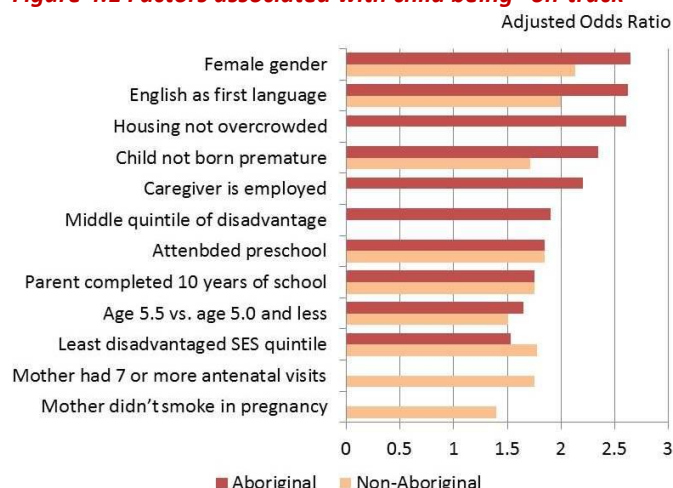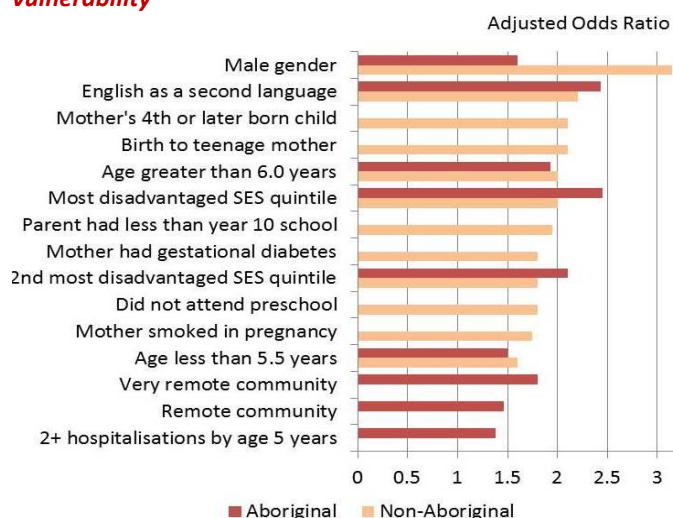*Figure 4.1 Factors associated with child being "on-track "*

*Figure 4.2 Factors associated with developmental vulnerability*

5. School attendance

The study next investigated the patterns of school attendance in urban, remote and very remote communities, and the factors predictive of attendance of Aboriginal and non-Aboriginal students. The findings point to a number of potentially modifiable factors which policy could address to improve school attendance.

Students' annual rates of school attendance: This varies markedly for Aboriginal and non-Aboriginal students over the years of their school career and also varies according to their school's level of remoteness. In Figure 5.1 it can be seen that attendance rates decline from Year 6 onward for both Aboriginal and non-Aboriginal students. Attendance rates for Aboriginal students in very remote areas in Year 11 and 12 remain at 40%. In contrast, attendance rates in Year 12 for Aboriginal students in outer regional and remote schools increase again to reach almost the same levels of school attendance of non-Aboriginal students. This could be due to the drop in enrolments of Aboriginal children after the age of compulsory schooling and that the Aboriginal students who then remain in school are those most likely to have been regular attenders throughout their school career.

