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Non-communicable disease mortality in young people with a history of contact with the youth justice system in Queensland, Australia: a retrospective, population-based cohort study

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Summary

Background Young people who have had contact with the criminal justice system are at increased risk of early death, especially from injuries. However, deaths due to non-communicable diseases (NCDs) in this population remain poorly described. We aimed to estimate mortality due to NCDs in people with a history of involvement with the youth justice system, compare NCD mortality rates in this population with those in the general population, and characterise demographic and justice-related factors associated with deaths caused by NCDs in people with a history of contact with the youth justice system.

Methods In this retrospective, population-based cohort study (the Youth Justice Mortality [YJ-Mort] study), we included all people aged 10–18 years (at baseline) charged with a criminal offence in Queensland, Australia, between June 30, 1993, and July 1, 2014. We probabilistically linked youth justice records with adult correctional records and national death records up to Jan 31, 2017. Indigenous status was ascertained from youth justice and adult correctional records, with individuals identified as Indigenous in either source classified as Indigenous in the final dataset. We estimated crude mortality rates and standardised mortality ratios (SMRs) for comparisons with data from the Australian general population. We identified risk factors for NCD deaths using competing-risks regression.

Findings Of 48 670 individuals aged 10–18 years (at baseline) charged with a criminal offence in Queensland, Australia, between June 30, 1993, and July 1, 2014, 11 897 (24·4%) individuals were female, 36 773 (75·6%) were male, and 13 250 (27·2%) identified as Indigenous. The median age at first contact with the youth justice system was 15 years (IQR 14–16), the median follow-up time was 13·4 years (8·4–18·4), and the median age at the end of the study was 28·6 years (23·6–33·6). Of 1431 deaths, 932 (65·1%) had a known and attributed cause, and 121 (13·0%) of these were caused by an NCD. The crude mortality rate from NCDs was 18·5 (95% CI 15·5–22·1) per 100 000 person-years among individuals with a history of involvement with the youth justice system, which was higher than among the age-matched and sex-matched Australian general population (SMR 1·67 [1·39–1·99]). Two or more admissions to adult custody (compared with none; adjusted sub-distribution hazard ratio 2·09 [1·36–3·22]), and up to 52 weeks in adult custody (compared with none; 1·98 [1·18–3·32]) was associated with NCD death.

Interpretation Young people with a history of contact with the justice system are at increased risk of death from NCDs compared with age-matched and sex-matched peers in the general Australian population. Reducing youth incarceration and providing young people's rights to access clinical, preventive, and restorative services should be a priority.

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Introduction

Adolescence (age 10–24 years)[1] is an important developmental stage that lays the foundation for future health outcomes.[2] The proportion of total deaths caused by non-communicable diseases (NCDs) in adolescents has increased considerably over the past decade and, in 2019, accounted for 27% of the estimated 1·49 million deaths among adolescents globally.[3,4]

The increasing prevalence of several risk factors for preventable NCDs in adolescents, such as obesity, tobacco smoking, and binge drinking,[5] indicates that this increase in deaths due to NCDs is likely to continue in the absence of substantial investment to improve adolescent health.[6] Structural factors such as inequalities in income and socioeconomic status have also been implicated in the onset of NCDs in adolescents.[7] Further inequities related to gender[8] and Indigenous status (eg, in Australia)[9] are key drivers of individual differences in health and wellbeing outcomes for this age group.

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Research in context

Evidence before this study

We searched the MEDLINE Ovid database up to Oct 11, 2022, for papers with any quantitative measure of the burden of non-communicable disease (NCD) mortality in young people (aged 10–24 years) with a history of contact with the criminal or youth justice system using the following search terms: (NCD* OR non-communicable) AND (mortality OR death* OR burden) AND (young OR youth OR adolescen* OR child* OR juvenile) AND (justice OR prison OR incarcerat* OR detention OR criminal OR custod* OR convict* OR offender*). No language restrictions were applied. Our search returned three peer-reviewed studies. One study examined the association between childhood adversity and all-cause mortality in adults, and included prison contact as an overall measure of childhood adversity but did not assess this component specifically. Another study investigated the association between childhood adversity and cancer in a birth cohort, without specifically assessing the association between justice system involvement and cancer. A third paper assessed mortality outcomes for adults in custody but did not focus on NCDs. None of these studies quantified NCD mortality among young people with a history of involvement with the criminal justice system.

Added value of this study

This is, to our knowledge, the first study to comprehensively characterise deaths due to NCDs for people with a history of contact with the youth justice system by age group, sex, and Indigenous status in Australia. We used probabilistic data linkage to create a globally unique dataset with youth justice, adult correctional, and death records combined for all young people who were charged with an offence during a period spanning more than two decades in the state of Queensland, Australia. We found that young people with a history of contact with the youth justice system had almost double the rate of deaths due to NCDs compared with their peers of the same age and sex in the general population. Further stratifying the analysis by Indigenous status showed that cardiovascular and digestive diseases were over-represented causes among deaths in our study cohort relative to the general population, especially for those who were Indigenous and male. Subsequent experiences of adult incarceration were also associated with an increased risk of death due to NCDs.

