

Exploring risk profiles of young people with self-harm hospital admissions in the Northern Territory

**Bernard Leckning
Gary Robinson
Steven Guthridge
Vincent He**

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A Child and Youth Development Research Partnership Project

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Executive summary

The Child and Youth and Development Research Partnership (CYDRP) is an agreement between Menzies School of Health Research and the NT Government to develop research infrastructure capable of exploring important determinants of health and social outcomes for NT children and youth. This study was commissioned, within the partnership agreement, as a first step towards investigating risks and outcomes associated with self-harm. It uses linked administrative data available within the CYDRP data repository to describe the characteristics of and pathways leading to hospital admission involving self-harm by young people to inform options for further research and improved targeting of preventive interventions.

The study population

Self-harm in young people is not only a maladaptive response to acute life stressors or mental illness, but it is one of the strongest predictors of subsequent suicide. Better understanding the characteristics of those who self-harm and what the opportunities are for prevention are vital to improving a range of outcomes for young Territorians.

Within the CYDRP repository, containing data on all NT children born between 1994 and 2014, 392 young people were identified in 509 hospital admissions involving self-harm between 2001 and 2017.

This report focuses on investigating the characteristics of these young people at the time of first episode of self-harm (FESH) admission to hospital and risk pathways leading to this event that could form the basis of clinical and social risk profiles of self-harm by young people in the NT. The development of these profiles can inform place-based and context-sensitive early intervention and prevention services and improve hospital assessment, management and preventive follow-up of young people admitted to hospital as a result of self-harm.

Characteristics of young people at first episode of self-harm hospital admission

- In this study population, FESH admissions peaked in late adolescence, with self-poisoning accounting for most of the hospital admissions, followed by self-cutting and then hanging.
- Young Aboriginal people make up over half of the FESH admissions.
- The characteristics of young Aboriginal people at FESH admission are distinct in that they differ from those of their non-Aboriginal counterparts, whose characteristics more closely resemble the profile of self-harm in the overall Australian population of young people.
- FESH admissions by young Aboriginal people are almost equally likely to be male or female, whilst FESH by young non-Aboriginal people are more likely to be female.

- At FESH admission, young Aboriginal people were more likely to be remote residents (although a sizeable proportion reside in urban areas), make use of self-cutting and hanging as methods of self-harm (although a sizeable proportion of self-poisoning exists), use potentially more lethal methods of self-harm and be diagnosed with comorbid substance misuse.
- Young non-Aboriginal people were more likely to be female, urban residents, use self-poisoning or self-cutting and to be diagnosed with depressive symptoms and anxiety disorders at FESH admission.
- Whilst characteristics of young non-Aboriginal people did not differ significantly by method at FESH admission, there were notable differences between young Aboriginal people: hanging was more strongly associated with remote residence and living in the Top End of the NT; self-cutting was predominantly a Central Australian phenomenon; and self-poisoning was more strongly associated with being female and urban residence.

Risk pathways associated with first episode of self-harm hospital admission

The findings in this section describe associations between different risk pathways and characteristics of young people at FESH admission to explore possible risk factors and opportunities for prevention. Risk pathways were identified by linking individuals with a self-harm hospital admission to their records of prior service contacts (e.g. health, educational, welfare services) in linked administrative datasets within the CYDRP data repository.

Early life health and adversity risk pathways

- No distinguishing early life health and adversity indicators were found that were clearly associated with characteristics of young people at FESH admissions.
- However, the high prevalence of early life health and adversity factors within the study population reinforces the need for early childhood interventions to reduce risks and promote healthy development.

Risk pathways indicating recent life stress and increasing psychological difficulties

- Just over 60% of young people were disengaged from school in the year prior to FESH admission.
- Just over 30% of young people in the study also had a recent prior hospital admission, and this was more likely for females, urban residents and those in older age groups at the time of FESH admission.
- Frequent hospital admissions in the year prior to FESH admission may be indicative of underlying morbidities or a lack of access to appropriate primary and specialist health care.

- Prior hospital admissions involving alcohol misuse were more commonly associated with young Aboriginal people in the study. This may represent an opportunity for early identification and reduction of risk associated with harmful use of alcohol.
- Although no particular characteristics of young people at FESH admission appear to be associated with recent prior child protection involvement, the high proportion of cases with child protection histories suggest these reports represent an opportunity for targeted preventive interventions in this high-risk population.
- The characteristics of young people at FESH admission associated with recent youth justice involvement highlights the extent to which there is overlap between young people at risk of subsequent suicide and youth justice involvement.

Implications for prevention and further research

The findings of this exploratory study provide support for a life course view of self-harm and its prevention by pointing to the prevalence of various risk pathways and their associations with different characteristics of FESH admissions. The risk pathways explored in this report provide important clarification of contextual influences of self-harm and related opportunities for prevention. The constraints of the current datasets also point to areas in which further development of potentially available clinical and administrative data would facilitate more comprehensive research.

Implications for prevention

- This study confirms the importance of early childhood and early- to mid-adolescence as targets for preventive early intervention to reduce risks associated with self-harm.
- Findings suggest that an early intervention approach to prevention should consist of a mix of universal and indicated programs for school-aged children. These may include measures to engage children who are becoming disengaged from school, combined with universal school-based social and emotional learning programs and/or indicated therapeutic interventions for those at identifiable risk.
- Prevention of self-harm should be embedded within early intervention initiatives that target young children with notifications for maltreatment.
- The findings also highlight the need for preventive interventions targeting young people involved with the child protection and youth justice systems that address a range of psychosocial risks and unmet health needs.

Further research and development

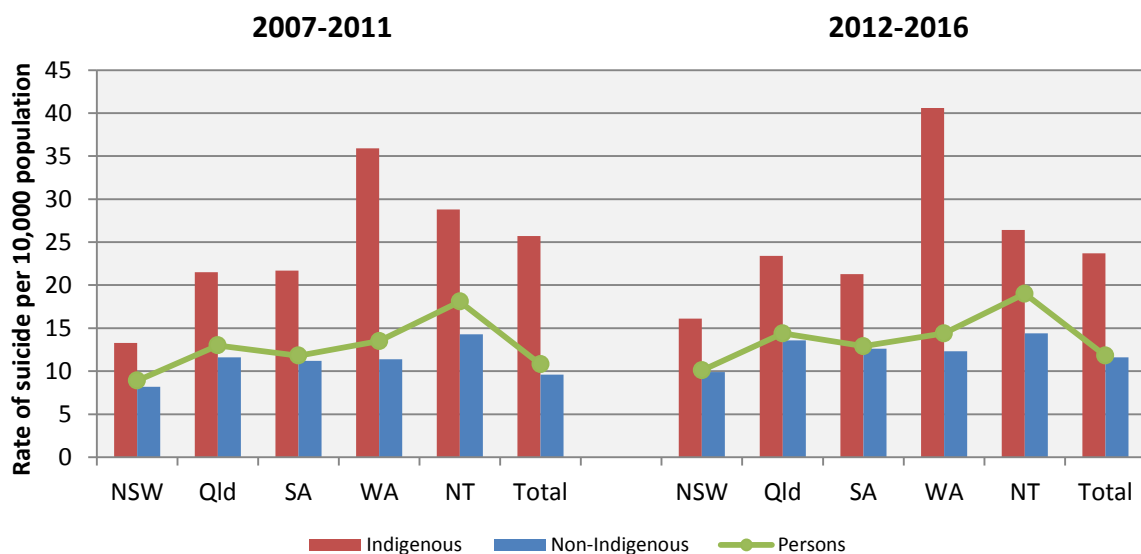
- Further investigation of the risk factors and pathways of self-harm hospital admissions amongst all young residents of the NT could provide clearer guidance for hospital assessments to improve their sensitivity to contextual influences and variations in risk associated with hospital admissions involving self-harm.
- A retrospective case-control study would help to establish the extent to which the various risk factors identified in this exploratory analysis have a causal influence.

- The development of data linkage capacity for including data on family members would enable the modelling of family risks, vulnerabilities and protective factors associated with self-harm and other child and youth outcomes.
- Expansion of the CYDRP data repository to include linked records on adults up to at least 35 years of age would facilitate investigation of the risks of self-harm and suicide through a key period of risk in adolescence and young adulthood.
- An exploratory audit of coronial files of deaths by suicide and other related external causes would assist the formulation of more clearly defined lines for further enquiry and help identify critical indicators for larger-scale controlled studies of suicide deaths in the NT.

1 Introduction

The high rates of suicide and self-harm in the NT's Aboriginal population represent a public health crisis that has received considerable public policy attention in recent years. Rates of suicide in the NT have been rising since the 1980s¹ and remain consistently higher compared to most other jurisdictions since 2001 (Figure 1).^{2,3}

Figure 1 Rates of suicide in NSW, Queensland, South Australia, Western Australia and Northern Territory by Indigenous status, 2007–2011 and 2012–2016

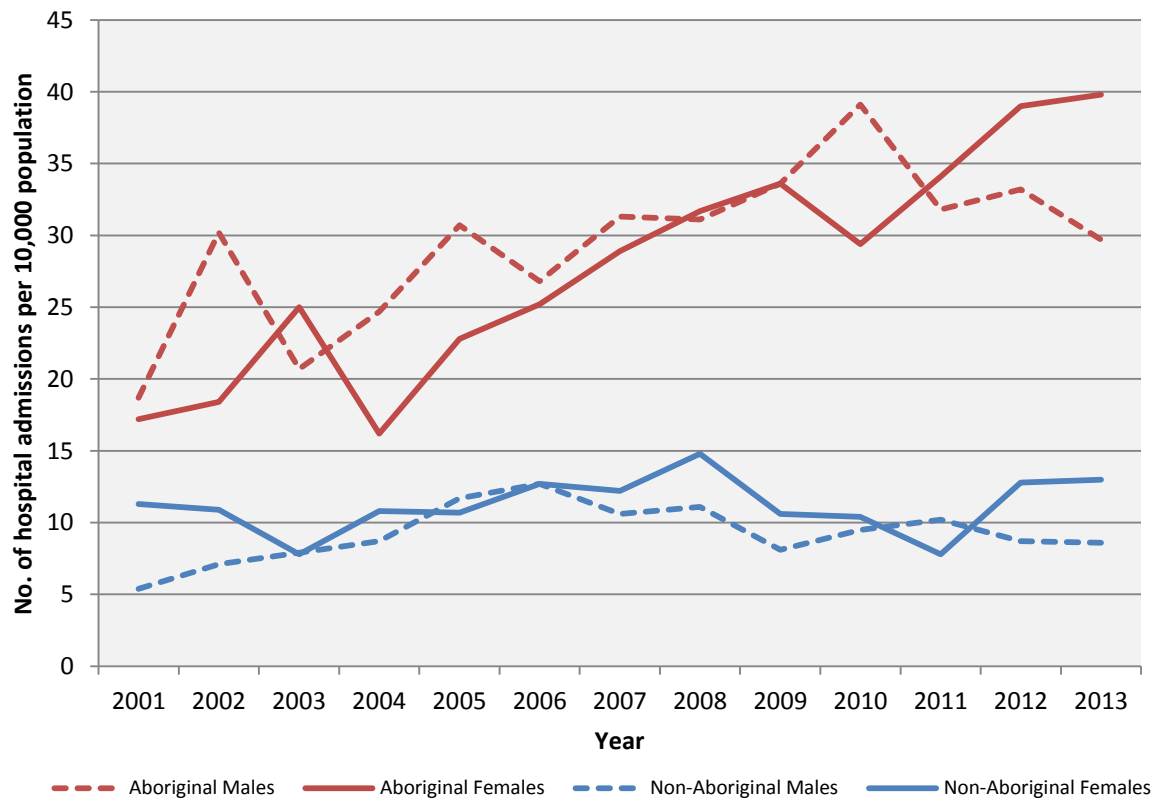


Sources: ABS, Cause of Death, 2011, Cat. no. 3303.0; ABS, Cause of Death, 2016, Cat. no. 3303.0

An earlier study of suicide in the Top End of the Northern Territory identified important differences in the socio-demographic characteristics and natural history of Aboriginal and non-Aboriginal cases.⁴ The importance of these differences has been reiterated in more recent studies of child and youth suicides in the NT⁵ and emphasised in other studies of Aboriginal suicide.^{6,7} This study aims to examine the implications of these differences within the NT for the development of a population-level response to prevention.

An important indicator of suicide risk at a population level is the rate of self-harm hospital admissions. In the NT, rates of self-harm hospital admissions are much higher than any other jurisdiction and are highest amongst Aboriginal residents.⁸ Importantly, as seen in Figure 2, rates of self-harm hospital admissions have continued to increase in recent years.⁸

Figure 2 Rates of hospital admission involving intentional self-harm by Indigenous status and gender, NT 2001–2013



Source: Leckning BA, Li SQ, Cunningham T, Guthridge S, Robinson G, Nagel T, et al. Trends in hospital admissions involving suicidal behaviour in the Northern Territory, 2001–2013. *Australasian Psychiatry*. 2016;24(3):300–4.

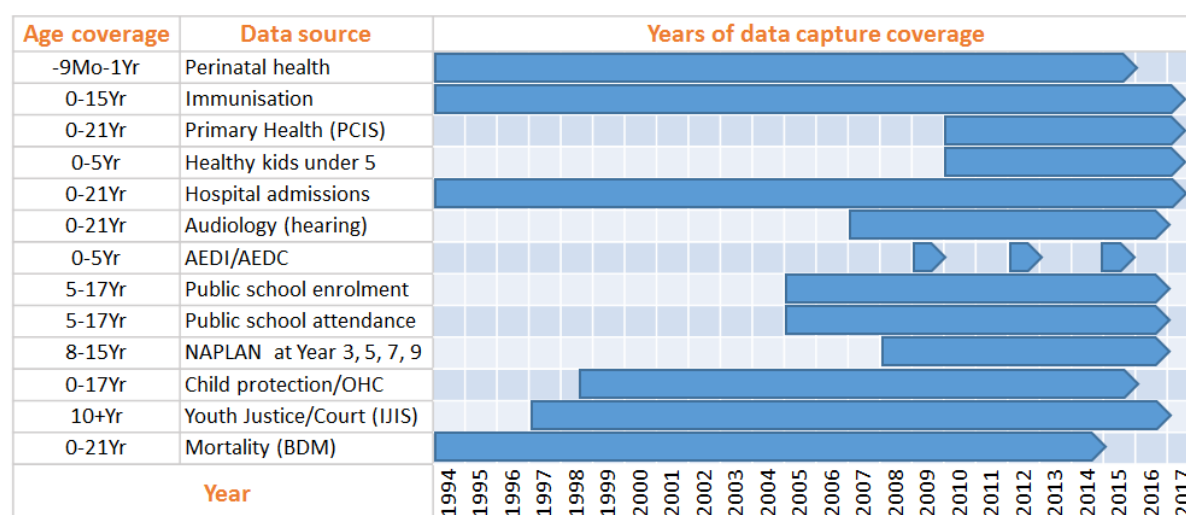
The risk of suicide following a hospital admission involving self-harm and suicidal ideation is the subject of ongoing research at the Menzies School of Health Research. Whilst self-harm is known to be one of the strongest predictors of suicide,^{9,10} limited evidence of these links exists for the NT population. Preliminary findings of research at Menzies have identified a higher risk of subsequent death by suicide amongst Aboriginal patients and those with repeat hospital admissions involving self-harm.¹¹ Therefore, the prevention of self-harm associated with hospital admissions constitutes an important ingredient of a strategic approach to reducing rates of suicide in the NT.

The primary aim of this report is to explore the characteristics and pathways of young people with self-harm hospital admissions in the NT using the Child and Youth Development Research Partnership (CYDRP) data repository of linked administrative datasets. This exploratory study will provide the foundation for establishing risk profiles of self-harm by young people that can improve the targeting of preventive interventions for different at-risk groups and improve patient outcomes by informing hospital practices of assessment and care for self-harm presentations. A secondary aim of this report is to assess the feasibility of using data linkage to investigate self-harm and suicide to inform suicide prevention policy and practice in the NT.

2 Adopting a life course approach to investigating self-harm by young people in the NT

The CYDRP agreement supports a substantial repository of de-identified administrative data for all children in the NT born between 1 January 1994 and 31 December 2014. The datasets held in the repository include children's records on their perinatal health status (including maternal health), admissions to NT public hospitals, primary health care contacts, public school enrolment and attendance, assessment of school readiness, academic achievement, child protection involvement, youth justice involvement and mortality. The birth cohort design of the data repository and availability of records in each of the datasets is outlined in Figure 3.