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Figure 5.1 Annual attendance rates by school year
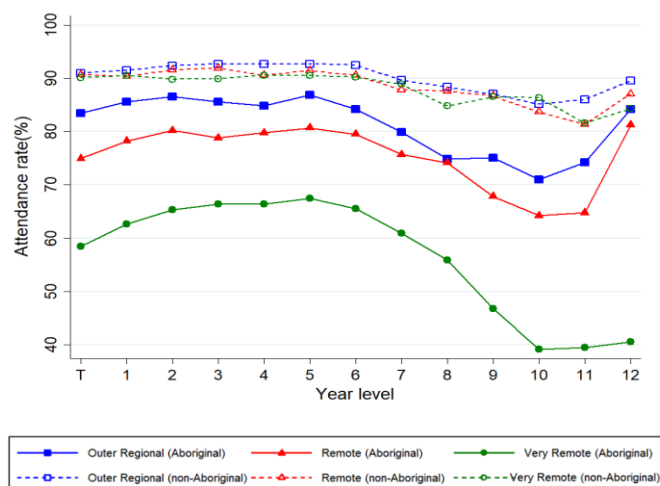
Weekly attendance rates by school year: The variation in weekly attendance rates of students in Years 1–3 for each of the 10 weeks of the four terms of the school year are shown in Figure 5.2. The overall pattern of attendance for Aboriginal and non-Aboriginal students within each school term was essentially the same, regardless of the school's geographic remoteness. Attendance rates are substantially lower in the first and last weeks of each school term, and are also lower for Aboriginal students in very remote locations in the third and fourth quarter of the year.

**Figure 5.2 Weekly attendance rates: Years 1–3**
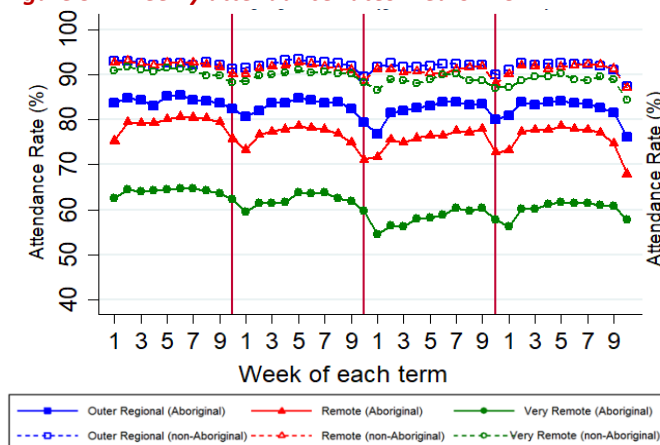
Similar patterns of weekly attendance are also evident for most of the later years of schooling. However, for Aboriginal students in very remote areas, weekly attendance drops markedly in the middle school years, e.g. just 60% in the first quarter of Years 7–9, but less than 50% in Year 10. Furthermore, attendance of Year 10 Aboriginal students falls to 40% in Terms 3 and 4. Possible reasons for the extent of this drop in attendance in Terms 3 and 4 could reflect seasonal patterns of mobility and cultural activities in different parts of the NT.

Factors associated with school attendance: Because other Australian studies have found that enduring patterns of attendance are established very early in a child's school career, special attention was given to identifying the relative importance of factors associated with Year 1 school

attendance. For Aboriginal students, multivariate regression modelling identified no less than 11 predictor variables having a significant independent association with Year 1 attendance. This highlights the extent to which multiple aspects of disadvantage influence school attendance. The predicted additional (or fewer) days of school attendance attributable to these factors in a typical school year for Aboriginal students is shown below in Figure 5.3.

Figure 5.3 Predicted effect of selected factors on Year 1 school attendance for Aboriginal students
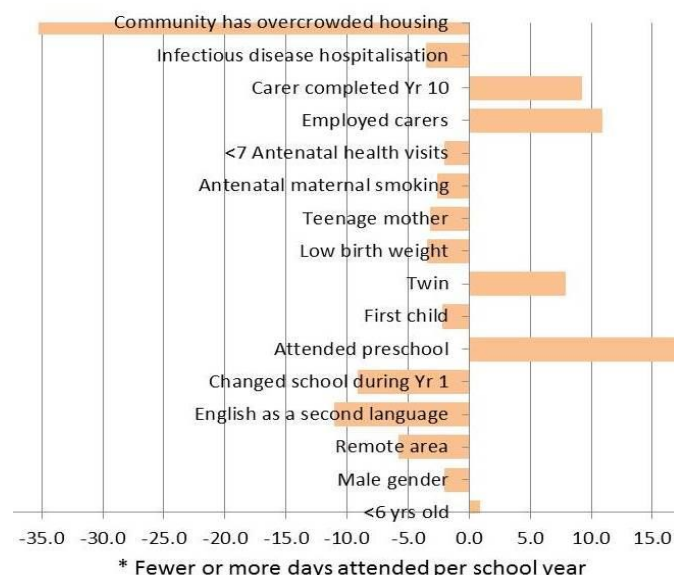
An Aboriginal student with just four of these factors (e.g. overcrowded housing, mobility between schools, English as a second language (ESL) and living in a very remote community) would thus be likely to have attended 61 fewer days over the school year, than a student with none of these factors.