Implications of all the available evidence

Our study provides compelling evidence of a high burden of NCD mortality in young people with a history of involvement with the youth justice system. Our findings indicate that youth justice agencies could play an important role in promoting health literacy and improved health behaviours, and working with community health-service providers to facilitate timely and continuous access to health care, both during and after contact with the criminal justice system.

Exposure to disadvantageous social determinants of health, such as social marginalisation and exclusion, during adolescence is strongly associated with an increased risk of contact with the criminal justice system, especially at a younger age.[10] Young people with involvement with the justice system often lie at the intersection of these and various other social disadvantages. In Australia, where the age of criminal responsibility is 10 years, 4695 (one in every 714) people younger than 18 years are under youth justice supervision, including community-based supervision and detention, on any given day.[11] Half of these individuals identify as Indigenous (Aboriginal and Torres Strait Islander peoples), although Indigenous people comprise only about 6% of people aged 10–18 years in the Australian general population.[11]

Young people who have contact with the justice system are more likely than other young people to experience suicidal behaviours, violence, and injury, which can lead to premature death.[12,13] However, evidence about the burden of NCDs in young people with a history of involvement with the justice system is lacking and poses an impediment to reform.[14]

This study aimed to address this gap in knowledge by (1) estimating crude mortality rates due to NCDs stratified by sex, Indigenous status, and level of contact with the youth justice system; (2) comparing crude mortality rates in adolescents with a history of involvement with the justice system with those in the general population of the same age group, sex, and Indigenous status; and (3) identifying static and time-varying risk factors for deaths from NCDs for people with a history of involvement with the youth justice system.

Methods

Study design and setting

The Youth Justice Mortality (YJ-Mort) study is a retrospective, population-based cohort study comprising linked data for all individuals aged 10–18 years who were charged with one or more criminal offences between June 30, 1993, and July 1, 2014, in Queensland, Australia (n=49 011). The sample includes those with charges that did not lead to a sentence (referred to as charge only), and those who were convicted and served a community-based order or youth detention order. Individuals were censored at the end of the study (Jan 31, 2017), and death from any cause was treated as a study endpoint.

Data sources and linkage

Youth justice records from Youth Justice Queensland formed the sampling frame for the YJ-Mort study and were probabilistically linked with adult correctional records (from Queensland Corrective Services) and death records from Australia's National Death Index. The

probabilistic linkage was done by the Queensland Government Statistician's Office using first, middle, and last names, date of birth, sex, and residential postcode. We used jurisdictional linkage keys and single-person identifiers to improve the linkage between the datasets. The post-probability linkage threshold for matching records in pairs was set at 23%. Individuals who did not have available data on age at first known contact with the youth justice system, and those with data linkage inconsistencies, were excluded.

Indigenous status was ascertained from youth justice and adult correctional records, and individuals identified as Indigenous in either source were classified as Indigenous in the final dataset. From youth justice records, we included information on sex, dates of all contacts with the youth justice system, age at first known contact over the study period (dichotomised into <14 years *vs* ≥14 years), and the nature of each event (charge only, community-based order, or youth detention). For the level of justice involvement, we derived a static variable defined by the most serious level of youth justice system contact at the end of the study (justice history) and a time-varying variable defined by the most serious level of youth justice system contact at any time during the study (justice penetration). To further characterise involvement with the youth justice system, we also included categorical variables for the number of charges (one to four or five or more charges), number of community-based orders (none, one, or two or more), number of youth detention admissions (none, one, or two or more), and aggregate time spent in youth detention during the study period (0, ≤12 weeks, or >12 weeks) in the analysis.

From adult correctional records, we obtained the dates of all community-based orders and incarceration episodes for the cohort from Jan 1, 1994, to Jan 31, 2017. From these records, we created categorical variables for the count of the total number of adult custody admissions (none, one, or two or more) and the total time spent in adult custody (0, ≤52 weeks, or >52 weeks) during the study period. From youth justice and adult correctional records combined, we derived a time-varying variable reflecting current legal status, categorised into two mutually exclusive categories: in the community (unsupervised); or under supervision (youth or adult).

We obtained death records for the cohort up to Jan 31, 2017, from the National Death Index, a database maintained by the Australian Institute of Health and Welfare (AIHW). We derived information on the dates and underlying causes of all deaths on the basis of the International Classification of Diseases Australian Modification (ICD-AM) versions 9 and 10 (we used version 9 for deaths that occurred on or before Dec 31, 1996, and version 10 for all deaths that occurred thereafter). ICD-10-AM codes for death records between Jan 1, 2016, and Jan 31, 2017 (end date of the study), were not available at the time of data extraction because of a lag in reporting. These deaths were coded as "no available cause". We compared the groups with and without an attributable cause of death (among those who died during the study) to assess whether those groups differed and how differences in this characteristic could have affected our results.