Figure 3 Age ranges and years of data collection for each linked unit-record dataset available in the CYDRP data repository

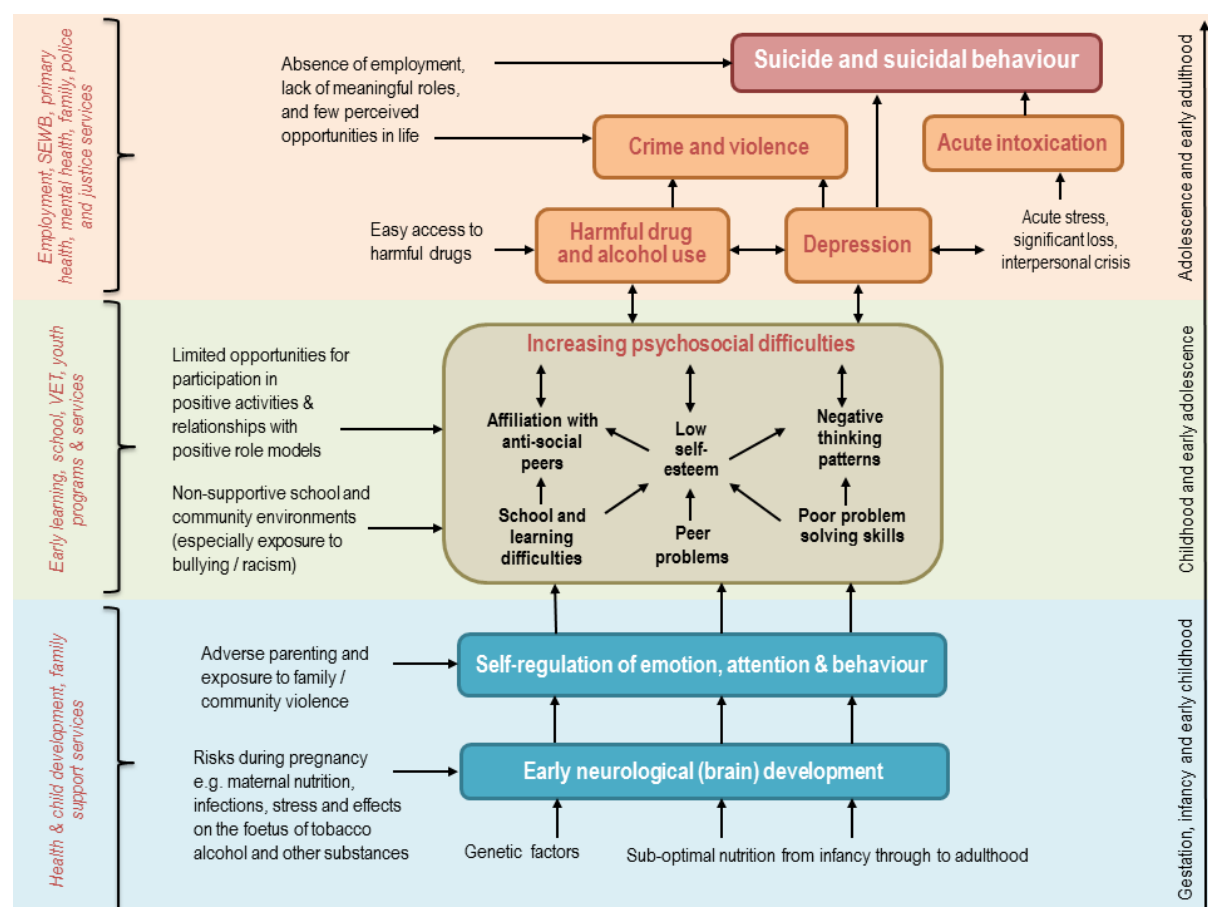


As this diagram illustrates, the availability of linked datasets within CYDRP permits comprehensive investigations of a range of phenomena from birth until early adulthood. This birth cohort design lends itself to longitudinal analyses identifying pathways across the services and institutions represented by the linked datasets that lead to health, educational, social and welfare outcomes. The approach taken in these kinds of longitudinal investigations are commonly referred to as life course studies.^{12,13} Such studies have the potential to provide important insights into the immediate and longer-term individual and contextual influences on suicidal behaviours. The exploratory analyses outlined in this report are designed to determine the feasibility of data linkage methods to support a life course approach to the study of self-harm and to identify some of the key risk pathways associated with this outcome.

The diagram below (Figure 4) depicts a theoretical life course model of developmental pathways leading to suicidal behaviours in adolescence.¹⁴ It was developed by the consultation team from the Centre for Child Development and Education at the Menzies School of Health Research for the National Aboriginal and Torres Strait Islander Suicide

Prevention Strategy (NATSISPS) in 2013¹⁴ and has gone on to inform the implementation of this key policy framework. This life course model provides an important reference point for this report for two reasons. Firstly, the model is relevant to the NT population because it is particularly sensitive to the developmental, cultural and historical contexts of Aboriginal suicidal behaviours whilst also remaining valid for understanding non-Aboriginal suicidal behaviours. Secondly, the longitudinal design of and data available in the CYDRP data repository lends itself to exploring some of the pathways described in the model and the opportunities for prevention they represent.

Figure 4 Developmental pathways reflecting a life course approach to understanding suicide and suicidal behaviour



Source: National Aboriginal and Torres Strait Islander Suicide Prevention Strategy. Australian Government. 2012.

Based on the life course model above (Figure 4) and the available measures in the CYDRP data repository, this report is structured around the following exploratory questions:

- What are the socio-demographic and clinical characteristics of young people at first episode of self-harm (FESH) hospital admissions?
- What are the risk pathways associated with different characteristics of young people at FESH hospital admissions?

The question of risk pathways associated with first episode of self-harm hospital admission is composed of a series of analyses within two more focussed sets of questions:

- What are the indicators of early life health and adversity associated with different characteristics of young people at FESH hospital admissions?
- What are some of the recent life stress and psychosocial difficulties associated with different characteristics of young people at FESH hospital admissions?

The findings from these exploratory investigations of the CYDRP birth cohort will be used to discuss options for population-level data linkage and other research that can inform the monitoring and prevention of self-harm and suicide by young people in the NT.

3 Methodology

This study makes use of de-identified administrative datasets prepared for the Menzies School of Health Research (HREC Ref: 16-2078) by SANT DataLink, with the approval of the custodians of the data. The project is governed by the CYDRP Steering Committee, consisting of key personnel from each of the NT departments of Health, Education, the Attorney-General and Justice, and Territory Families. The datasets in the CYDRP data repository were created through confidential data linkage processes facilitated by SANT DataLink, the authorised data integrating authority for data linkage research in the NT. A more detailed overview of the linkage process and management of these datasets is outlined elsewhere.¹⁵ The datasets currently available in the CYDRP data repository are outlined in Figure 3 above. These datasets contain de-identified unit-level records on all young people in the NT born between 1994 and 2014, except for youth justice and child protection datasets that contain records for all young people 17 years or under. Individuals are uniquely identified using a Project Specific Linkage Key (PSLK), which allows researchers to link records from various datasets for all individuals in the repository.

3.1 Study population

First episode of self-harm (FESH) hospital admissions

The self-harm study population is drawn from all individuals born between 1 January 1994 and 31 December 2014 with a record of at least one hospital admission between 1 July 2000 and 30 June 2017 in the NT Inpatient Activity dataset containing a coded diagnosis (International Classification of Disease 10, Australian Modification (ICD-10-AM)) of intentional self-harm.

The NT Inpatient Activity dataset consists of 392 individuals with 509 hospital admissions involving self-harm.

The first episode of self-harm (FESH) hospital admission is used to define the study population (N=392). Two cases of FESH admissions died in hospital because of their self-harm. They have been retained in the study population because all analyses are either contemporaneous to the first episode hospital admission or retrospective investigations of risk pathways (see Section 3.3).

Appendix 1 provides further technical details of how selection criteria were defined and applied to the data to define the study population.

Suicide

The suicide study population is defined as all individuals born between 1994 and 2014 with a mortality record in the death register held by the NT Births, Deaths and Marriages Registry with underlying cause of death recorded as intentional self-harm (i.e. suicide) (Appendix A1.1 for selection criteria used). Twenty-seven suicide deaths were identified in the death register. The small number of cases do not permit meaningful analysis within this data

linkage study; however, a very brief description of these cases and options for further investigation are provided in Appendix 2 of this report. The rest of this report will focus solely on the self-harm study population described above.

3.2 Data used in the current study

The de-identified, unit-record (person specific) data used in the study were extracted from the various administrative datasets linked within the CYDRP repository described above and outlined in Figure 3.

Characteristics of FESH admissions

The characteristics of FESH admissions used in this study are derived entirely from socio-demographic, hospital activity and comorbidities from ICD-10-AM coded diagnosis data in the NT Inpatient Activity dataset which contains all hospital admissions between 1 July 2000 and 30 June 2017 by children in the CYDRP birth cohort. Age at the time of admission is presented in five-year age groups. Residence is presented as urban or remote by mapping locality recorded in the hospital data to the Australian Statistical of Geography Standard (ASGS) of the Australian Bureau of Statistics (ABS). Hospital network reflects administrative structures that coordinate the hospital management of patients between the district hospitals in regional and remote settings with the two main public hospitals in Darwin and Alice Springs. Thus, the Top End Health Service refers to the network of Royal Darwin Hospital, Gove District Hospital and Katherine Hospital; the Central Australian Health Service refers to the network of Alice Springs Hospital and Tennant Creek Hospital. Individual types of self-harm are reflected in ICD-10-AM diagnosis codes and are listed in Appendix A1.1. Another distinction is made between potentially more lethal and less lethal types of self-harm as these have both clinical and preventive implications. A lethal method of self-harm is one where there is a higher risk of a fatal injury, which is based on case fatality studies. References to potentially lethal methods of self-harm in this report are based on Australian research that has identified self-harm by firearms, hanging and motor vehicle poisoning as the top-ranking lethal methods of self-harm (see Technical Appendix A2 for details).¹⁶ Where more than one method is present in a hospital admission, the potentially most lethal type is retained. Psychiatric comorbidities are also included for analysis (Appendix A3).

Indicators of early life health and adversity

Early life health indicators are derived from the NT Perinatal Registry dataset that captures information on the pregnancy, maternal health and perinatal health for all children born in the NT. NT Perinatal Registry data in the CYDRP repository covers all the years of the birth cohort, from 1994 to 2014. The indicators included for analysis are maternal smoking and alcohol consumption during pregnancy, low birth weight and preterm birth (see Appendix A1.4 for details).

Additionally, for the purposes of this analysis, *early life adversity* is indicated by notifications of alleged child maltreatment to the child protection system between 1 January 1999 and 31 March 2017.

Recent life stress and psychological difficulty

Recent life stress and *psychological difficulties* are often related to each other when it comes to the onset of self-harming and suicidal behaviours in young people. There are four indicators in the CYDRP data repository that are used to represent recent life stress and psychological difficulty in the year prior to first episode of self-harm hospital admissions:

- *school disengagement* (measured as low attendance)
- *recent hospital admissions* (indicative of health-related risk)
- *child protection notifications* (indicative of possible abuse or neglect)
- *youth justice involvement* (indicative of antisocial behaviour and associations).

Data regarding mental health-related hospital admissions in the year prior to a FESH hospital admission are used to explicitly identify acute episodes of psychological difficulty or the onset of mental illness.

The Technical Appendix A5 contains further details of data used to derive indicators of recent life stress and psychological difficulty.

3.3 Analytic approach

The analyses used in this study are cross-sectional and descriptive in nature, focussed largely on identifying differences in the characteristics of individuals at FESH admission and according to prior risk pathways identified in linked administrative datasets from the CYDRP data repository. This means the denominator in most analyses refers to the whole study population (N=392).

Given the evidence of differences in Aboriginal and non-Aboriginal self-harm and suicide described in the introduction, all analyses in this report are conducted separately by Indigenous status where possible (Aboriginal n=232; non-Aboriginal n=160).

Overall, this study makes use of bivariate descriptive statistics to describe the distribution of characteristics and risk pathways within the study population. Where statistical tests of differences in proportions (chi-squared test) or means (t-test) are used, the significance of the results will be indicated.

The analytic approach to each of the research questions outlined in the introduction are provided in more detail below.

Characteristics of first episode of self-harm hospital admissions

Socio-demographic and clinical characteristics of FESH admissions are presented as frequencies and proportions within the study population. Where these characteristics are compared to each other, the bivariate statistics described above are applied to determine the statistical significance of any differences and associations.

Risk pathways and factors associated with first episode of self-harm hospital admissions

The *prevalence of risk pathways* is established using frequencies and proportions of the study population or analysis sample with linked records in administrative datasets described above that are indicative of the presence of risk pathways.

The *distribution of risk pathways and factors* in the study population is described using frequencies and proportions by socio-demographic and clinical characteristics of young people at FESH admission and is tested using the bivariate statistics described earlier. Statistically significant differences are used to imply different groups of young people with first-episode self-harm hospital admissions based on the clinical characteristics associated with risk pathways and factors.

Where possible, separate multivariate logistic regression analyses are used to more rigorously identify differences in the likelihood of these risk pathways being present according to characteristics of first episode of self-harm hospital admissions. The results of multivariate logistic regressions are presented as adjusted odds ratios (AOR) that indicate the strength of the association between a characteristic at FESH admission and the risk pathway being predicted by the model. Therefore, an $AOR > 1$ indicates the risk pathway is more likely to be present for individuals with this characteristic at FESH admission, whereas an $AOR < 1$ indicates the risk pathway is less likely for individuals with this characteristic at FESH admission after adjusting for other characteristics included in the model. Where possible, multivariate logistic regression models are stratified by Indigenous status. Summaries of model fit are provided in Appendix 1.

Several analyses of risk pathways make use of restricted samples to overcome limitations within the CYDRP data repository. These analysis samples are described in each of the sections where such restrictions apply.

4 Characteristics of young people at first episode of self-harm (FESH) hospital admission

4.1 Overview

The study population comprises 392 young people residing in the NT, born between 1994 and 2005 who were admitted to a public hospital on 509 occasions for self-harm.ⁱ Just over 20% (n=82) of young people in the study population had more than one hospital admission involving self-harm. Self-poisoning accounted for about half of all admissions involving self-harm (n=262; 51.4%), followed by cutting with a sharp object (n=125; 24.6%) and hanging (n=111; 21.8%). Overall, 114 (22.4%) self-harm hospital admissions involved potentially lethal methods (see Section 4.3 and Appendix A1.2 for details of lethality). Sixteen admissions (3.1%) involved more than one method of self-harm. In the analyses that follow, only the FESH hospital admission is used because this provides insights into the onset of self-harm in adolescence and early adulthood. Where more than one method of self-harm is recorded in admission diagnosis codes, only the method considered potentially most lethal is retained.

4.2 Socio-demographic characteristics

Indigenous status and gender

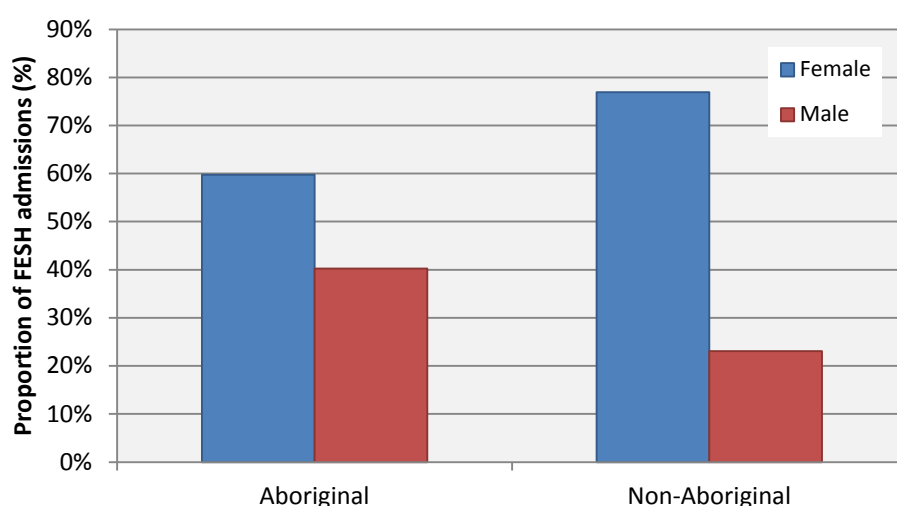
Aboriginalⁱⁱ patients make up over half of the young people in the study population (n=236/392; 60.2%), which is comparable to the known population prevalence of hospitalised self-harm in the NT for age groups in this study.⁸ There are noticeable differences in the characteristics of FESH admissions by Indigenous status and gender, which are summarised in Figure 5 below.

Females comprise most FESH admissions amongst young people. However, for Aboriginal patients, the difference is less pronounced than for non-Aboriginal patients ($\chi^2=14.48$ df=1; $p<0.001$). The minimal gender differences observed in Aboriginal FESH are not uncommon when compared to the population incidence of self-harm in the NT (see Figure 2). However, the gender differences in non-Aboriginal FESH are quite distinct.