Early childhood development and attendance: Investigation was made of the association between children's Year 1 school attendance and their early development outcomes assessed in the 2009 and 2012 AEDC. Children's AEDC scores are considered a reliable indication of their readiness for formal schooling (Australian Government Department of Education and Training 2015). Children are assessed by teachers using the AEDC online checklist early in their first year of compulsory education—usually around age 5 years.

Linear regression modelling was performed to establish unadjusted estimates of each included covariate's association with the outcome measure. It was followed by multivariable regression modelling performed with adjustment for school fixed effect to produce the adjusted estimation of association at the level of schools. Potential confounding and influence coming from other factors was controlled by retaining a number of factors based on past literature in the adjusted model. They included the child's age in months at the time of AEDC; gender; ESL; student mobility (a derived dichotomous variable on whether the child had attended two or more schools in Year 1); percentage of preschool days attended; history of low birthweight; whether born to a teenage

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mother; parent/carer's employment status; and parent/carer's educational status.

Figure 5.4 summarises the findings from the fully adjusted model regarding the expected reduction in days of Year 1 school attendance associated with specific aspects of developmental vulnerability measured by the AEDC.

Figure 5.4 Reduction in school days attended associated with AEDC developmental vulnerability indicators
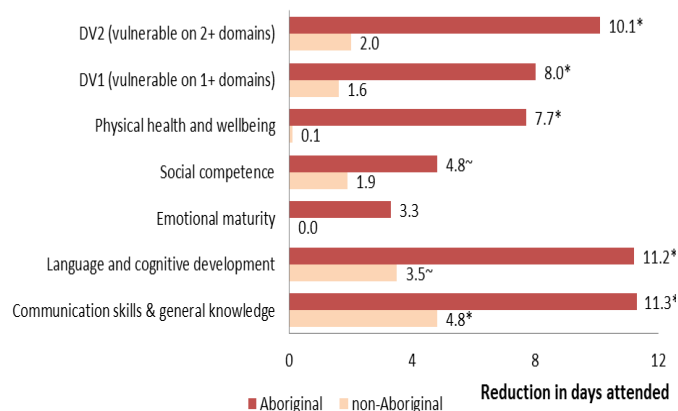
* Statistical significance of the association at the 0.1% level (p < 0.001)
~ Statistical significance of the association at the 1.0% level (p < 0.01)

This analysis found there was little difference between the attendance rates of non-Aboriginal students assessed as 'developmentally on track' and those who were 'developmentally vulnerable' on each of the AEDC scores. However, for Aboriginal students, the attendance of students assessed as 'developmentally vulnerable' was generally lower than for those considered 'developmentally on track'. This was particularly evident for the AEDC scores on the 'language and cognitive skills' domain (median school attendance rate of 65.3% vs 82.7%) and 'communication skills and general knowledge' domain (66.3% vs 80.1%).

6. Preschool participation, school attendance and academic achievement

The next stage of the study involved an investigation of the following research questions: a) Is any level of preschool attendance associated with improved early years (Transition to Year 3) school attendance? b) How much is a child's level ('dose') of preschool attendance associated with their subsequent early years (EY) school attendance, and; c) Does the type of preschool attended in remote NT areas moderate the relationship between preschool attendance and EY school attendance?