For comparisons with the general Australian population, we acquired aggregate population mortality data for 2015 from the AIHW, including the number of deaths and total population by age group, sex, and Indigenous status for the Australian states of Queensland, New South Wales, Western Australia, South Australia, and the Northern Territory, which are considered by the AIHW to have adequate ascertainment of Indigenous status. The year 2015 was selected for comparison because ICD-10-AM codes for death records between Jan 1, 2016, and Jan 31, 2017, were not available in our study.

Ascertainment of causes of death

Using the disease classification structure for ICD-9 and ICD-10 codes from the Global Burden of Disease Study (GBD) 2019,[15] underlying causes of death were grouped into three mutually exclusive first-level categories: (1) NCDs; (2) communicable, maternal, neonatal, and nutritional diseases; and (3) injuries, including self-harm and suicide. Consistent with the GBD methodology, deaths with ICD-9 and ICD-10 codes that did not fit any of these three first-level categories were classified as having no attributable cause.

We further categorised deaths caused by NCDs into 12 second-level categories: neoplasms, cardiovascular diseases, chronic respiratory diseases, digestive diseases, neurological disorders, mental disorders, diabetes and kidney conditions, skin and subcutaneous diseases, sense organ diseases, musculoskeletal disorders, substance use disorders, and other NCDs. Because we observed no deaths caused by mental disorders, skin and subcutaneous disorders, or sense organ diseases as underlying causes of deaths, these second-level categories were not included in the cause-specific analysis.

Because of small numbers (<5), deaths caused by diabetes and kidney diseases and musculoskeletal disorders were grouped with other NCDs. The list and cause hierarchy of all health conditions included in each of the first-level and second-level categories and the ICD-9-AM and ICD-10-AM codes used for the classification process are presented in the appendix (pp 1–13).

See Online for appendix

Statistical analysis

We report sample characteristics for the whole cohort stratified by sex and history of youth justice system involvement, and present the number of deaths, time at risk in the study (in person-years), and crude mortality rates for deaths caused by NCDs stratified by youth justice history, age at first known contact with the youth justice system, sex, and Indigenous status. We calculated

	Charged (n=28 250)		Community-based order (n=12 278)		Detention (n=7542)		All (n=48 670)		p value*
	Female (n=7959)	Male (n=20 291)	Female (n=2631)	Male (n=10 247)	Female (n=1307)	Male (n=6235)	Female (n=11 897)	Male (n=36 773)	
Age at first contact with youth justice system									
<14 years	655 (8·2%)	1355 (6·7%)	463 (17·6%)	1617 (15·8%)	399 (30·5%)	2102 (33·7%)	1517 (12·8%)	5074 (13·8%)	0·0037
≥14 years	7304 (91·8%)	18 936 (93·3%)	2168 (82·4%)	8630 (84·2%)	908 (69·5%)	4133 (66·3%)	10 380 (87·3%)	31 699 (86·2%)	..
Indigenous status									
Indigenous	1966 (24·7%)	3480 (17·2%)	1150 (43·7%)	3080 (30·1%)	656 (50·2%)	2918 (46·8%)	3772 (31·7%)	9478 (25·8%)	<0·0001
Non-Indigenous	5993 (75·3%)	16 811 (82·9%)	1481 (56·3%)	7167 (69·9%)	651 (49·8%)	3317 (53·2%)	8125 (68·3%)	27 295 (74·2%)	..
Number of charges									
1–4	7842 (98·5%)	19 936 (98·3%)	1977 (75·1%)	7624 (74·4%)	426 (32·6%)	1666 (26·7%)	10 245 (86·1%)	29 226 (79·5%)	<0·0001
≥5	117 (1·5%)	355 (1·8%)	654 (24·9%)	2623 (25·6%)	881 (67·4%)	4569 (73·3%)	1652 (13·9%)	7547 (20·5%)	..
Number of youth justice orders									
0	7959 (100%)	20 291 (100%)	1470 (55·9%)	5031 (49·1%)	218 (16·7%)	544 (8·7%)	8177 (68·7%)	20 835 (56·7%)	<0·0001
1	0	0	1161 (44·1%)	5216 (50·9%)	186 (14·2%)	667 (10·7%)	1656 (13·9%)	5698 (15·5%)	..
≥2	0	0	0	0	903 (69·1%)	5024 (80·6%)	2064 (17·4%)	10 240 (27·9%)	..
Number of youth detention admissions									
0	7959 (100%)	20 291 (100%)	2631 (100%)	10 247 (100%)	0 (0%)	0 (0%)	10 590 (89·0%)	30 538 (83·0%)	<0·0001
1	0	0	0	0	677 (51·8%)	2558 (41·0%)	677 (5·7%)	2558 (7·0%)	..
≥2	0	0	0	0	630 (48·2%)	3677 (59·0%)	630 (5·3%)	3677 (10·0%)	..
Number of adult detention admissions									
0	7351 (92·4%)	16 471 (81·2%)	2125 (80·8%)	6327 (61·7%)	857 (65·6%)	2197 (35·2%)	10 333 (86·9%)	25 995 (68·0%)	<0·0001
1	266 (3·3%)	1486 (7·3%)	197 (7·5%)	1169 (11·4%)	124 (9·5%)	741 (11·9%)	587 (4·9%)	3396 (9·2%)	..
≥2	342 (4·3%)	2334 (11·5%)	309 (11·7%)	2751 (26·9%)	326 (24·9%)	3297 (52·9%)	977 (8·2%)	8382 (22·8%)	..