ⁱ The only private hospital in the NT does not provide medical services relevant to the treatment of self-harm (i.e. emergency acute care, mental health), and therefore, it is reasonable to assume self-harm admissions to public hospitals represent all self-harm hospital admissions in the NT.

ⁱⁱ The term 'Aboriginal' has been used throughout this report to respectfully refer to Aboriginal, Torres Strait Islander or Aboriginal and Torres Strait Islander peoples.

Figure 5 Distribution of FESH admission by Indigenous status and gender, 2001–2017



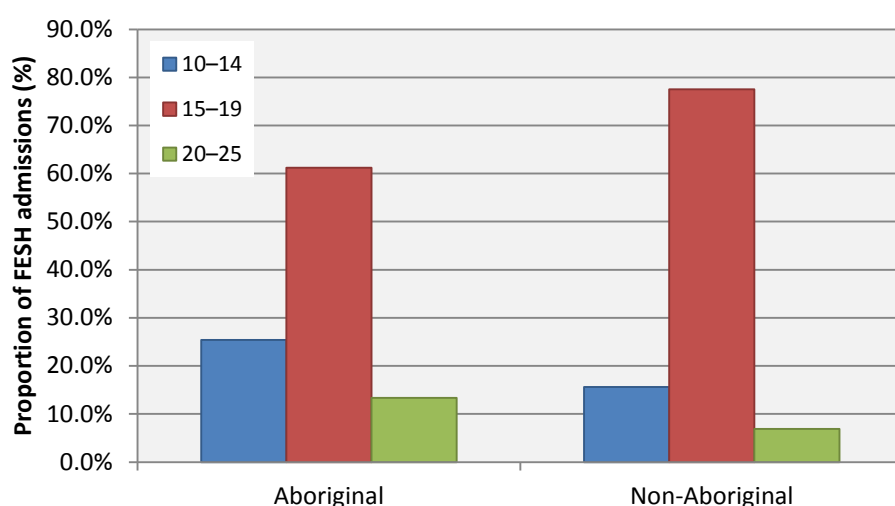
The implications for prevention of different gender ratios by Indigenous status are important to consider. The relatively low gender ratio runs contrary to evidence of a ‘gender paradox’ of suicidal behaviour¹⁷ that points to higher risks of hospitalised self-harm among females compared to males and a higher risk of suicide among males compared to females. Questions can therefore be raised about the effectiveness of hospital-based or initiated suicide prevention if hospitals are admitting predominantly low-risk population groups, such as females. However, recent research in the NT has produced evidence of higher risk of subsequent suicide amongst males hospitalised for suicidal behaviour.¹¹ The relatively high proportion of young Aboriginal males in this sample clearly suggests that self-harm hospital admissions in the NT represent an important opportunity for prevention targeting this at-risk population group.

Age

The onset of self-harm for the full sample is concentrated in mid- to late-adolescence (Figure 6). However, just over a quarter ($n=60/236$; 25.4%) of FESH admissions by Aboriginal patients occur in early adolescence (under 15 years of age).

It should be noted that self-harm hospital admissions in older age groups, especially 20–25 years of age, are under-represented in this analysis because the CYDRP data repository only contains records of children born between 1994 and 2014 (see details in Appendix A1.6). Therefore, some caution is needed with the use and interpretation of results including age.

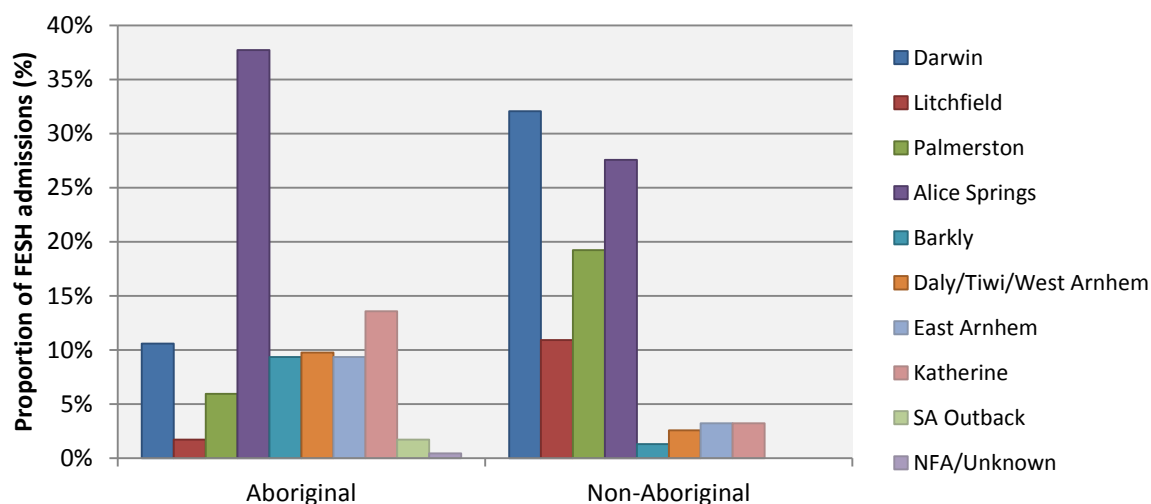
Figure 6 Distribution of FESH admission by Indigenous status and age group, 2001–2017



Geographic distribution

The geographic distribution of FESH admissions in the CYDRP birth cohort reflects differences in the patterns of residence between Aboriginal and non-Aboriginal populations in the NT and is consistent with population trends in hospitalised self-harm.⁸ Young non-Aboriginal people with a FESH admission are concentrated in NT urban centres (Darwin and surrounds, and Alice Springs) (n=141; 90.4%) as opposed to remote locations (n=21; 13.5%), whilst young Aboriginal people in the study population are widely distributed (urban: n=107; 45.3% vs. remote: n=122; 51.7%) ($\chi^2=74.86$ df=1; $p<0.001$).

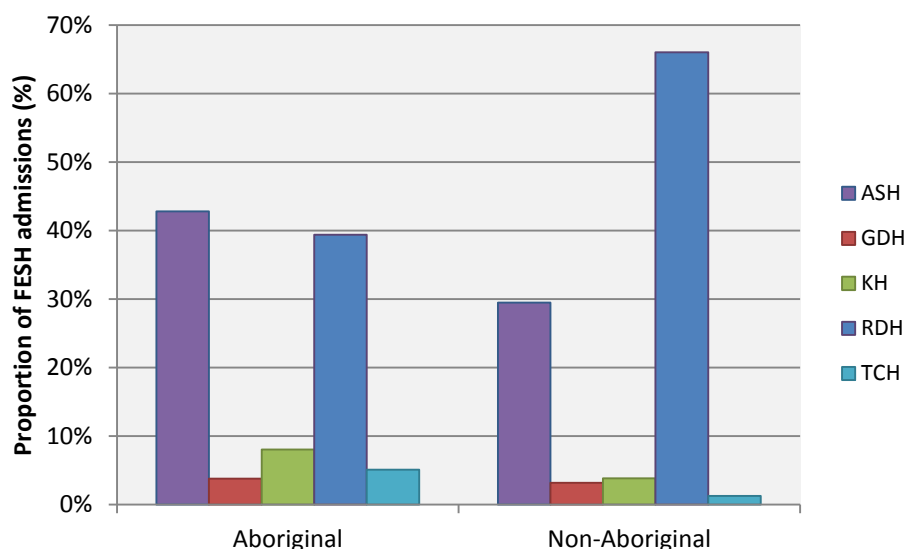
Figure 7 Distribution of FESH admission by Indigenous status and residence, 2001–2017



Note: Residence is reported at the level of SA3 regions as defined by the Australian Statistical Geography Standard (ASGS)¹⁸

The distribution of FESH admissions across the NT public hospital network also reflects differences in patterns of residence by Indigenous status, seen below in Figure 8.

Figure 8 Distribution of FESH admission by Indigenous status and hospital of admission, 2001–2017



Note: ASH = Alice Springs Hospital; GDH = Gove District Hospital; KH = Katherine Hospital; RDH = Royal Darwin Hospital; TCH = Tennant Creek Hospital.

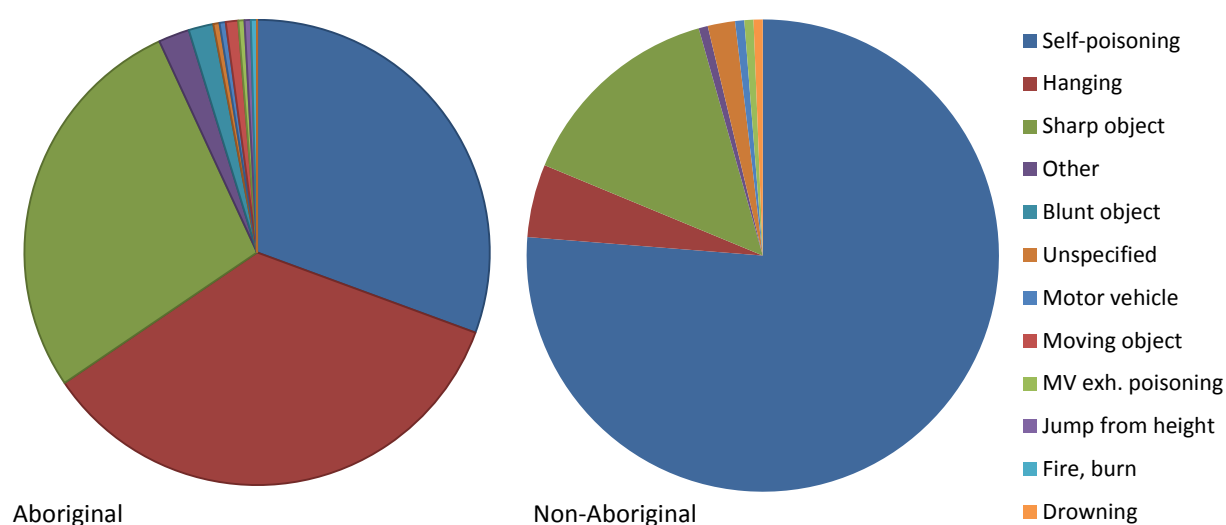
The concentration of admissions at Alice Springs Hospital and Royal Darwin Hospital may also reflect the seriousness of the self-harm or the need for specialist services that require admission of these young people from remote and regional settings to these tertiary hospitals. From a service perspective, the distribution of FESH hospital admission across the hospital network differs significantly by Indigenous status, with young Aboriginal people with FESH admissions spread across both the Top End (n=121; 51.3%) and Central Australia (n=113; 47.9%) and young non-Aboriginal people with FESH admissions concentrated in the Top End (n=114; 73.1%) compared to Central Australia (n=48; 30.8%) ($\chi^2=13.18$ df=1; $p<0.001$).

4.3 Clinical characteristics

Type of self-harm

Differences in the type or method of self-harm can be indicative of differences in risk for subsequent suicide and other adverse outcomes.^{16,19} Overall, self-poisoning was involved in almost half of all FESH admissions by young people (n=194/392; 49.5%). However, there are important differences in methods of self-harm by Indigenous status that are illustrated in Figure 9 below.

Figure 9 Distribution of FESH admission by Indigenous status and method of self-harm, 2001–2017



Self-poisoning ranks by far as the most prevalent method of self-harm for young non-Aboriginal people. But amongst young Aboriginal people, there is a more even distribution between self-poisoning, cutting by sharp objects and hanging.

The risk of suicide indicated by the type of self-harm is confirmed by population case-fatality studies. Differences in the rates of hospital admissions and deaths involving intentional self-harm by method are used to establish case fatality ratios that are indicative of which methods of self-harm are the most potentially lethal. In Australia, the three types of self-harm considered potentially most lethal according to case-fatality ratios are intentional self-harm by hanging and firearm and intentional self-poisoning by motor vehicle exhaust.¹⁶ Within the study population, young Aboriginal people were more likely to have used potentially more lethal forms of self-harm ($n=83/236$; 35.2%) compared to young non-Aboriginal people ($n=9/156$; 5.7%) ($\chi^2=45.20$ $df=1$; $p<0.001$).

To better understand these differences by type of self-harm, Tables 1 and 2 below describe the socio-demographic characteristics for the top ranked methodsⁱⁱⁱ of self-harm by Indigenous status. For young Aboriginal people, these are self-hanging, self-poisoning and self-cutting; for young non-Aboriginal people, these are self-poisoning and self-cutting.

ⁱⁱⁱ Defined as the types of self-harm observed with the highest frequency for Aboriginal and non-Aboriginal young people at FESH hospital admission.

Table 1 Number and proportion of young Aboriginal people with FESH admissions involving hanging, self-poisoning and sharp objects by socio-demographic characteristics, 2001–2017

	Hanging		Self-poisoning		Sharp object		Total	
	n	col %	n	col %	n	col %	n	col %
Total	82	100.0%	72	100.0%	66	100.0%	220	100.0%
Gender**								
Female	41	50.0%	59	81.9%	33	50.0%	133	60.5%
Male	41	50.0%	13	18.1%	33	50.0%	87	39.5%
Age (group)**								
10–14	21	25.6%	29	40.3%	8	12.1%	58	26.4%
15–19	52	63.4%	40	55.6%	43	65.2%	135	61.4%
20–25	9	11.0%	3	4.2%	15	22.7%	27	12.3%
Residence**								
Urban	24	29.3%	42	58.3%	34	51.5%	100	45.5%
Remote	57	69.5%	30	41.7%	28	42.4%	115	52.3%
Hospital network**								
Top End	53	64.6%	46	63.9%	16	24.2%	115	52.3%
Central Australia	29	35.4%	26	36.1%	50	75.8%	105	47.7%

** Indicates $p < 0.01$

There are pronounced gender differences in young Aboriginal people with FESH admissions for self-poisoning, with a much higher proportion of females admitted for this type of self-harm. However, no notable differences by gender are reported for self-harm involving sharp objects or hanging. The onset of self-harm by self-poisoning appears to be more skewed towards early adolescence compared to hanging and self-cutting. Hanging is prevalent in the Top End and remote settings. Whilst self-harm by sharp objects and self-poisoning are both slightly more prevalent in urban areas, self-poisoning is more concentrated in the Top End, especially Darwin, and self-harm using sharp objects in Central Australia, especially Alice Springs. These regional variations likely indicate cultural differences and patterns of presentation that require further investigation to better understand how they can inform hospital assessment and follow-up.

Although there is very little difference in the characteristics of young non-Aboriginal people by type of self-harm, the ratio of males to females is much greater in self-poisoning than self-cutting.

Table 2 Number and proportion of young non-Aboriginal people with FESH admissions involving self-poisoning and sharp object by socio-demographic characteristics, 2001–2017

	Self-poisoning		Sharp object		Total	
	n	col %	n	col %	n	col %
Total	121	100.0%	21	100.0%	142	100.0%
Gender*						
Female	100	82.6%	13	61.9%	113	79.6%
Male	21	17.4%	8	38.1%	29	20.4%
Age (group)						
10–14	20	16.5%	2	9.5%	22	15.5%
15–19	94	77.7%	18	85.7%	112	78.9%
20–25	7	5.8%	2	9.5%	8	5.6%
Residence						
Urban	108	89.3%	19	90.5%	129	90.8%
Remote	13	10.7%	2	9.5%	18	12.7%
Hospital network						
Top End	108	89.3%	19	90.5%	127	89.4%
Central Australia	13	10.7%	2	9.5%	15	10.6%

* Indicates $p < 0.05$

Identifying the type or method of self-harm is an important consideration for assessing suicide risk in clinical settings. Even where suicidal intent is absent, the lethality of hanging and other ‘choking games’ amongst vulnerable children can have fatal consequences,²⁰ and this has been evidenced in a number of asphyxiation deaths involving younger children in the NT.⁵ Few other high-ranking types of potentially more lethal self-harm—such as self-harm by firearm or self-poisoning by motor vehicle exhaust—were observed in the study population. This suggests that hanging, which is known to be particularly associated with Aboriginal suicidal behaviour,^{21,22} is an important type of self-harm that should be closely monitored in hospital settings. Although not often considered potentially as lethal as other types of self-harm, proper assessment of self-poisoning hospital admissions, especially by females, is required given this type of self-harm has been found to be associated with a relatively higher intent to die compared to other methods.²³ Self-cutting, whilst typically ascribed to motivations of self-punishment and tension release,²³ may have different motivations amongst young Aboriginal people. Traditionally, self-inflicted cuts have represented culturally constrained and sanctioned ritual responses to grief and mourning amongst adults,²⁴ especially in the desert regions of Central Australia. The self-cutting reported in this study is almost exclusively from remote regions leading to admissions at Alice Springs Hospital, which places further weight on the potential association with traditional ‘sorry cuts’. However, the young age at which self-cutting is observed in this study may indicate the extent to which these behaviours are detached from such cultural

moorings and instead represent individual responses to social stressors that are indicative of suicide risk.²⁵

Comorbidities

To aid with an understanding of the clinical characteristics of young people with a FESH admission in the NT, Table 3 summarises differences in relevant psychiatric comorbidities by Indigenous status. In the analysis, there is overlap between diagnosis categories as these are based on prior research and evidence indicating the association with self-harming behaviour that are less focussed on mutually exclusive diagnosis groupings (e.g. casemix classifications). Further explanation of these and other diagnosis categories examined but not reported here can be found in the Appendix 1.3.