A statistical model was used to estimate the relationships of interest (McCullagh and Nelder 1989), which are presented schematically in Figure 6.1. In this model, β (beta) measures the association between preschool attendance and EY primary school attendance. For the model to be robust, it needs to take account of potential confounders, e.g. factors at the school, community, family or individual level which are

not in the pathway specified in the model, but which may have influenced either the child's likelihood of attending preschool or the likelihood of the child's EY primary school attendance, or both. Unfortunately, the analysis dataset did not include school-level information on school and teaching quality factors such as teacher/staff /student ratios, school/community relations, available resources, and peer group effects that are school district-specific. However, it is possible to statistically control for the combined effect of these unmeasured school-specific factors. This was done by including a 'fixed effects' indicator variable specific to each school which could operate as a proxy for these unmeasured factors.

Figure 6.1 Theoretical model investigated
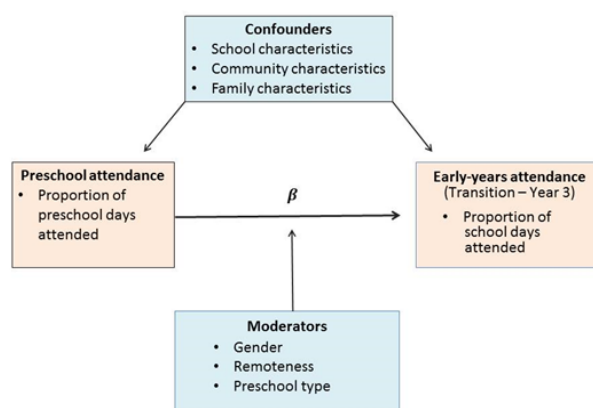
After adjusting for all possible confounders, the analysis found that Aboriginal children who attended any form of preschool went on to attend an average of 4.5% or 12 more days per school year than those who had not attended preschool. However, in very remote areas, where Aboriginal EY attendance is around 60%, the 4.6% increase associated with preschool attendance is equivalent to 15 additional days of school per year; and in outer regional areas where the average Aboriginal EY attendance is 82%, this would be associated with 11 more days of school attended per year.

Does the type of preschool make a difference? The analysis also found that Aboriginal children attending any of the three types of preschool provided in very remote areas of the NT (i.e. general preschools, early years classes, and mobile preschools) had a significant positive association with EY school attendance. On average, the children who attended a general preschool attended 22 more school days per year, those who attended an early years class attended 13 more days of school per year, and those who attended a mobile preschool attended 11 more days of school per year.
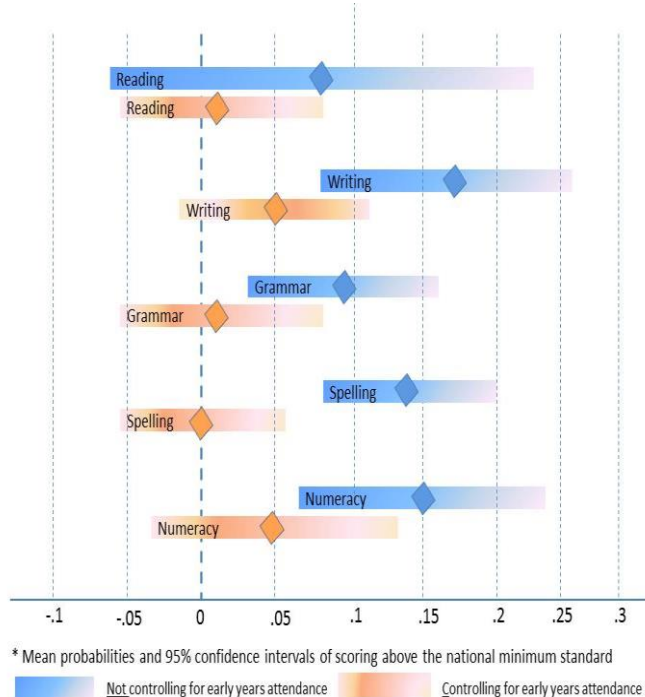
Does the level of preschool attendance matter? The next stage of the analysis modelled the percentage improvements in EY school attendance that could theoretically be expected from different levels of preschool attendance (i.e. ranging from 0% to 100%). This found that in comparison with the other types of preschool, the general preschool model offered the greatest potential impact in increasing children's expected days of school attendance.