Data are n (%). *Two-tailed χ^2 test for difference between male and female individuals.

Table 1: **Characteristics of study participants by sex and level of contact with the youth justice system**

p values from χ^2 tests for categorical variables and from *t* tests for continuous numerical variables. We estimated standardised mortality ratios (SMRs) for deaths caused by NCDs, comparing the crude mortality rates in our study with rates in the general Australian population of the same age and sex. We also estimated SMRs further standardised by Indigenous status, in addition to age and sex, for which crude mortality rates in our study were compared with rates in the population of people of the same age, sex, and Indigenous status. Deaths without a reported or attributable cause were included in the estimation of all-cause mortality but not in the cause-specific crude mortality rates and SMRs.

We fitted univariable and multivariable competing-risks regression models with sub-distribution hazard ratios using the Fine and Gray method[16] to assess associations between risk factors and deaths due to NCDs. The competing event was defined as death by any cause other than an NCD. All multivariable models were adjusted for sex, Indigenous status, and age (time-varying, entered as a binary variable [<19 *vs* ≥19 years], which represents a cutoff point between youth and adult corrective services records). We did tests based on Akaike's Information Criteria (AIC), which showed that the model with the covariates sex, Indigenous status, and age (time-varying) had a better fit (lower AIC) than a model with only sex and Indigenous status as covariates (AIC 2442 *vs* 2451). All p values were two-tailed. Given the use of population-based linked datasets in which all individuals had complete data, we had no missing data for exposures or outcomes in the competing risk models (other than deaths with no reported or attributable cause).

Analyses were done in Stata (version 16.0). Ethical approval was obtained from the Griffith University (2016/376) and AIHW (EO2016/3/280) Human Research Ethics Committees. This study used secondary data from government-held databases; therefore, a waiver of consent was obtained. Data access approvals were obtained from Youth Justice Queensland and the Queensland Corrective Services Research Committee. This study is reported in accordance with the STROBE statement (appendix p 17).[17]

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

We identified 49 011 individuals aged 10–18 years who were charged with a criminal offence in Queensland, Australia, between June 30, 1993, and July 1, 2014, of whom we excluded 341 (<0·1%) because of data linkage inconsistencies or for not having available data on age at first known contact with the youth justice system,

	NCD deaths (%)	Person-years at risk (%)	CMR (95% CI)	SMR (95% CI)
Total deaths	1431	653 651	218·9 (207·9–230·6)	4·1 (3·9–4·4)
NCD deaths	121	653 651	18·51 (15·49–22·12)	1·67 (1·39–1·99)
Youth justice history				
Charged	57 (47·1%)	365 784 (56·0%)	15·58 (12·02–20·20)	1·41 (1·09–1·83)
Community-based order	39 (32·2%)	185 261 (28·3%)	21·05 (15·38–28·81)	1·85 (1·35–2·53)
Detention	25 (20·7%)	102 605 (15·7%)	24·37 (16·46–36·06)	2·25 (1·52–3·33)
Age at first contact				
<14 years	20 (16·5%)	92 234 (14·1%)	21·68 (13·99–33·61)	2·39 (1·54–3·71)
≥14 years	101 (83·5%)	561 417 (85·9%)	17·99 (14·80–21·86)	1·57 (1·29–1·91)
Sex				
Female	22 (18·2%)	150 901 (23·1%)	14·58 (9·60–22·14)	1·64 (1·08–2·49)
Male	99 (81·8%)	50 750 (76·9%)	19·69 (16·17–23·98)	1·67 (1·37–2·04)
Indigenous status				
Indigenous	35 (28·9%)	173 354 (26·5%)	20·19 (14·50–28·12)	1·91 (1·27–2·67)
Non-Indigenous	86 (71·1%)	480 297 (73·4%)	17·91 (14·94–22·12)	1·58 (1·28–1·96)
Indigenous status and sex				
Indigenous and female	5 (4·1%)	46 194 (7·1%)	10·82 (4·51–26·01)	1·28 (0·53–3·06)
Indigenous and male	30 (24·8%)	127 161 (19·5%)	23·59 (16·50–33·74)	2·09 (1·46–2·99)
Non-Indigenous and female	17 (14·0%)	104 707 (16·0%)	16·24 (10·09–26·12)	1·79 (1·11–2·88)
Non-Indigenous and male	69 (57·0%)	375 590 (57·4%)	18·37 (14·51–23·26)	1·54 (1·22–1·95)

Data are n or n (%), unless otherwise indicated. CMR=crude mortality rate per 100 000 person-years. NCD=non-communicable disease. SMR=standardised mortality ratio, standardised by age group and sex.