Table 3 Number and proportion of young people with and without psychiatric comorbidities at FESH admission by Indigenous status, 2001–2017

		Aboriginal		Non-Aboriginal		Total
		n	%	n	%	n
Total		236	60.2%	156	39.8%	392
Any psychiatric diagnosis	No	136	62.7%	81	37.3%	217
	Yes	100	57.1%	75	42.9%	175
Alcohol or other substance misuse disorder***	No	172	55.5%	138	44.5%	310
	Yes	64	78.0%	18	22.0%	82
Depressive symptoms***	No	206	66.5%	104	33.5%	310
	Yes	30	36.6%	52	63.4%	82
Anxiety disorders	No	230	61.2%	146	38.8%	376
	Yes	6	37.5%	10	62.5%	16
Severe stress and adjustment disorders**	No	209	63.1%	122	36.9%	331
	Yes	27	44.3%	34	55.7%	61
Suicidal ideation	No	220	60.1%	146	39.9%	366
	Yes	16	61.5%	10	38.5%	26

*** Indicates $p < 0.001$; ** Indicates $p < 0.01$

Just under half ($n=175$; 44.6%) of all FESH admissions within the study population involved a psychiatric comorbidity. Substance misuse (both alcohol and other substances combined) was the most prevalent comorbid condition, followed closely by reactions to symptoms relating to severe stress and adjustment problems. Aboriginal patients make up the majority of FESH admissions with comorbid alcohol and other substance misuse compared to non-Aboriginal patients in the study. Non-Aboriginal patients comprised the greater part of FESH

admissions with symptoms relating to depressive mood and severe stress and adjustment problems.

The association of reactions to severe stress and adjustment problems and depressive symptoms with young non-Aboriginal people and of alcohol and other substance misuse with young Aboriginal people in the study point to differing manifestations of individual vulnerability to psychosocial stressors. While the onset of mental illness should not be discounted, it is important to consider the different circumstances and contexts in which these diagnoses represent psychosocial stressors that may lead to self-harming behaviour within different patterns of presentation in the hospital setting. These differences have implications for hospital assessment. Further investigation of prior contacts with health, education and welfare services may help to improve sensitivity of assessment to these pathways and contextual influences.

4.4 Summary

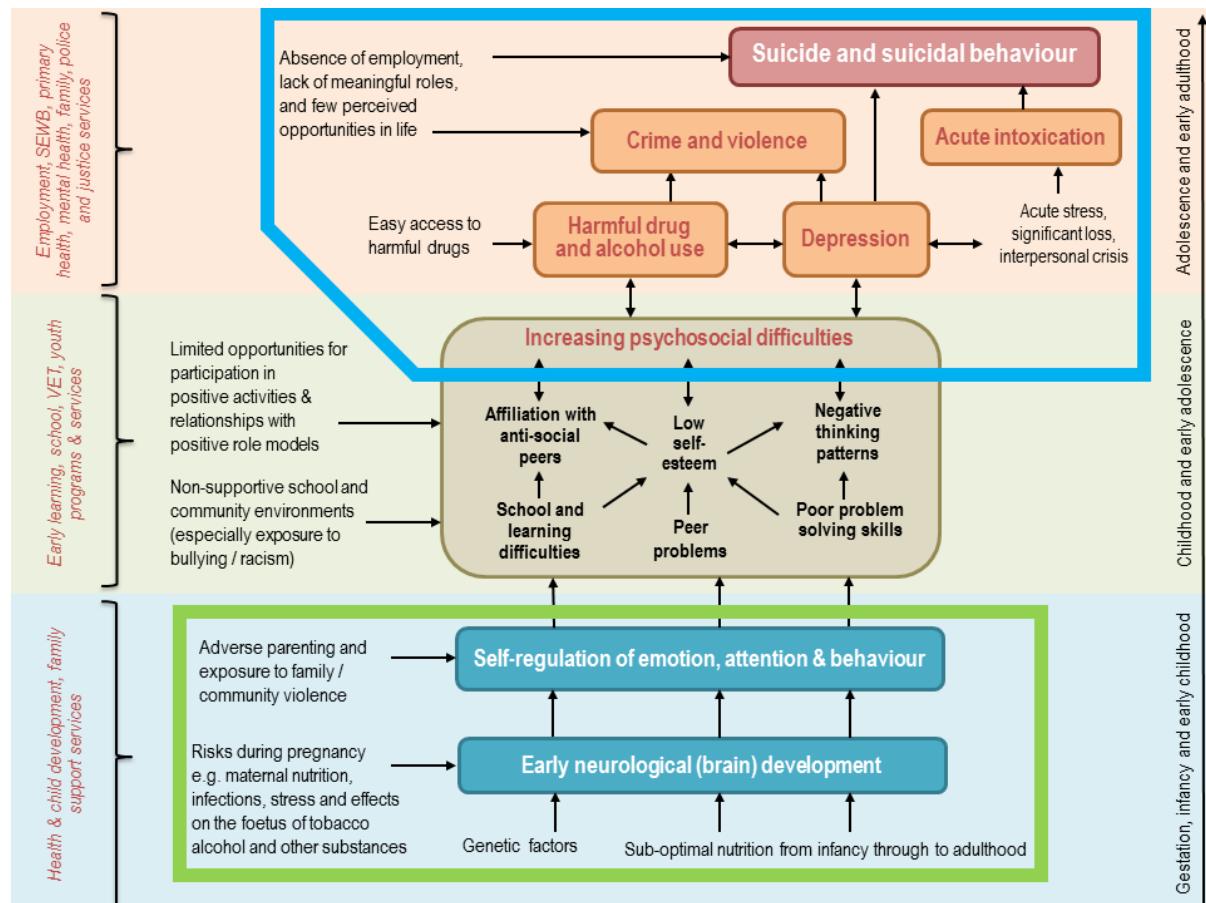
This summary of socio-demographic and clinical characteristics of young people at FESH admissions highlights some important differences in the contours of the risk profiles of the onset of self-harm in adolescence and young adulthood in the NT. In particular, the differences in gender, age and clinical characteristics by Indigenous status are quite stark. For young non-Aboriginal people in the study, patterns of socio-demographic and clinical characteristics are much closer to what is known about adolescent self-harming behaviour in the general Australian population.^{26,27} This indicates that existing evidence-based recommendations for hospital assessment and management²⁸ of these admissions are likely to be applicable and effective for young non-Aboriginal residents of the NT. However, for young Aboriginal residents, further investigation of other clinically-relevant factors and subsequent risk can inform improved assessment and management of hospital admissions involving self-harm and, therefore, the kinds of care and support these patients receive following discharge.

Of particular note in the NT are the geographic differences in characteristics of FESH admissions by young people. For young Aboriginal people, in particular, differences in the characteristics of urban and remote residents by method of self-harm points to important contextual and socio-cultural differences behind the patterns of admission observed. These differences highlight the need for contextually sensitive protocols for assessment and potentially a requirement for different strategies for care and prevention.

5 Risk pathways associated with FESH admissions

This section makes use of linked records within select administrative datasets in the CYDRP data repository to explore potential risk pathways leading to FESH admissions by young people in the NT. The measures and datasets chosen are informed by the life course model of suicidal behaviour presented in the introduction and re-presented below with an outline of the particular pathways that will be investigated.

Figure 10 Developmental pathways leading to suicide and suicidal behaviour with outlines of risk pathways that will be explored in this section



As illustrated by the green box in Figure 10 above, the analyses in this section will firstly investigate some of the early life health and adversities relevant to early neurological growth and the development of foundational social and emotional competencies. This will be followed by an exploration of recent events recorded in the CYDRP data repository that signal increasing psychosocial difficulties, such as the presence of life stressors and psychological difficulties (blue box in Figure 10).

The feasibility of undertaking such an investigation required the establishment of linkage rates to unit-level records in the administrative datasets held by in the CYDRP data repository to ensure that adequate sample sizes were available for analysis. The linkage

rates to each administrative dataset in the CYDRP data repository for this study and the implications of these rates for the analyses presented below can be found in Appendix 1.6.

As highlighted in the Methodology (see Section 3), there are two main cross-sectional analyses used in this chapter for identifying and discussing risk pathways: firstly, the proportion of contacts recorded in linked administrative datasets are interpreted as the prevalence of potential risk factors or opportunities for prevention, and secondly, differences in contacts recorded in linked administrative datasets according to characteristics of young people at FESH admission are used to identify potentially different risk pathways and factors associated with FESH.

5.1 Early life risk pathways associated with FESH admissions

5.1.1 Pre-natal and perinatal health risk pathways

The few studies that have examined the relationship between pre- and perinatal health with self-harm and suicide in later life suggest certain risk factors: restricted fetal growth, younger maternal age, lower gestational age and low birth weight.^{29,30} The analyses of early life health relating to FESH hospital admissions in this study are limited to the 288 individuals with linked perinatal records, of whom 204 (70.8%) are Aboriginal and 84 (29.2%) are non-Aboriginal people. The lower proportion of young non-Aboriginal people with perinatal records is the result of the high level of interstate migration of this group during childhood. Indicators used in this analysis are any self-reported smoking or alcohol consumption during pregnancy. Perinatal health indicators used are preterm birth and low birth weight (< 2500g).

The average age of mothers at the time of birth was 23 years for the young Aboriginal people in the sample and 28 years for the young non-Aboriginal people in the sample. Prevalence of early life health indicators are summarised in Figures 11 and 12 below for the young Aboriginal people and non-Aboriginal people in the study, respectively.

Figure 11 Distribution of early life health indicators from perinatal records linked to young Aboriginal people with a FESH hospital admission (n=204), 1994–2014.

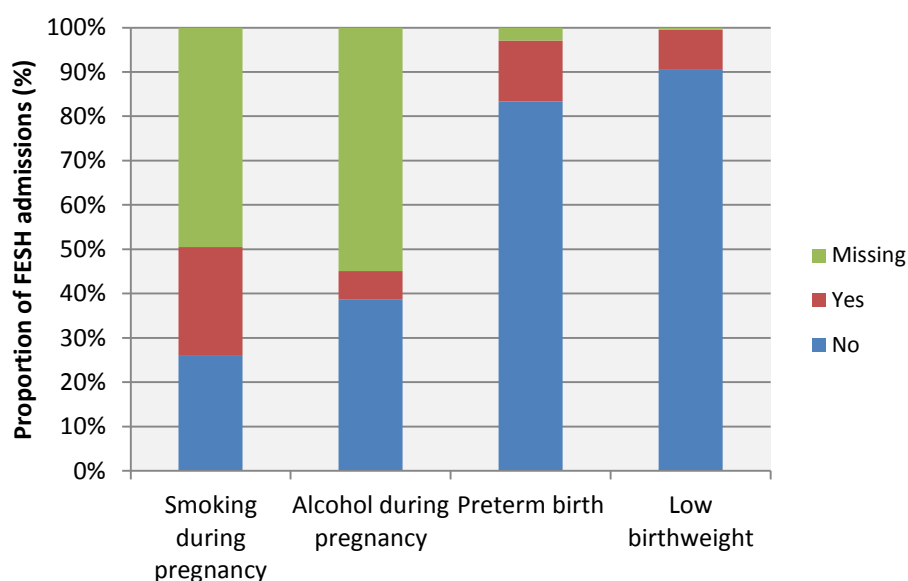
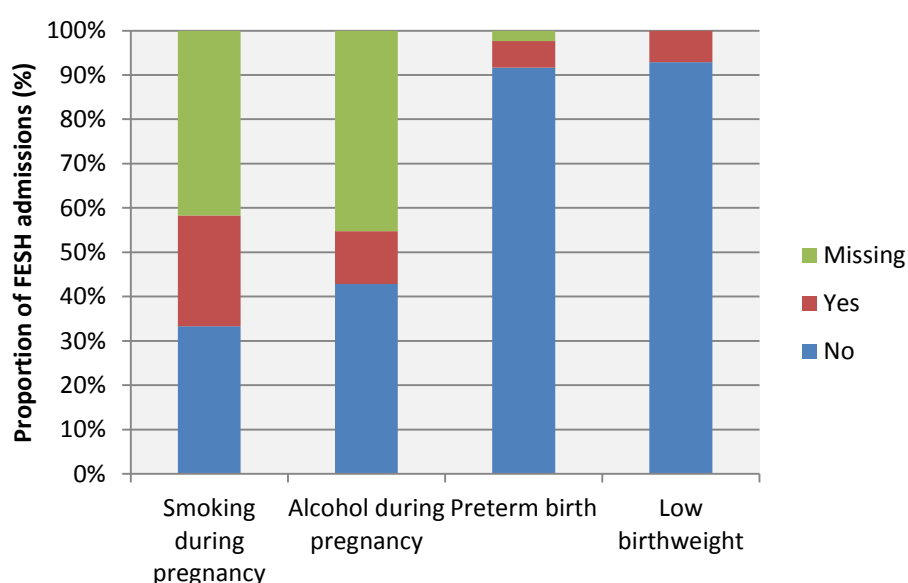


Figure 12 Distribution of early life health indicators from perinatal records linked to young non-Aboriginal people with a FESH hospital admission (n=84), 1994–2014.



Compared to population rates in the CYDRP birth cohorts,³¹ the proportion of mothers who reported smoking at any time during pregnancy appears to be quite high in the analysis sample of both Aboriginal and non-Aboriginal young people with FESH. However, caution is needed before giving much weight to this result as almost 50% of the data are missing for this variable. Maternal age and rates of self-reported alcohol consumption during pregnancy, preterm births and low birth weight in the analysis sample do not appear to differ substantially from those of the whole CYDRP birth cohort.³¹

5.1.2 Adverse childhood experiences

Adverse childhood experiences represent substantial short- and longer-term risk to children during an important but vulnerable phase of development.^{32,33} Moreover, adverse childhood experiences are known to have a direct and significant impact on lifetime suicide attempts,^{34,35} and self-harm is one of the outcomes most strongly associated with experiencing multiple co-occurring adverse events in childhood.³⁶ Reports of child maltreatment to child protection agencies provide a useful population-level indicator of the presence of adversity in the lives of children, even in the absence of substantiated harm. A prospective population study from Western Australia found that child protection notifications were a reliable indicator of elevated risk of self-harm in adolescence.³⁷

The analyses presented below examine associations between the characteristics of young people at FESH admission and child protection notifications in the first five years of life (between ages 0 and 4 years) that are indicative of exposure to adversity and/or maltreatment likely to be associated with self-harm in adolescence and young adulthood. The analyses will not differentiate by type of harm or abuse due to sample size restrictions. Furthermore, longitudinal studies of subsequent self-harm and suicide have shown there is little to no difference by type of harm and that any such differences are mediated by psychosocial factors in adolescence.³⁸ Child protection data in the CYDRP data repository is available from 1999, and to reduce any bias in the sample due to censoring effects, the analysis presented here is restricted to young people in the study born in or after 1999 (n=102).

A little under a quarter (n=23; 22.5%) of the young people with a FESH admission born from 1999 onwards experienced a child protection notification between 0 and 4 years of age, with most of those notifications involving Aboriginal children (n=20/23; 87.0%).

Table 4 Number and proportion of analysis sample (n=102) with a child protection notification between 0 and 4 years of age by type of harm and outcome (1999–2017)

Child protection notification between 0 and 4 years of age	n	col%
No	79	77.5%
Yes	23	22.5%
Physical abuse	19	82.6%
Sexual abuse	7	30.4%
Emotional abuse	17	73.9%
Neglect	13	56.5%
Substantiated harm	13	56.5%

Note: A single notification may report more than one kind of alleged maltreatment simultaneously. Therefore, the number of notifications reported in this table by type will not add up to the total number of notifications overall. It should also be noted that the number of individuals with any notification (n=23) is used as the denominator for calculating percentages by type of notification.

With such small numbers of records of notification for young non-Aboriginal people in the analysis sample, the rest of this section will focus on characteristics of FESH hospital admissions by young Aboriginal people with records of early childhood notifications to child protection authorities.