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In practical terms, this modelling for Aboriginal children in very remote areas found that a minimum preschool attendance level of 45% was needed for children to achieve the population average school attendance of 62%. The corresponding minimum preschool attendance in the other forms of preschool needed for average school attendance was 55% for early year classes, and 65% for mobile preschools.

Preschool attendance and NAPLAN outcomes: Finally, we estimated the potential benefits of increasing Aboriginal children's preschool attendance for later Year 3 NAPLAN outcomes of a subsample of 1,788 Aboriginal children living in very remote areas for whom data were available for their NAPLAN scores, preschool and EY school attendance. After adjusting for the same control variables and school fixed effects described in the preceding analysis, the analysis calculated the marginal effects of the model at the mean of all control variables to estimate their effect on the probability of a student scoring above the NAPLAN national minimum standard (NMS).

Figure 6.2 presents the hypothetical effect on student's NAPLAN outcomes of increasing their preschool attendance from 0% to 100%. The blue horizontal bars show that such an increase in preschool attendance would be associated with significant increases in the probabilities of scoring above the NMS on four out of five Year 3 NAPLAN domains (i.e. their confidence intervals do not span zero). However, the orange horizontal bars then indicate that these probabilities would reduce and become non-significant when the analysis also controls for the effect of students' EY school attendance (i.e. over the school years from Transition to Year 3).

Figure 6.2 Marginal probability effect* of increasing preschool attendance on Year 3 NAPLAN outcomes

* Mean probabilities and 95% confidence intervals of scoring above the national minimum standard

Not controlling for early years attendance   Controlling for early years attendance

This shows that while preschool attendance is clearly associated with better EY school attendance, it is not associated with NAPLAN achievement over and above the effects of EY school attendance. This has the important implication that the immediate school learning benefits of increasing preschool attendance are likely to be lost unless there is a commensurate improvement in children's EY school attendance.

7. Summary and conclusions

The study findings first and foremost demonstrate the extent to which sociocultural and economic circumstances influence all children's early health, development and learning, and why it is essential that current efforts to improve school attendance and achievement also focus on addressing the known early determinants of these outcomes.

They also highlight the extent to which children's development and school learning is underpinned by their health status—particularly in early life and throughout childhood.

The findings demonstrate the significant benefits of preschool and the necessity of children attending preschool regularly. This suggests that improving children's access to, and participation in, preschool is one of the best immediately available strategies for improving the NT's concerning rates of Aboriginal school attendance and achievement.

At the same time, it is evident that the initial benefits of preschool can easily 'fade out' unless they are reinforced by regular attendance and effective engagement with school learning in the early years of primary school. This underscores the necessity of that policy and services supporting children's transition into formal school learning extending through to at least Year 3.

The findings are consistent with other research in identifying critical transition points in children's school careers which are opportunities for leveraging better outcomes: a) from preschool to Year 1—especially for Aboriginal students through targeted additional learning and language support, and; b) from Year 6 to Year 7—through middle school programs which maintain student's engagement and facilitate their retention in high school and further learning.

In conclusion, the overall findings strongly support the direction and potential benefits of the NT Government's recent investment of $35.6 million over four years to implement a whole-of-government plan in collaboration with community organisations to improve early childhood services and the lives of Territorian children (Northern Territory Government 2018). They validate the plan's emphasis on developing a more integrated and place-based approach to the planning and delivery of universal and targeted services to young children and their families. They also provide a baseline against which many of the plan's short- and longer-term performance outcomes could be monitored.

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