Table 2: **Mortality due to NCDs stratified by history of contact with the youth justice system, age at first contact, Indigenous status, and sex**

yielding a final valid sample of 48 670 individuals (table 1).

11 897 (24·4%) individuals were female and 36 773 (75·6%) were male. 13 250 (27·2%) were identified as Indigenous, including 52 individuals who were identified as being Indigenous in either only youth justice or only adult correctional records (table 1). Among those who were sentenced to a community-based order or detention, 7804 (38·2%) were Indigenous (table 1). The median age at first contact with the youth justice system during the study period was 15 years (IQR 14–16). The median follow-up time was 13·4 years (8·4–18.4) and the median age at the end of the study was 28·6 years (23·6–33·6). 1431 deaths occurred in the cohort during the study period, 932 (65·1%) of which had a known and attributed cause recorded at the time of data extraction. Of these, 121 (13·0%) deaths were from NCDs, 800 (85·8%) from injuries, and 11 (1·2%) from communicable or maternal diseases. The remaining 499 (34·9%) deaths either did not have an attributable cause (n=342 [23·9%]) or did not have an available cause of death (n=157 [11·0%]) in the death records. The group with an attributable cause of death had a higher proportion of Indigenous (31·2% *vs* 22·5%; χ^2 p=0·0024), a higher proportion of male individuals (85·3% *vs* 79·0%; χ^2 p=0·0067), and were younger at death compared with the group without an attributable cause (mean of 23·2 *vs* 25·4 years, *t* test p<0·0001).

110 (91%) of 121 deaths due to NCDs happened in the community after youth justice system contact; five (4%) deaths occurred during a youth or adult community-based order. The median age at death due to an NCD was 30·5 years (IQR 25·8–34·0). The crude mortality rate for deaths due to NCDs was 18·51 (95% CI 15·49–22·12) per 100 000 person-years (table 2). Mortality due to NCDs was higher among individuals with a history of contact with the youth justice system than among the general population (SMR 1·67 [1·39–1·99]), with increased mortality rates among those who had their first contact with the youth justice system before age 14 years (SMR 2·39 [1·54–3·71]) and in those who had experienced at least one episode of detention (SMR 2·25 [1·52–3·33]; table 2). Rates of deaths due to NCDs were higher than for the comparable general population for female (SMR 1·64 [1·08–2·49]), male (SMR 1·67 [1·37–2·04]), Indigenous (SMR 1·91 [1·27–2·67]), and non-Indigenous people (SMR 1·58 [1·28–1·96]; table 2). Figure 1 describes cumulative incidence curves of NCD deaths during the study period by youth justice history (time-varying), and by sex and Indigenous status, including effect sizes from the competing risk regression models. The incidence of NCD deaths was highest for those who experienced detention and for Indigenous males in those analyses (figure 1).

Deaths caused by cardiovascular disease (SMR 2·56 [95% CI 1·81–3·62]) and digestive conditions (SMR 2·81