Table 5 Distribution of child protection notifications (1999–2017) between 0 and 4 years of age by characteristics of young Aboriginal people in the analysis sample (n=67) at FESH admission

	Child protection notification between 0 and 4 years of age				
	No		Yes		Total
	n	%	n	%	n
Total	47	70.1%	20	29.9%	67
Gender					
Female	31	70.5%	13	29.5%	44
Male	16	69.6%	7	30.4%	23
Age (group) at FESH admission					
10–14	29	72.5%	11	27.5%	40
15–19	18	66.7%	9	33.3%	27
Residence at FESH admission					
Urban	23	69.7%	10	30.3%	33
Remote	23	69.7%	10	30.3%	33
Hospital network at FESH admission					
Top End	26	74.3%	9	25.7%	35
Central Australia	21	65.6%	11	34.4%	32
Type of self-harm at FESH					
Less potentially lethal method	30	73.2%	11	26.8%	41
More potentially lethal method	17	65.4%	9	34.6%	26
Comorbid psychiatric diagnosis at FESH admission?					
No	33	73.3%	12	26.7%	45
Yes	14	63.6%	8	36.4%	22

The descriptive summary above suggests that child protection notifications in early childhood are not associated with any specific characteristics of young Aboriginal people at FESH admission. This implies the risk indicated by these early childhood reports of neglect and abuse may apply evenly to the young Aboriginal people in this analysis sample as early childhood adversity is known to be an important risk factor. However, this undifferentiated effect of childhood adversity on FESH is likely to be masking the extent to which the early

indicated risks of FESH are mediated or moderated by subsequent experiences in later childhood.³⁹ Whilst this analysis was unable to identify characteristics of FESH more likely to be associated with child protection notifications in early childhood, it is quite likely these children are at greater risk than their counterparts in the general population.

5.1.3 Summary

While this exploratory analysis of currently available data did not provide strong clarification of distinct risk factors and pathways in early life that may differentiate groups of young people at risk of later self-harm, it is important to note that a relatively high proportion of children in this cohort appear to experience early life health issues and adversities. Early adversity leading to the onset of suicidal behaviour and other poor outcomes in adolescence has been shown to reflect a number of intersecting influences, including quality of parenting, parental mental illness, parent and family suicidal behaviour, exposure to family violence, and inherited genetic vulnerabilities.⁴⁰ To more definitively differentiate pathways to adolescent self-harm, further research utilising data linkage should aim at modelling family vulnerabilities and protective influences in childhood (e.g. supportive family relationships, use of effective services and interventions) using a range of potentially available data yet to be included in the CYDRP data repository.

It is also important to note that subsequent experiences in later childhood may be mediating or moderating the risks in early childhood.³⁹ Thus, whilst the best start to life is vital to preventing poor outcomes in adolescence and adulthood, there are other opportunities in subsequent developmental phases—‘critical periods’ or ‘turning points’^{41,42}—for sustaining normal development and improving outcomes for those who are vulnerable. In particular, there is evidence that vulnerabilities in early childhood linked to suicidal behaviours in adolescence and adulthood are often mediated by ongoing sources of stress and adversity⁴³ and moderated by improved social supports.⁴⁴ Further investigation of these influences across the life course and across the social, educational and other experiences of young people should form part of the strategy for further investigation of developmental pathways for young people.

5.2 Risk pathways indicating recent life stress and increasing psychological difficulties prior to FESH admissions

Vulnerabilities to self-harm and suicide often emerge close to the onset of such behaviours.³⁹ Proximal risk pathways, as indicated by the life course model of self-harm and suicide in Figure 10, include stressful life events, the onset of physical and mental health issues in adolescence, engaging in criminal and violent behaviours, alcohol and other substance misuse, and poor family and social supports. Additionally, recent research into child and youth suicides in the NT identified disengagement from school as a potential indicator of risk in need of further investigation.⁵ This section will examine the presence of these risk pathways in the year prior to FESH admission for young people in the study as

indicators of recent life stress and increasing psychological difficulties that represent opportunities for prevention.

5.2.1 Recent school disengagement

Although little research has focussed explicitly on the relationship between school engagement and suicidal behaviours, numerous studies have shown that underlying psychopathology and/or psychological distress is strongly associated with poorer school attendance⁴⁵ and higher likelihood of school dropout.⁴⁶ Schools may also represent a source of stress for young people, with more evidence emerging that links bullying with a higher risk of self-harm^{47,48} and a stronger sense of belonging at school with a lower risk of self-harm.⁴⁹ Therefore, this section will seek to establish associations between recent school attendance and the characteristics of young people at FESH admission to provide a basis for understanding possible links between school engagement and self-harm behaviours.

The measure of school disengagement used in this analysis is based on whether the annual attendance rate of young people in the sample is within the 25th percentile for their year level and remoteness of residence in the calendar years of and prior to FESH admission. The sample for analyses used in this section are all young people with a FESH admission found to be enrolled at a government school between 2005 and 2016 and who were aged 16 years or younger at the time of their FESH admission as this is the age up to which conventional schooling is compulsory (i.e. up to Year 10).

The prevalence of school disengagement in the analysis sample was high, with just over 60% (n=112/186) of young people in the analysis identified in the 25th percentile of school attendance in the year of and prior to their FESH admission. For young Aboriginal people in the analysis sample, just under 55% (n=58/107) were considered disengaged. A descriptive overview of differences in characteristics of young Aboriginal people with a FESH admission is provided, comparing those recently engaged and disengaged with school.

Table 6 Distribution of school disengagement (2005–2016) by characteristics of young Aboriginal people in the analysis sample (n=107) at FESH admission

Recent school disengagement					
	No		Yes		Total
	n	%	n	%	n
Total	49	45.8%	58	54.2%	107
Gender					
Female	32	46.4%	37	53.6%	69
Male	17	44.7%	21	55.3%	38
Age (group) at FESH admission **					
10–14	19	33.9%	37	66.1%	56
15–19	30	58.8%	21	41.2%	51
Residence at FESH admission					
Urban	25	42.4%	34	57.6%	59
Remote	24	50.0%	24	50.0%	48
Type of self-harm at FESH admission					
Less potentially lethal method	38	49.4%	39	50.6%	77
More potentially lethal method	11	36.7%	19	63.3%	30
Comorbid psychiatric diagnosis at FESH admission?					
No	32	43.8%	41	56.2%	73
Yes	17	50.0%	17	50.0%	34

** Indicates $p < 0.01$

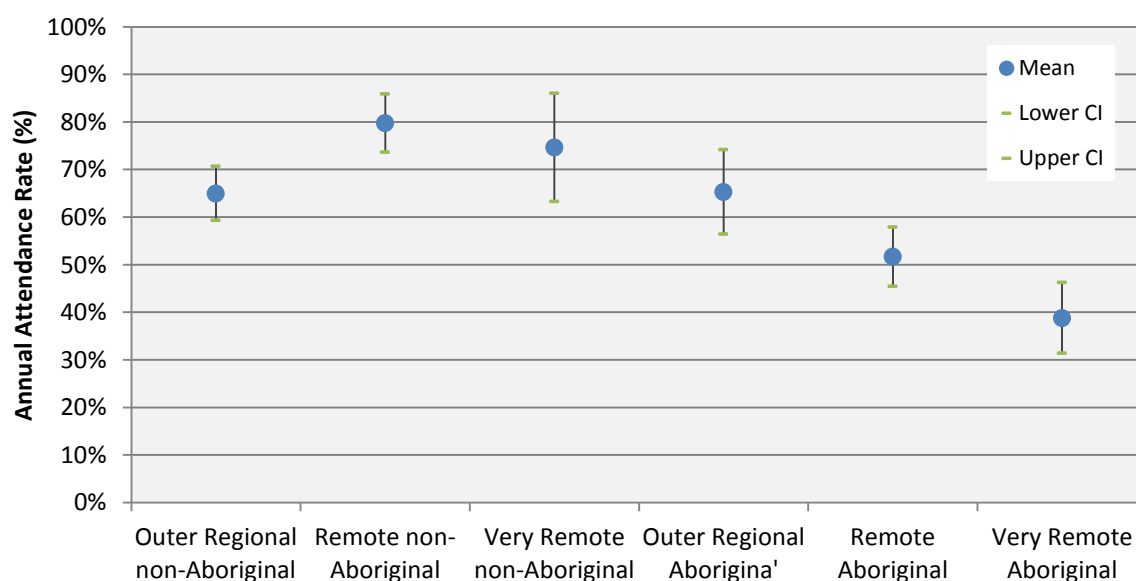
The average age of young Aboriginal people was lower amongst the disengaged (mean=13.72; 95% CI: 13.27-14.18) compared to those who were more engaged (mean=14.65; 95% CI: 14.28-15.02) ($p < 0.01$). This difference remained statistically significant even after adjusting for other characteristics at the time of FESH admission (AOR 0.60, 95% CI 0.43-0.82) (see Appendix 1.7 for results of multivariate logistic regression). This may in part reflect the younger age of Aboriginal people in the analysis sample. Despite sample limitations, this suggests that school disengagement may be an indicator of early onset FESH admissions and warrants further investigation.

Although the disengaged represented almost 70% (n=54/79) of young non-Aboriginal people in the sample, the under-representation of this group in non-government school enrolments and small numbers prevent meaningful interpretation of the results (see Appendix 1.9 for a descriptive summary). In summary, descriptive analyses found no statistically significant differences in characteristics of FESH admissions between the disengaged and engaged groups of young non-Aboriginal people.

There is evidence for the effectiveness of suicide prevention⁵⁰ and broader mental health and wellbeing programs⁵¹ in educational settings. However, the reach of school-based programs may be limited in some areas given regional variations in rates of school attendance. The average annual rate of attendance in the year of and prior to FESH are presented below (Figure 13) for the whole analysis sample by Indigenous status and remoteness of residence.

As can be seen, rates of government school attendance around the time of FESH admission differ quite markedly, confirming the need for regional approaches to school-based prevention. However, these findings are quite suggestive for very remote regions that are comprehensively covered by government schools—the high rates of disengagement and low average rates of attendance in very remote regions suggest the need to complement school-based initiatives with community-based interventions for school-aged Aboriginal children.

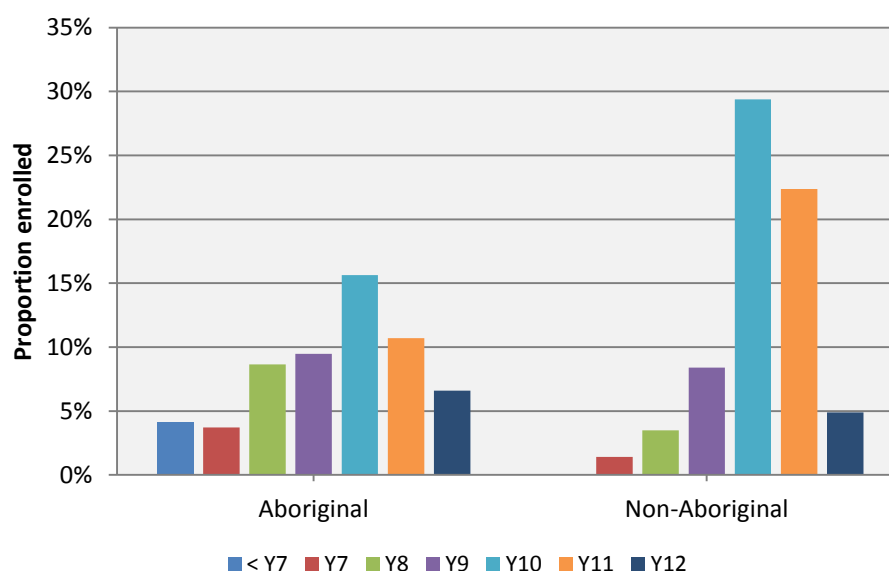
Figure 13 Average annual attendance rates (2005–2016) within the analysis sample (n=186) by Indigenous status and remoteness of residence at time of FESH admission



The graph below (Figure 14) shows year levels at last enrolment at a public school within the analysis sample to further illustrate critical points for school-based intervention. For young non-Aboriginal people in the analysis sample, the sharp peak of FESH admissions around Year 10 enrolments in government schools suggests that universal preventive interventions for this population group should focus on middle school to build resilience and support students through difficult transitions to senior years that may be associated with an increased risk of self-harming behaviour. For both Aboriginal and non-Aboriginal young people in the analysis sample FESH hospital admissions peak around enrolment in Year 10. However, for young Aboriginal people the peak is lower and is accompanied by a less sloping gradient, with a higher proportion occurring earlier in primary years of schooling. This suggests that early intervention preventions targeting Aboriginal students should begin

with universal programs to develop basic social and emotional competencies in early childhood and primary school with a mix of indicated and universal programs in middle school to promote social and emotional learning and to address risks associated with self-harming behaviours for this population.⁵²

Figure 14 Proportion of enrolments (2005–2016) by young people in the analysis sample (n=186) by year level and Indigenous status



5.2.2 Recent hospital admissions

Hospital admission records not only identify opportunities for engaging at-risk groups in preventive intervention, but the diagnoses at admission may indicate modifiable risk factors or health-related life stress that such interventions can target. This section will examine the extent to which prior hospital admissions and their frequency are associated with differences in characteristics of young people at FESH admission and whether these have implications for hospital-based assessment and prevention.

There are three analyses presented in this section, designed to facilitate a better understanding of risk factors and pathways associated with FESH admission, each dealing separately with the presence, frequency and diagnoses of hospital admissions in the year prior. Firstly, a descriptive summary and multivariable logistic regression analysis are provided to identify differences in characteristics of young people in the study (n=392) associated with one or more prior hospital admissions. Secondly, an analysis of young people in the study with prior hospital admissions is undertaken to identify the characteristics of ‘frequent users’ of hospital services (FU). The third analysis describes differences by Indigenous status in types of recent hospital admissions, according to different diagnoses recorded.

A total of 131 (33.4%) young people in the study were observed with at least one hospital admission in the previous year. There were no statistically significant differences between

the proportion of young Aboriginal (n=83/236; 35.2%) and non-Aboriginal (n=48/156; 30.8%) people in the study with prior hospital admissions ($\chi^2=0.82$ df=1; p=0.366). The descriptive overview of differences in characteristics of young non-Aboriginal people in the study with a recent hospital admission is provided in Appendix 1.9 as many of the results could not be meaningfully interpreted due to the small number of cases. The table below reports differences in the characteristics of young Aboriginal people at the time of FESH admission that were and were not found with a hospital admission in the year prior.

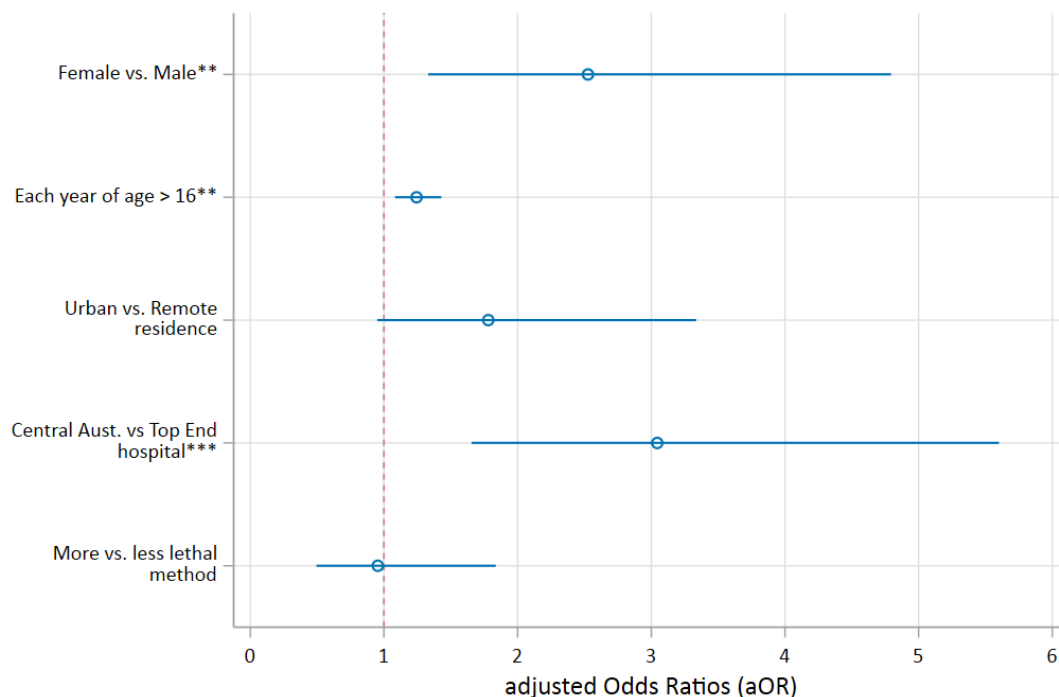
Table 7 Distribution of past-year hospital admissions (2000–2017) by characteristics of young Aboriginal people (n=236) at FESH admission

Hospital admission in year prior to FESH admission					
	No		Yes		Total
	n	%	n	%	n
Total	153	64.8%	83	35.2%	236
Gender **					
Female	80	56.7%	61	43.3%	141
Male	73	76.8%	22	23.2%	95
Age (group) at FESH admission					
10–14	43	71.7%	17	28.3%	60
15–19	93	64.6%	51	35.4%	144
20–25	17	53.1%	15	46.9%	32
Residence at FESH admission**					
Urban	59	55.7%	47	44.3%	106
Remote	90	72.0%	35	28.0%	125
Hospital network at FESH admission ***					
Top End	94	76.4%	29	23.6%	123
Central Australia	59	52.2%	54	47.8%	113
Type of self-harm at FESH admission					
Less potentially lethal method	93	60.8%	60	39.2%	153
More potentially lethal method	60	72.3%	23	27.7%	83
Comorbid psychiatric diagnosis at FESH admission?					
No	89	65.4%	47	34.6%	136
Yes	64	64.0%	36	36.0%	100

*** Indicates $p < 0.001$; ** Indicates $p < 0.01$

This descriptive overview highlights differences in the characteristics of young Aboriginal people in the study with and without a prior hospital admission by gender, age, residence and hospital network of FESH admission. These characteristics are further analysed in multivariate logistic regression (see Appendix 1.9 for further details). Figure 15 below shows the results from the final model.

Figure 15 Likelihood of past-year hospital admission (2000–2017) associated with characteristics of young Aboriginal people at FESH admission (n=236)



Note: A reference line is provided (dashed pink vertical line) to indicate where no differences in odds exist across categories of variables being analysed (i.e. AOR=1). The blue horizontal lines indicate the 95% confidence intervals for each of the estimated Adjusted Odds Ratios (hollow blue circle marker).

*** Indicates $p < 0.001$; ** Indicates $p < 0.01$

This graph illustrates that young Aboriginal people in the study with a recent hospital admission are more likely to be female (AOR 2.53, 95% CI 1.33-4.79) and just over three times more likely to be associated with FESH admissions in the Central Australian as opposed to Top End hospital network (AOR 3.04, 95% CI 1.65-5.60). Furthermore, there is approximately 25% more chance of a young Aboriginal person having a prior hospital admission for each year of age above 16 at the time of a FESH admission (AOR 1.24, 95% CI 1.08-1.43).

Frequency of recent hospital admissions

Two hundred and sixty-one young people with FESH hospital admissions (66.6%) did not have any hospital admissions in the year prior to their FESH. The 131 young people in the study who had a hospital admission in the year prior to their FESH were admitted on 213 occasions during that time (Table 8).

Table 8 Frequency of past-year hospital admissions by number of young people and separations, 2000–2017

No. of hospital admissions < 1 year before FESH	No. of individuals	col%	No. of separations	col%
1	72	55.0%	72	33.8%
2	28	21.4%	56	26.3%
3	13	9.9%	39	18.3%
4 or more	18	13.7%	46	21.6%
Total	131	100.0%	213	100.0%

A previous study in the NT identified frequent users (FU) as individuals with four or more hospital admissions in a calendar year, although this pattern of frequent use was considered less applicable to younger age groups.⁵³ Whilst just over 13% (n=18) of young people with four or more hospital admissions comprised just over 20% (n=46) of all admissions observed in the year prior to FESH admission, 23.6% (n=31) of young people with three or more hospital admissions accounted for almost 40% (n=85) of all prior hospital admissions. Therefore, three or more hospital admissions in the year prior to FESH (n=31/392; 7.9%) are taken to define FU for this study population and will be used for descriptive analyses presented below.

Of the 31 FU identified in prior hospital admissions, 25 (80.6%) were Aboriginal persons. Due to small numbers, a meaningful analysis of non-Aboriginal FU in the study is not possible. Table 9 below describes associations between FU status and characteristics of young Aboriginal people at FESH admission (n=236). Although statistically significant differences were found by age and type of self-harm, multivariate logistic regression analyses did not yield a model that adequately fit the data describing differences in characteristics of young people at FESH admission according to FU status.

Table 9 Distribution of frequent users of hospital services (2000–2017) by characteristics of young Aboriginal people (n=236) at FESH admission

	Frequent user of hospital services in year prior to FESH admission?				
	No		Yes		Total
	n	%	n	%	n
Total	211	89.4%	25	10.6%	236
Gender					
Female	121	85.8%	20	14.2%	141
Male	90	94.7%	5	5.3%	95
Age (group) at FESH admission **					
10–14	57	95.0%	3	5.0%	60
15–19	129	89.6%	15	10.4%	144
20–24	25	78.1%	7	21.9%	32
Residence at FESH admission					
Urban	93	87.7%	13	12.3%	106
Remote	113	90.4%	12	9.6%	125
Hospital network at FESH admission					
Top End	113	91.9%	10	8.1%	123
Central Australia	98	86.7%	15	13.3%	113
Type of self-harm at FESH admission **					
Less potentially lethal method	n.p.	-	n.p.	-	153
More potentially lethal method	n.p.	-	n.p.	-	83
Comorbid psychiatric diagnosis at FESH admission?					
No	121	89.0%	15	11.0%	136
Yes	90	90.0%	10	10.0%	100

n.p. Results not presented as numbers are too small and risk re-identification

** Indicates $p < 0.01$

Types of recent hospital admission

To better identify potential risk factors and pathways leading to FESH admission, select groups of diagnoses recorded in recent hospital admissions are described for the sample of young people in the study with at least one prior hospital admission (n=131). The descriptive summary presented in Table 10 below includes results for the top six ranked diagnosis groups found in hospital admissions from the year prior to FESH admission by Indigenous status. Appendix 1.12 provides details of all diagnosis groups considered.

Table 10 Distribution of diagnosis groups observed in past-year hospital admissions (2000–2017) by young people with a FESH admission (n=392) by Indigenous status

Diagnosis groups from recent hospital admissions	Aboriginal		Non-Aboriginal		Total	
	n	col%	n	col%	n	col%
Total	83	100.0%	48	100.0%	131	100.0%
Any psychiatric diagnosis						
No	54	65.1%	28	58.3%	82	62.6%
Yes	29	34.9%	20	41.7%	49	37.4%
Adjustment disorders						
No	76	91.6%	40	83.3%	116	88.5%
Yes	7	8.4%	8	16.7%	15	11.5%
Alcohol misuse*						
No	n.p.	-	n.p.	-	117	89.3%
Yes	n.p.	-	n.p.	-	14	10.7%
Injury-related						
No	61	73.5%	36	75.0%	97	74.0%
Yes	22	26.5%	12	25.0%	34	26.0%
Potentially avoidable hospitalisation^a						
No	68	81.9%	41	85.4%	109	83.2%
Yes	15	18.1%	7	14.6%	22	16.8%
Suicidal ideation						
No	72	86.7%	39	81.3%	111	84.7%
Yes	11	13.3%	9	18.8%	20	15.3%

Note: a. Most potentially avoidable hospital admissions were comprised of acute or chronic health conditions, with only one recent hospital admission identified as potentially vaccine preventable.

n.p. Results not presented as numbers are too small and risk re-identification

* Indicates $p < 0.05$

Although prior hospital admissions involving alcohol misuse were associated with young Aboriginal people in the study, the relationship may not be based on a reliable estimate due to such small numbers. It should be noted that there was a similarly high prevalence of mental health- and injury-related recent hospital admissions for young Aboriginal and non-Aboriginal people in the study. While mental health-related admissions are not necessarily reflective of mental illness or disorder, the recording of these diagnoses in administrative datasets often represents significant comorbidities associated with poorer health outcomes.⁵⁴ Although injuries are common in adolescence and mostly unintentional in cause, further investigation by type of injury is warranted but not feasible with the small number of cases available for analysis in this sample.

Summary

Recent hospital admissions prior to FESH admission are indicative of potentially important risk factors and pathways related to self-harm by young people. The administrative records of recent hospital admissions appear to be more sensitive to explaining risk factors and pathways in the hospital system for young Aboriginal people in the study, which may reflect higher hospital service usage (80.6% of FU identified) as much as it indicates poorer health. As multivariate analyses have shown, the likelihood of these recent hospital admissions prior to FESH admission are more strongly associated with female gender, remote residence, older age and FESH admission in Central Australia. In examining the types of recent hospital admissions prior to FESH, those involving alcohol misuse appear to be more strongly associated with young Aboriginal people in the study, but high proportions of recent mental health and injury-related hospital admissions were identified for all young people in the study. Along with frequent use, these hospital admissions indicate potential risk for future self-harm and should be considered as targets for early intervention prevention.

5.2.3 Recent child protection involvement

Notifications to child protection authorities can signal recent adverse life events and the absence of familial and social supports known to be associated with suicidal behaviours in adolescence.³⁹ The analyses in this section use a restricted sample of the study population who were minors at the time of FESH admission (aged 17 years or younger) to adjust for the legal age limit of children that can be reported to child protection authorities (n=277). This reduces any bias due to age differences in the study population and child protection cohort.

The prevalence of child protection notifications was very high, with just under 40% (n=110/277; 39.7%) of the analysis sample found to have been the subject of a child protection notification in the year prior to their FESH hospital admission and just over 30% of those notifications (n=38) were investigated and substantiated.

Table 11 Number and proportion of analysis sample (n=277) with at least one child protection notification in the year prior to FESH admission by type of reported harm and outcome (1999–2017)

	n	%
No notifications	167	60.3%
At least one notification	110	39.7%
Physical abuse	41	37.3%
Sexual abuse	18	16.4%
Emotional abuse	61	55.5%
Neglect	82	74.5%
Substantiated harm	38	34.5%

Note: A single notification may report more than one kind of alleged maltreatment simultaneously. Therefore, the number of notifications reported by type will not add up to the total number of notifications overall. The denominator used for calculating percentages by type of notification is the number of young people in the analysis sample with at least one notification (n=110).

Of the 110 total child protection notifications in the year prior to FESH admission within the analysis sample, a higher proportion were identified in young Aboriginal (n=84/157; 53.5%) compared to non-Aboriginal (n=26/120; 21.7%) people ($\chi^2=14.48$ df=1; $p<0.001$). The descriptive analysis below is restricted to the sample of young Aboriginal people (n=157) as the number of non-Aboriginal cases is too small to support any meaningful comparison.

Table 12 Distribution of past-year child protection notifications (1999–2017) by characteristics of young Aboriginal people in the analysis sample (n=157) at FESH admission

	Child protection notification in year prior to FESH admission				
	No		Yes		Total
	n	%	n	%	n
Total	73	46.5%	84	53.5%	157
Gender					
Female	44	44.4%	55	55.6%	99
Male	29	50.0%	29	50.0%	58
Age (group) at FESH admission**					
10–14	20	33.3%	40	66.7%	60
15–19	53	54.6%	44	45.4%	97
Residence at FESH admission					
Urban	35	44.3%	44	55.7%	79
Remote	37	48.1%	40	51.9%	77
Hospital network at FESH admission					
Top End	40	50.0%	40	50.0%	80
Central Australia	33	42.9%	44	57.1%	77
Type of self-harm at FESH admission					
Less potentially lethal method	49	49.0%	51	51.0%	100
More potentially lethal method	24	42.1%	33	57.9%	57
Comorbid psychiatric diagnosis at FESH admission?					
No	46	46.9%	52	53.1%	98
Yes	27	45.8%	32	54.2%	59

** Indicates $p < 0.01$

The observation that such a high proportion of young Aboriginal people in the study population had early (n=20/67; 29.9%) and more recent (n=84/157; 53.5%) child protection notifications suggests that the child protection population may be a group at higher risk of self-harm. This has recently been confirmed by research in Western Australia that examined the influence of child protection involvement on self-harm in adolescence.³⁷ A prospective study of the NT child protection population would help identify the population-level risks attributable to involvement in the child protection system and mediators and moderators of self-harm in adolescence that can inform improved coordination of preventive interventions and programs for these children across a range of human services.

5.2.4 Recent youth justice involvement

Numerous studies have shown that adults who come into contact with the criminal justice system are at much higher risk of self-harm⁵⁵, self-harm with higher suicidal intent⁵⁶, and death by suicide and other external causes^{57,58} compared to the general population. Involvement with the justice system is indicative of developmental contexts and trajectories associated with increased vulnerability to suicidal behaviours: family and community dysfunction, socio-economic disadvantage and deprivation, affiliations with antisocial peers and engaging in risky behaviours with adverse health outcomes, such as substance misuse. The elevated risk of self-harm and suicide amongst young people who come into contact with the youth justice system is also known to be associated with a range of psychopathologies.⁵⁹ Therefore, the analyses in this section will explore the associations between recent youth justice involvement in the year prior to FESH as a risk pathway indicative of these individual and contextual vulnerabilities to self-harming and suicidal behaviours.

The analyses presented below describe the prevalence of recent youth justice involvement (i.e. being charged with an offence) in the study population aged 17 years or younger (n=277) at FESH hospital admission.

Table 13 Proportion of young Aboriginal people in the analysis sample (n=277) with past-year youth justice involvement (1997–2017) by offence type

Youth justice involvement in year prior to FESH admission?	n	%
No	239	86.3%
Yes	38	13.7%
Property offences	29	76.3%
Violent offences	20	52.6%
Offences related to govt. order, procedures, etc.	19	50.0%
Public order offences	13	34.2%
Other offences	10	26.3%
Weapon/explosive offences	5	13.2%
Danger/neglect to others	2	5.3%
Illicit drug offences	1	2.6%

Note: A single contact with the youth justice system may include one or more offences. Therefore, the number of offences reported in this table will not add up to the total number of contacts overall. It should also be noted that the number of individuals with any youth justice involvement (n=38) is used as the denominator for calculating percentages by offence type.

Violent offences and property offences were each reported in over half of the youth justice involvements by young people in the year prior to FESH admission. Offences relating to government orders, etc. are indicative of prior involvement with police and/or the youth justice system, suggesting that almost half of the young people with an offence in the year preceding their FESH admission had prior offences or involvement with police.

Of the 38 young people with recent youth justice involvements, the majority were Aboriginal (n=34; 89.5%). Given the number of young non-Aboriginal people in the analysis sample is too small for meaningful comparison, the subsequent analyses will be restricted to investigating associations between recent prior youth justice involvement and the characteristics of young Aboriginal people aged 17 or younger at the time of FESH admission (n=157).

Table 14 Distribution of past-year youth justice involvement (1999–2017) by characteristics of young Aboriginal people in the analysis sample (n=157) at FESH admission

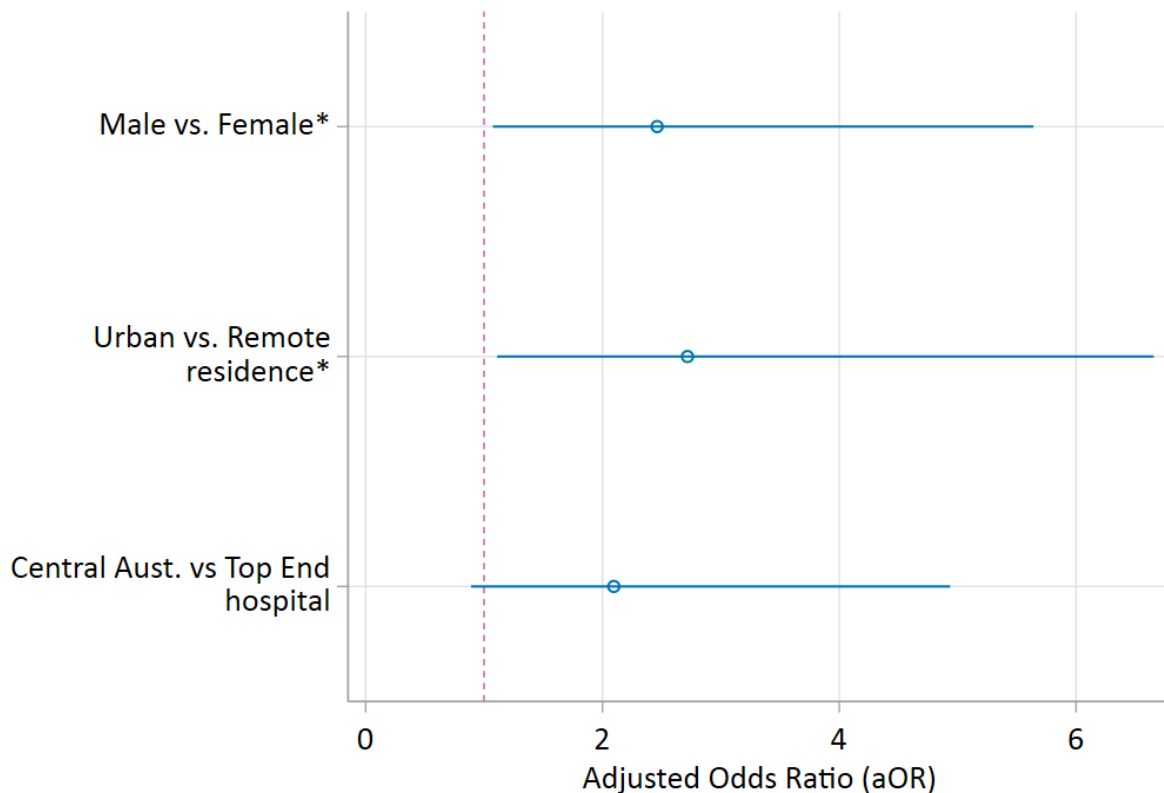
	Youth justice involvement in year prior to FESH?				
	No		Yes		Total
	n	%	n	%	n
Total	123	78.3%	34	21.7%	157
Gender					
Female	82	82.8%	17	17.2%	99
Male	41	70.7%	17	29.3%	58
Age (group) at FESH admission					
10–14	46	76.7%	14	23.3%	60
15–19	77	79.4%	20	20.6%	97
Residence at FESH admission**					
Urban	55	69.6%	24	30.4%	79
Remote	67	87.0%	10	13.0%	77
Hospital network at FESH admission*					
Top End	69	86.3%	11	13.8%	80
Central Australia	54	70.1%	23	29.9%	77
Type of self-harm at FESH admission					
Less potentially lethal mechanism	79	79.0%	21	21.0%	100
More potentially lethal mechanism	44	77.2%	13	22.8%	57
Comorbid psychiatric diagnosis at FESH admission?					
No	76	77.6%	22	22.4%	98
Yes	47	79.7%	12	20.3%	59

** Indicates $p < 0.01$; * Indicates $p < 0.05$

There are substantial differences in the proportion of recent youth justice involvement prior to FESH admission for urban residents and young people admitted to hospital in Central Australia. Further analyses were undertaken using multivariate logistic regression (see

Appendix 1.10 for details) to better quantify these associations, and the results of this analysis are provided in the graph below.