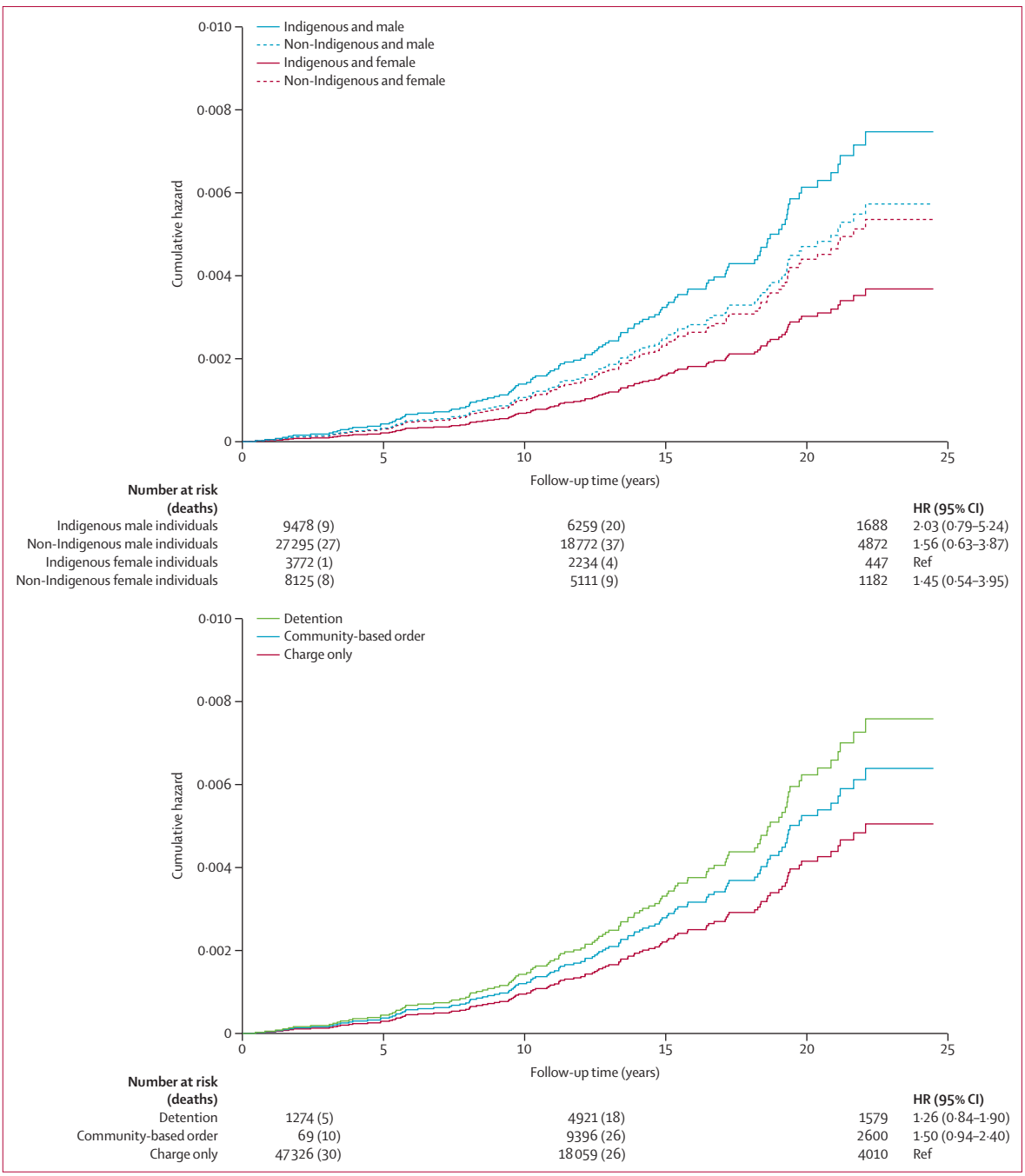


Figure 1: **Cumulative incidence of deaths due to NCDs during the study period by history of contact with the youth justice system (time-varying), and by sex and Indigenous status**
Effect sizes calculated using competing-risks regression models. NCD=non-communicable disease.

[1·41–5·62]) were more common in the group with a history of youth justice system involvement than in age-matched and sex-matched individuals in the general population (figure 2). However, mortality rates due to chronic respiratory diseases were lower among individuals with a history of contact with the youth justice system than in the general population (0·08 [0·04–0·17]; figure 2; appendix p 15). Rates of other specific causes of NCD deaths did not differ significantly between those with a history of involvement with the youth justice system and age-matched and sex-matched individuals in the general population (figure 2). Those who were Indigenous and male had higher rates of deaths due to cardiovascular disease (SMR 4·79 [2·72–8·43]) and digestive conditions

(SMR 5·38 [1·73–16·68) compared with the general Australian population of the same age and sex (figure 2; appendix p 15).

When SMRs were further standardised by Indigenous status (in addition to sex and age), we found that non-Indigenous people in our study had a higher rate of deaths due to NCDs (SMR 1·72 [95% CI 1·39–2·12]) compared with age-matched and sex-matched non-Indigenous people in the community. The overall rate of deaths due to NCDs for Indigenous people with a history of youth justice system involvement was not different to age-matched and sex-matched Indigenous people in the community (SMR 0·72 [0·52–1·00]). These results, including stratifications by sex, are given in the appendix (p 15).

SMRs for deaths caused by neoplasms among non-Indigenous female individuals (2·17 [95% CI 1·17–4·03]), deaths caused by cardiovascular disease in non-Indigenous male individuals (2·81 [1·72–4·58]), and deaths caused by digestive diseases in Indigenous male individuals (3·92 [1·26–12·16]) were higher among those who had a history of youth justice system involvement than among their peers of the same sex, age group, and Indigenous status in the general population (appendix p 15).

In the competing risk regression models, having two or more adult custody admissions was associated with an increased risk of death due to an NCD compared with no adult custody admissions, after adjusting for sex, age (time-varying), and Indigenous status (adjusted sub-distribution hazard ratio 2·09 [95% CI 1·36–3·22]), consistent with the unadjusted estimate (2·00 [1·32–3·03]; table 3). Spending up to 52 weeks (1·74 [1·09–2·77]) or more than 52 weeks (1·98 [1·18–3·32]) in adult custody (compared with no adult incarceration) were also associated with increased risk of death due to an NCD (table 3). Results from a model adjusted for sex and Indigenous status only confirmed results from our main multivariable model (appendix p 16).