Figure 16 Likelihood of past-year youth justice involvement (1997–2017) associated with characteristics of young Aboriginal people in the analysis sample (n=156) at FESH admission



Note: A reference line is provided (dashed pink vertical line) to indicate where no differences in odds exist across categories of variables being analysed (i.e. AOR=1). The blue horizontal lines indicate the 95% confidence intervals for each of the estimated Adjusted Odds Ratios (hollow blue circle marker).

* Indicates $p < 0.05$

The results of multivariate analysis identified urban residents were almost three times more likely to have a recent youth justice involvement at the time of FESH admission (AOR 2.72, 95% CI: 1.11-6.66). Males were just over twice as likely than females to have a recent youth justice involvement prior to FESH admission (AOR 2.46, CI: 1.07-5.64). The results of the multivariate analysis appear to reflect the socio-demographic characteristics of youth justice involvement in the broader NT population.⁶⁰ This highlights the extent to which prior youth justice involvement may in and of itself represent a risk for self-harm.

6 Emerging risk profiles associated with first episode of self-harm (FESH) hospital admissions in the NT

Self-harm and other suicidal behaviour result from the complex interplay of multiple individual and contextual influences over time that have largely evaded reliable prediction.⁴⁰ This exploratory data linkage study outlines potential risk factors and pathways from early childhood to adolescence that are associated with different characteristics of FESH admissions in the NT.

Findings suggest the prevalence of poor early life health (see Figure 12 in Section 5.2.1) and high levels of adversity (almost 25%, see Section 5.2.2) within the study population are likely to be associated with vulnerability to suicidal behaviours in adolescence and adulthood. However, there are no notable differences in the characteristics of young people at FESH admission according to pre- and perinatal health indicators and child protection notifications before age five. This suggests there is a need for more comprehensive longitudinal investigations of self-harm that include additional markers of developmental impairment and difficulties in middle and later childhood that are likely to mediate or moderate these early childhood influences.

This report highlights the utility of data linkage research in exploring patterns of risk pathways indicating recent life stress and psychological difficulties that may exacerbate existing vulnerabilities to self-harm in adolescence and young adulthood. Recent school disengagement was prevalent in the study population (just over 60%, see Section 5.3.1). It confirms other research suggesting there is a need for interventions at key developmental periods: beginning in early childhood services and primary school for Aboriginal children and again in middle school where the onset of self-harm suggests the need for a mix of universal and indicated psychosocial interventions that target specific health-related behaviours such as peer and early sexual relations, and alcohol and substance misuse.

Recent hospital admissions prior to FESH admissions (just over 30% overall, see Section 5.3.2) represent an opportunity to identify and address potential health risk factors leading to self-harm. The findings show that patterns of recent hospital admission differ by Indigenous status. It shows that young Aboriginal people in the study who are female, older, urban residents and admitted in Central Australia are more likely to have had a recent hospital admission. The findings also indicate that 'frequent users' of hospital services may represent a distinct risk group that needs better access to primary and specialist health services. Previous hospital admissions involving alcohol misuse are more prevalent amongst young Aboriginal people with a FESH admission, a result that underscores the importance of current public health efforts to reduce alcohol-related harm amongst young people in the NT. Additionally, the proportion of both young Aboriginal and non-Aboriginal people in the study with prior hospital admissions involving mental health- and injury-related diagnoses was quite high and potentially indicative of psychosocial risk factors.

There is a high prevalence of recent child protection notifications (approximately 40%, see Section 5.3.3) amongst young people with a FESH admission. Only one third of these cases were substantiated, and the small numbers limited any meaningful analysis. However, the prevalence of notifications is consistent with other research that suggests the levels of adversity indicated by allegations of maltreatment in later childhood are a useful indicator of the risk of self-harm in adolescence.³⁷ Since notifications in early childhood are also relatively high within the study, there is a need for research that models family risks and vulnerabilities over time through investigations of relevant child protection and additional data sources to more clearly differentiate how early childhood adversity predicts later outcomes.

The prevalence of youth justice involvement in the year prior to FESH admission (just under 15%, see Section 5.3.4) requires further attention. Recent youth justice involvement may reflect important contextual influences of males and urban residents who present to hospital with self-harm. Further research is needed to better understand contextual influences that may help improve hospital assessments for these young people. Future data linkage studies incorporating other potentially available clinical and administrative data could assist in developing a better understanding of these contexts of risk. This could include contacts with police, and other human services that may be indications of emerging antisocial behaviour and exposure to adverse life circumstances.

In conclusion, the descriptive analysis of FESH admissions within the CYDRP birth cohorts confirms existing research describing differences in socio-demographic and clinical characteristics of these presentations by Indigenous status. Findings from the exploratory investigation of early life health and adversity indicate their importance in establishing vulnerabilities to self-harm in adolescence, but further work is needed to establish the utility of the CYDRP data repository to undertake prospective longitudinal analyses to identify causal mechanisms. Findings from the exploratory investigation of recent contacts with health, educational and welfare services have highlighted differences in proximal risk pathways leading to FESH admissions that can inform improvements to hospital assessment and, therefore, patient outcomes.

Given the relatively high proportion of young people in the study born interstate (approximately 20%) and what is known about the high rates of in- and out-migration,⁶¹ a retrospective approach to investigating the influence of risk pathways on FESH admissions is recommended. The study design should make use of a control group to provide a more reliable identification of risk associated with those pathways. This would enable better identification of which risk pathways should be targeted for different groups of FESH admissions to maximise the effect of preventive interventions. These findings also suggest extending the analysis presented here to better describe the combination of the separate risk pathways identified in this report and their association with characteristics of young people with FESH admissions. This could form the basis of clinical and social risk profiles of different groups of young people with FESH admissions according to patterns of risk

pathways experienced to better inform more context-sensitive hospital assessment of self-harm admissions by young people and, therefore, better hospital management and follow-up care on discharge. Taken together, this program of research offers significant potential to improve the evidence-base for both policy makers and practitioners making decisions about how best to prevent self-harm and its outcomes.

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Appendix 1: Technical details

A1.1 Study population selection criteria

First episode of self-harm hospital admission

The CYDRP data repository is designed around a cohort of approximately 145 000 children in the records of NT administrative datasets born between 1 January 1994 and 31 December 2014.

The population for this study was drawn from the hospital records for this birth cohort. Prior to applying the selection criteria, the hospital records were first cleaned to remove any duplicate separations that do not reflect episodes of care (i.e. statistical discharges, transfers, boarders). Where episodes of hospital care involved multiple separations spanning inter-hospital transfers, the separation records from the presenting hospital were retained as records from the transfer hospital often relate only to sequelae of the original self-harm and do not reflect original comorbidities, many of which are acute and episodic and, therefore, only recorded in the separation records at the presenting hospital.

Individuals were included in the study if they were observed with a hospital admission between 1 July 2000 and 30 June 2017 with at least one intentional self-harm diagnosis code in any one of the 50 diagnosis codes provided for each separation record. The full range of ICD-10-AM codes used to select the study population is provided below:

Table 15 Descriptive labels and ICD-10-AM codes used to identify self-harm hospital admissions in the NT Inpatient Activity dataset

Descriptive label used in report	ICD-10-AM Codes
Self-poisoning	X60-X69
Self-poisoning by motor vehicle exhaust	X67
Hanging	X70
Drowning	X71
Firearms	X72-X74
Fire, burn, etc.	X75-X77
Sharp object/self-cutting	X78
Blunt object	X79
Jump from height	X80
Moving object	X81
Motor vehicle (crash)	X82
Other	X83 and X84

Therefore, the study population can be described as all NT children born between 1994 and 2014 with a hospital admission involving intentional self-harm between 2000 and 2017.

Suicide

Mortality records held by the NT Births, Deaths and Marriages Registry include data collected through the completion of death certificates by professionals who are formally authorised according to legislation to do so (e.g. coroners, health workers, funeral directors). Death certificates must include information about the causes of death. The CYDRP repository contains all the data from death certificates in a de-identified form.

Suicide deaths were identified by first applying the rules recommended by the World Health Organisation for deriving ICD-10 mortality codes from free text descriptions of causes of death from death certificates and then applying further rules depending on the codes derived to identify the underlying cause of death.⁶² For this study, regular expression searches were used to identify free text cause-of-death descriptions with at least partial matches with the rules specified for identifying intentional self-harm (ICD-10 codes X60 to X84). The regular expression matches were then manually reviewed by the author to confirm suicide as the underlying cause of death. A conservative approach was taken with confirming cases of suicide deaths: there had to be clear indication of intent. For example, hanging deaths were not classified as suicide deaths where no perpetrator was mentioned or the perpetrator was self but intent was not clearly indicated. These ambiguous cases were further reviewed using the algorithm developed by the Australian Institute for Suicide Research and Prevention at Griffith University for classifying probable suicide deaths.⁶³

A1.2 Derivation of lethality of types of self-harm from ICD-10-AM diagnosis codes in hospital admission data

Lethality of diseases and injuries are defined through population-level case fatality studies. Typically, these studies compare the population rate of hospital admissions related to these diseases with the population rate of deaths caused by them to establish a case fatality ratio. In the case of suicidal behaviours, this is conventionally done by comparing hospital admissions and deaths involving self-harm according to the method of self-harm listed above. The most recent case fatality study of self-harm in Australia was undertaken in 2012, and some of the results based on hospital admissions and suicide deaths from 1994 to 2007 are presented below:

Table 16 Number of deaths, attempts and case fatality ratio by self-harm mechanisms, Australia, 1994–2007¹⁶

Mechanism	Deaths	Attempts	Case fatality ratio
Hanging	13,493	9,322	59.1
Motor vehicle exhaust poisoning	6,120	7,500	44.9
Other poisoning	4,216	288,160	1.4
Firearms	3,490	1,215	74.2
All other mechanisms	4,622	72,780	6.0

It should be noted that method of self-harm does not adequately capture the lethality of a suicide attempt alone as other factors, such as intent to die and access to different means, also play a large role. Therefore, on the basis of the available evidence, references will be made to potentially more lethal methods of self-harm, and these include hospital admissions with diagnosis codes for intentional self-harm by hanging (X70), intentional self-poisoning by motor vehicle exhaust (X67) and intentional self-harm by firearms (X72-75).

A1.3 Derivation of psychiatric comorbidities from ICD-10-AM diagnosis codes in hospital admission data

The full range of diagnosis codes for psychiatric comorbidities in hospital admission records are contained within Chapter V Mental and behavioural disorders of ICD-10-AM. Many psychiatric comorbidities used for analysis were the blocks of diagnosis codes defined in Chapter 5. They are not repeated here. The table below describes diagnosis code groups that have been derived specifically for this study:

Table 17 Comorbidities and ICD-10-AM diagnosis groups used for analyses

Comorbidity	ICD-10-AM diagnosis codes			Comments
Any psychiatric comorbidity	F00-F99			Derived from large population-based register study ⁶⁴
Alcohol-related admissions	E52 F10 G31.2 I42.6 K29.2	K70 K85.2 K86.0 T51	Z50.2 Z72.1 Z71.4 G62.1	Based on estimated population attributable fractions used in other studies using hospital admission data in the NT ⁶⁵
Alcohol use disorders	F10			Reliability established in large population-based register study ⁶⁴
Other substance misuse disorders	F11-F19			Reliability established in large population-based register study ⁶⁴
Psychotic symptoms	.5 and .7 of F10-F19 F20-F29 F30.2	F31.2, F31.5 F32.3 F33.3		Based on longitudinal analysis of administrative data ⁶⁶
Bipolar disorders	F30-F31			Derived from large population-based register study ⁶⁴
Non-affective psychotic disorders	F20-F29			Derived from large population-based register study ⁶⁴
Depressive symptoms	F31.3-5 F32 F33	F34.1 F41.2	F43.2 F20.4	Based on systematic review of depression diagnoses in administrative data ⁶⁷
Depressive disorders	F32 and F33			Derived from large population-based register study ⁶⁴
Anxiety disorders	F40-F42			Derived from large population-based register study ⁶⁴
Personality disorders	F60-F69			Derived from large population-based register study ⁶⁴

A1.4 Indicators of recent life stress and psychological difficulty

The ICD-10-AM diagnosis code groups are presented below that were used to define types of hospital admissions reflecting recent life stress and psychological difficulty by type of hospital admission (see Section 5.3.2).

Table 18 Diagnosis groups and ICD-10-AM codes used to identify hospital admissions related to recent life stress and psychological difficulties

Diagnosis groups	ICD-10-AM diagnosis codes	Comments
Any psychiatric diagnosis	F00-F99	Chapter V of ICD-10-AM
Injury-related	S00-T98	Excludes any records that also have intentional self-harm codes listed in Table 15
Potentially avoidable hospitalisation	<p><i>Vaccine-preventable:</i> J10, J11, J13, J14, J15.3, J15.4, J15.7, J15.9, J16.8, J18.1, J18.8, A35, A36, A37, A80, B05, B06, B16.1, B16.9, B18.0, B18.1, B26, G00.0, M01.4</p> <p><i>Chronic conditions:</i> E10.1-E10.8, E11.0-E11.8, E13.0-E13.8, E14.0-E14.8, E40-E43, E55.0, E64.3, D50.1-D50.9, I10, I11.9, I11.0, I50, J81, I20, I24.0, I24.8, I24.9, J41-J44, J47, (J20), J45, J46</p> <p><i>Acute conditions:</i> E86, K52.2, K52.8, K52.9, G40, G41, O15, R56, H66, H67, J02, J03, J06, J31.2, A69.0, K02-K06, K08, K09.8, K09.9, K12, K13, K25.0- K25.2, K25.4-K25.6, K26.0-K26.2, K26.4-K26.6, K27.0-K27.2, K27.4-K27.6, K28.0-K28.2, K28.4-K28.6, K35.0, N10, N11, N12, N13.6, N70, N73, N74, L03, L04, L08.0, L08.8, L08.9, L88, L98.0, L98.3</p>	Derived from classifications of diagnosis code groups defined in the Atlas of avoidable hospitalisations in Australia ⁶⁸ that have been used previously in the NT ⁶⁹
Suicidal ideation	R51.9	Defined by ICD-10-AM

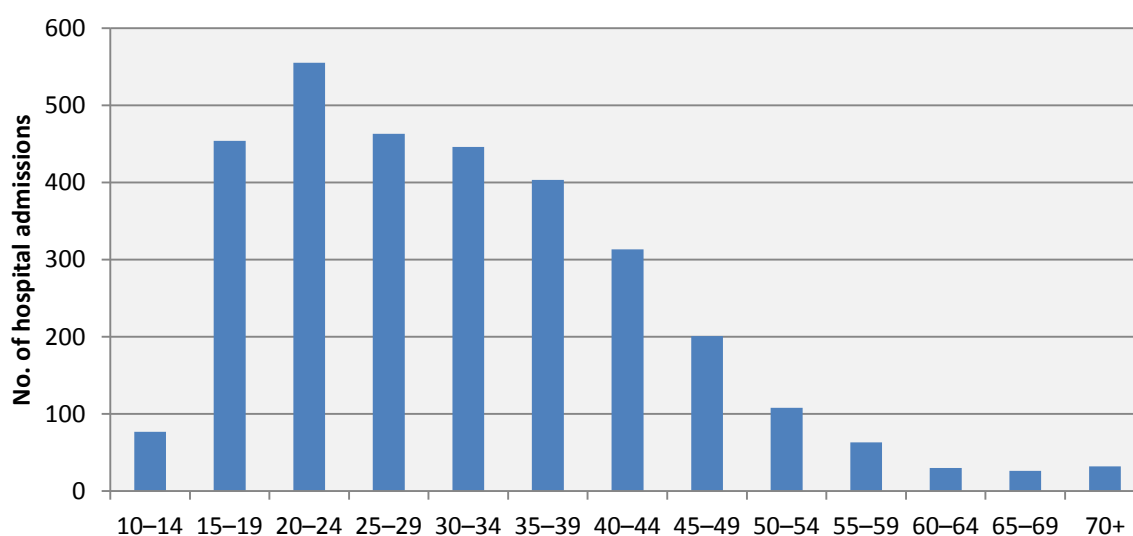
A1.5 The CYDRP birth cohort and its effects over time in identifying and analysing FESH admissions

As described in 1.1, the study population is drawn from the population of all NT children born between 1994 and 2014. The extent to which inferences from this exploratory study can be generalised to the wider population must take into account the incomplete data on participants (censoring and truncation) and the effect of time (age, period and cohort effects).

To ensure a focus on the descriptive and exploratory aims of this study, a retrospective study design was adopted to maximise the available sample. Because the mechanisms underpinning incomplete or missing data is different for each of the administrative datasets in the repository (see 1.6 for some discussion of this with respect to linkage rates), analyses were undertaken separately for each dataset included in this study. Within each separate analysis, careful consideration was given to appropriate sampling procedures, selection of indicators and analysis methods to minimise any bias relating to incomplete data.

However, the birth cohorts defined in the repository create artefacts that can be seen as age effects in this study. Self-harming behaviours differ according to age. Figure 17 shows all FESH admissions between 2001 and 2013 by age group from a population study in the NT.⁸

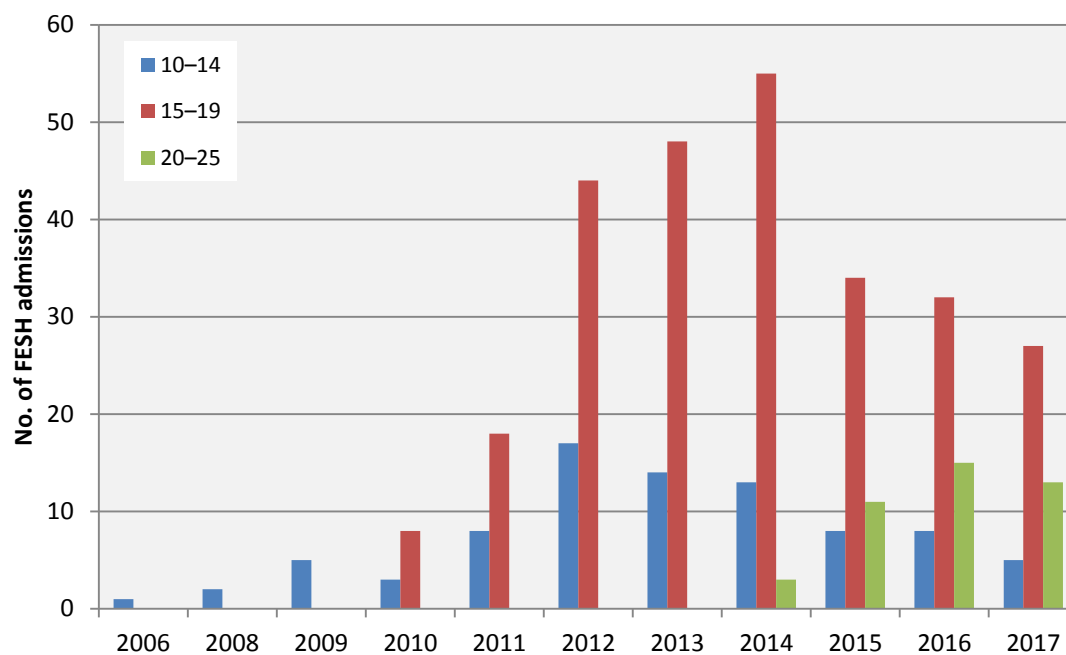
Figure 17 Number of hospital admissions by age group, NT 2001–2013



Source: Bernard Leckning, unpublished NT Hospital Inpatient Activity data, 2001-2013.

As can be seen, the peak of first episode of self-harm hospital admissions is in the 20–24 year age group. The oldest individual in the CYDRP birth cohorts (1994–2014) that could be identified in the Inpatient Activity dataset (2000–2017) would be aged 23 years. This means only four of the 20 years of births in the cohort (i.e. births from 1994 to 1997) are in the peak age group of self-harm hospital admissions in the NT. With respect to the 15–19 year age groups, all birth cohorts up to 2002 contribute individuals to the study. Thus, there is some censoring within the 15–19 and 20–25 year age groups in this investigation. This is illustrated in Figure 18 below by showing age at FESH admission by year of admission.

Figure 18 Number of FESH admissions within CYDRP birth cohorts by age group and year of admission



The drop in numbers of 10–14 and 15–19 year-old FESH admissions towards the latter years represents the way in which fewer birth cohorts are being observed during those years. The rise of 20–25 year-old first episode of self-harm hospital admissions reflects the observation of earlier birth cohorts in the hospital admissions dataset.

The CYDRP data repository provides full coverage of the birth cohorts up to age 13. Therefore, care has been exercised with interpreting any age-related analyses as these are likely to be skewed by the younger age of individuals in the study population.

A1.6 Linkage rates within CYDRP data repository for first episode of self-harm hospital admissions

Crude linkage rates are provided below and calculated as the proportion of individuals in the study population with at least one linked unit-record in each dataset from the CYDRP repository selected for consideration in this study.

Table 19 Number and proportion of FESH study population linked to CYDRP administrative datasets, 2017

Dataset	Linkage rate	
	n	%
Perinatal (1994–2014)	288	73.47%
School attendance (2005–2016)	357	91.07%
National Assessment Program – Literacy and Numeracy (NAPLAN) (2008–2016)	290	73.98%
Child protection (1998–2017)	243	61.99%
Youth justice (1997–2017)	77	19.64%

The relatively low linkage rates to perinatal records are most likely to reflect interstate births in the study population. The high proportion of the study population linked to school attendance records may be misleading in that it says very little about when the school attendance was recorded. In particular, for Aboriginal children, rates of school attendance drop drastically from middle school onwards—the years during which FESH was most likely observed. Therefore, analyses using school attendance must consider the recency of school attendance and year level. Furthermore, analyses should be restricted to the school-aged sample that are supposed to be observed in school attendance records between 2005 and 2016. NAPLAN linkage rates are also a reflection of school attendance patterns within the study population and can help with identifying possible censoring. Linkage rates for child protection and youth justice involvement can be taken to represent the prevalence of these contacts within the study population. However, some of these contacts may occur after the FESH admission.

A1.7 Multivariate logistic regression describing the association of recent school disengagement with characteristics of young Aboriginal people at FESH admission

Table 20 Logistic regression outputs estimating likelihood of school disengagement by FESH characteristics

Characteristics at FESH admission	Unadjusted models		Adjusted model	
	OR	95% CI	OR	95% CI
Male vs. female	1.068	0.482-2.367	1.036	0.429-2.504
Each year of age above 16	0.587**	0.427-0.809	0.595**	0.430-0.822
Remote vs. urban resident	0.735	0.342-1.582	0.562	0.235-1.346
Central Australia vs. Top End hospital	0.522	0.242-1.130	0.479	0.202-1.140
More vs. less lethal method of self-harm	1.683	0.707-4.003		
Observations	107			
Pseudo R-squared	0.113			
Hosmer-Lemeshow test	$\chi^2=2.98$; df=8; p=0.9357			
Sensitivity	65.52%			
Specificity	63.27%			
Correctly classified	64.49%			
Area under ROC curve	0.72			

** Indicates $p < 0.01$

A1.8 Multivariate logistic regression describing the association of past-year hospital admissions with characteristics of young Aboriginal people at FESH admission

Table 21 Logistic regression outputs describing unadjusted and adjusted odds of past-year hospital admissions associated with characteristics of young Aboriginal people at FESH admission

Characteristics at FESH admission	Unadjusted models		Adjusted model	
	OR	95% CI	AOR	95% CI
Female vs. male	2.530**	1.414-4.526	2.526**	1.331-4.793
Each year of age above 16	1.138*	1.012-1.279	1.244**	1.083-1.429
Urban vs. remote resident	2.048*	1.185-3.540	1.781	0.950-3.335
Central Aust. vs. Top End hospital	2.967***	1.701-5.175	3.044***	1.655-5.601
Any vs. no psychiatric comorbidity	1.065	0.621-1.828		
Self-poisoning vs. other methods	0.958	0.482-1.904		
Hanging vs. other methods	0.576	0.292-1.138		
Other vs. self-poisoning and hanging	1.571	0.529-4.667		
More vs. less lethal methods	0.594	0.333-1.061	0.954	0.495-1.836
Alcohol misuse comorbid vs. not	1.021	0.518-2.013		
AOD misuse comorbid vs. not	0.866	0.472-1.591		
Observations			231	
Pseudo R-squared			0.124	
Hosmer-Lemeshow test			$\chi^2=10.37$; df=8; p<0.239	
Sensitivity			52.44%	
Specificity			85.23%	
Correctly classified			73.59%	
Area under ROC curve			0.73	

*** Indicates p < 0.001; ** Indicates p < 0.01; * Indicates p < 0.05

A1.9 Descriptive overview of recent hospital admissions prior to FESH admission by young non-Aboriginal people

Table 22 Past-year hospital admissions (2000–2017) by characteristics of young non-Aboriginal people at FESH admission (n=156)

	Hospital admission in year prior to FESH?				
	No		Yes		Total
	n	%	n	%	n
Total	108	69.2%	48	30.8%	156
Gender					
Female	83	69.2%	37	30.8%	120
Male	25	69.4%	11	30.6%	36
Age (group) at FESH					
10–14	n.p.	-	n.p.	-	24
15–19	83	68.0%	39	32.0%	122
20–25	n.p.	-	n.p.	-	10
Residence at FESH					
Urban	97	69.8%	42	30.2%	139
Remote	11	64.7%	6	35.3%	17
Hospital network at FESH					
Top End	78	70.9%	32	29.1%	110
Central Australia	30	65.2%	16	34.8%	46
Type of self-harm at FESH					
Less potentially lethal mechanism	n.p.	-	n.p.	-	147
More potentially lethal mechanism	n.p.	-	n.p.	-	9
Comorbid psychiatric diagnosis at FESH					
No	56	69.1%	25	30.9%	81
Yes	52	69.3%	23	30.7%	75

A1.10 Multivariate logistic regression of clinical characteristics of FESH on youth justice involvement

Table 23 Logistic regression outputs describing unadjusted and adjusted odds of prior youth justice involvement associated with characteristics of young Aboriginal people at FESH admission

Characteristics at FESH admission	Unadjusted models		Adjusted model	
	OR	95% CI	AOR	95% CI
Male vs. female	1.714	0.794-3.701	1.709	0.736-3.970
Each year of age above 16	0.973	0.755-1.255	0.929	0.702-1.230
Urban vs. remote residence	2.924*	1.288-6.634	3.063*	1.235-7.597
Central Aust. vs. Top End hospital	2.672*	1.198-5.957	1.781	0.742-4.275
Any vs. no psychiatric comorbidity	1.036	0.474-2.265		
Self-poisoning vs. other methods	0.354*	0.143-0.875	0.332*	0.121-0.912
Self-cutting vs. other methods	2.138	0.933-4.900		
Hanging vs. other methods	1.152	0.525-2.524		
More vs. less lethal methods	1.111	0.508-2.434		
Alcohol misuse comorbid vs. not	2.058	0.795-5.325		
AOD misuse comorbid vs. not	2.138	0.933-4.900		
Observations	156			
Pseudo R-squared	0.113			
Hosmer-Lemeshow test	$\chi^2=4.91$; df=8; p=0.767			
Sensitivity	11.76%			
Specificity	95.08%			
Correctly classified	76.92%			
Area under ROC curve	0.74			

* Indicates $p < 0.05$

Appendix 2: Exploring data linkage and other study designs for investigating suicide deaths in the NT

The utility of data linkage for investigating suicide deaths is less well-established in the research literature. The majority come from Scandinavian countries with long-established high-quality population registers that combine administrative and clinical data.⁷⁰ The advantage of these linked population registers is that they enable powerful prospective longitudinal studies that identify and quantify the influence of risk and protective factors throughout the entire life course, from birth right through to death. Although the availability of clinically relevant data is limited through CYDRP for emulating such investigations, the breadth of data available theoretically provides the capacity for such prospective longitudinal studies of suicide that may identify pathways leading to suicide.

As described in the methodology (see Section 3), 27 cases of suicide death were identified in the CYDRP data repository of children in the NT born between 1994 and 2014. The majority were Aboriginal and involved hanging. Three cases of suicide deaths had a previous hospital admission involving self-harm. Due to the small number of cases, options for further analysis of suicide within the CYDRP data repository is limited, and detailed analysis of available linked records is not possible here. It is therefore important to consider the range of options for investigating suicide deaths⁷¹ that are applicable to the NT context and can facilitate a better understanding of risk and protective factors and pathways through which preventive interventions can be most effective.

The ideal study using a prospective longitudinal design to establish causal mechanisms may not be well suited to the NT population. As is well recognised, suicide is a rare event that requires both high-quality data and large sample sizes gathered over lengthy periods of time to adequately establish causal mechanisms from statistically significant associations. Because rates of suicide peak in adulthood, it is important to expand any investigation of the influence of child and youth development up to at least 35 years of age. While this would improve the sample for a prospective longitudinal investigation of suicide, the population dynamics of NT residents would pose further challenges. Many suicide deaths would be difficult to follow-up from birth since many are likely to be born interstate—approximately 30% of suicide deaths in the CYDRP birth cohorts were born interstate, and this proportion is likely to be higher with increasing age given what is known about migration patterns of NT residents over time.⁶¹

Although a prospective longitudinal study of suicide may be feasible for Aboriginal residents, who have lower rates of in- and out-migration compared to non-Aboriginal residents, there is a need to consider the extent to which the administrative datasets currently within and potentially available to CYDRP can adequately explain suicide deaths in the NT. The most recent review of evidence regarding risk factors leading to youth suicide⁷⁰ suggest CYDRP may not contain all of the clinically and contextually relevant data to explain these deaths. Thus, the utility of a prospective longitudinal study of suicide deaths using

data linkage alone may be limited. An alternative approach would be to prospectively recruit individuals in the community for follow-up. Although this would permit the collection of relevant data that are not captured in administrative datasets, the expense of such a study would far outweigh the benefits given the viability of such a research project would be undermined by the very high rates of attrition due to high levels of mobility and migration in the NT.

It is, therefore, recommended that a retrospective approach be taken to investigating both the factors influencing suicide deaths and the pathways through which they can be prevented. Since many cases of suicide deaths are likely to be born interstate and not observed for lengthy periods in the NT, a focus on the proximal influences on suicide deaths is recommended to identify causal mechanisms where possible and services through which preventive interventions can better target those at risk. As a first step, there would be a need to expand the study population to include adults up to at least 35 years, which is when suicidal behaviours tend to peak in the general population.⁷²

Psychological^{9,73} or sociological⁷⁴ autopsy study designs provide a rich source of life course, interpersonal and contextual data on suicide deaths. When such studies make use of control groups, they allow for stronger evidence of the causal nature of contextual influences and individual clinical characteristics.⁷⁵ Furthermore, a controlled autopsy study could make use of data linkage research capacity within CYDRP to expand and enrich the understanding of risk pathways through different services that may represent important opportunities for prevention. However, numerous steps are required to build towards such a program of research. An extended and contemporary version of previous exploratory audit studies of coronial records of suicide and related deaths^{4,5} is needed to identify the potential cases of suicide over at least the last 10 years to establish the hypotheses for a future large-scale controlled retrospective mixed-method investigation of suicide deaths in the NT.