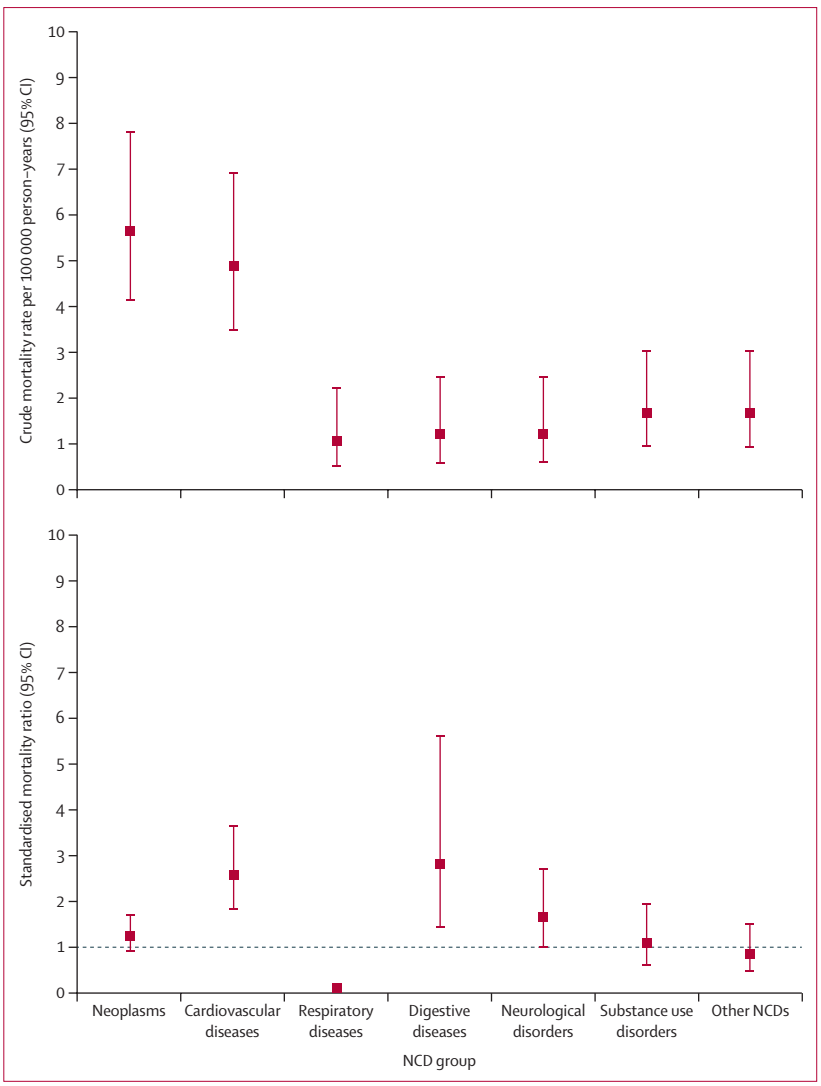


Figure 2: **Cause-specific crude mortality ratios and standardised mortality ratios**
NCD=non-communicable disease.

Discussion

In this retrospective, population-based cohort study of young people who had contact with the youth justice system between the ages of 10 and 18 years in the state of Queensland, Australia, we found that the rate of death from NCDs was susbtantially higher among individuals with a history of youth justice system involvement than among peers of the same age and sex in the general Australian population. Our study is, to our knowledge, the first to quantify the NCD mortality burden in young people with a history of contact with the youth justice system. The increased NCD mortality observed in our cohort is consistent with evidence of young people reporting a high prevalence of complex health problems during detention.[12]

We found that rates of death due to cardiovascular and digestive diseases were particularly increased among those with a history of involvement with the youth justice system compared with the age-matched and sex-matched general population. The increased rates of cardiovascular diseases contrasts with previous reports that both male and female individuals in detention have higher rates of physical activity than their age-matched and sex-matched general population in Australia.[18] Proportionally to their increased health needs, adults released from prison might have high rates of acute health-care use.[19,20] However, evidence suggests that young people released from incarceration frequently experience inadequate continuity and quality of care in the community compared with older groups, despite also commonly being affected by multiple health conditions.[21]

We found that first contact with the youth justice system before age 14 years was associated with a substantially increased NCD mortality rate compared with the general population, and subsequently that

	Deaths	Person-years at risk	Univariable sub-distribution hazard ratio (95% CI)	Multivariable sub-distribution hazard ratio (95% CI)*
Sex				
Female	22	150 901	Ref	Ref
Male	99	502 750	1·27 (0·80–2·02)	1·24 (0·78–1·98)
Indigenous status				
Non-Indigenous	86	480 297	Ref	Ref
Indigenous	35	173 354	1·15 (0·78–1·71)	1·08 (0·72–1·63)
Age at first contact with youth justice				
<14 years	20	92 234	Ref	Ref
≥14 years	101	561 417	0·84 (0·52–1·35)	1·02 (0·60–1·71)
Youth justice penetration†				
Charge without community-based order or detention	57	376 168	Ref	Ref
Order without detention	39	181 362	1·26 (0·84–1·90)	1·18 (0·77–1·80)
Detention	25	96 122	1·50 (0·94–2·40)	1·29 (0·78–2·12)
Legal status†				
Community (unsupervised)	111	585 125	Ref	Ref
Under youth or adult justice supervision‡	10	68 527	0·91 (0·48–1·75)	0·65 (0·31–1·35)
Number of charges				
1–4	98	544 791	Ref	Ref
≥5	23	108 860	1·07 (0·68–1·69)	0·89 (0·53–1·48)
Number of youth justice orders				
0	61	387 057	Ref	Ref
1	38	187 712	1·16 (0·77–1·74)	1·07 (0·71–1·64)
≥2	22	78 883	1·45 (0·89–2·36)	1·23 (0·73–2·10)
Number of youth detention admissions				
0	96	557 529	Ref	Ref
1	11	42 585	1·42 (0·76–2·65)	1·31 (0·70–2·46)
≥2	14	53 536	1·34 (0·76–2·35)	1·11 (0·62–1·99)
Time spent in youth detention				
None	96	557 532	Ref	Ref
≤12 weeks	14	62 947	1·23 (0·70–2·16)	1·11 (0·63–1·95)
>12 weeks	11	33 173	1·60 (0·86–3·00)	1·35 (0·69–2·62)
Number of adult custody admissions				
0	75	531 570	Ref	Ref
1	11	43 252	1·36 (0·72–2·57)	1·38 (0·73–2·61)
≥2	35	78 829	2·00 (1·32–3·03)	2·09 (1·36–3·22)
Time spent in adult custody				
None	75	531 570	Ref	Ref
≤52 weeks	23	68 705	1·70 (1·07–2·73)	1·74 (1·09–2·77)
>52 weeks	23	53 376	1·89 (1·17–3·08)	1·98 (1·18–3·32)

Data are n, unless otherwise indicated. *Adjusted for sex, age (<19 *vs* ≥19 years), and Indigenous status. †Time-varying covariate, defined by the most serious level of youth justice system contact at any time during the study. ‡Includes community-based orders and detention.

Table 3: **Association between risk factors and NCD mortality in people with a history of contact with the youth justice system**

experiencing two or more episodes of adult incarceration (compared with none) was a risk factor for death from an NCD. Early-life physical and social adversity have been associated with adolescent criminalisation,[10] making a case for early interventions before justice system contact takes place, and where possible, investment in alternatives to criminal sanctioning for vulnerable young people. These early interventions are especially important in Australia, where the age of criminal responsibility is as low as 10 years, and where Aboriginal and Torres Strait Islander children and adolescents are disproportionally incarcerated.[11] In Queensland, where children aged 10–13 years can be held criminally liable if they are deemed to have understood that their actions were wrong (a provision known as *doli incapax*), the overrepresentation of Indigenous compared with non-Indigenous young people under supervision in the youth justice system (by a factor of 22:1, in 2021–22)[11] suggests systematic discrimination against Indigenous people.

Indigenous people with a history of youth justice system involvement had similar rates of death from NCDs to their age-matched and sex-matched Indigenous peers in the general population. This finding might reflect the disproportionally high risk of deaths due to external causes at younger ages (before the typical age of onset of NCDs) for Indigenous compared with non-Indigenous people.[22] Nonetheless, rates of death from NCDs for Indigenous people with a history of youth justice system involvement were still twice as high as those in the (age-matched and sex-matched) general Australian population.

We observed a higher proportion of deaths without an attributable cause (also referred to as garbage codes) in those with a history of contact with the youth justice system (24% in our study) than in the general Australian population (14%).[23] This finding suggests that coronial records for justice-involved youth are often of poor quality, in line with existing evidence that higher age-standardised proportions deaths without an attributable cause are associated with a lower socio-demographic index.[24] Although a lack of available data did not allow us to compare whether groups with and without an attributable cause of death were different in terms of their location of residence (ie, rural *vs* urban), we found that those with an attributable cause of death were more likely to be Indigenous, male, and younger at death compared with those without an attributable cause of death. The Sustainable Development Goals[25] and the Global Strategy for Women's, Children's, and Adolescents' Health (2016–30)[26] have highlighted the importance of high-quality adolescent health monitoring systems. Particular efforts are needed to improve the quality of death data for marginalised groups, including young people with justice system involvement.

The results of our study advance understanding of overall NCD mortality in Australia—a country with an epidemiological profile that has transitioned from a higher relative burden of communicable diseases to a higher relative burden of NCDs and injuries in the past four decades.[3] Although our findings confirmed that injuries remain the largest contributor to deaths in people with a history of contact with the youth justice

system, we have provided clear evidence of increased NCD mortality among individuals with contact with the youth justice system. Although our methods did not allow inference of a causal link between justice system contact and risk of death due to NCDs, the co-occurrence of the two factors indicates that they could have similar origins. Because justice system contact commonly co-occurs with many other sources of social exclusion, such as homelessness and inadequate engagement with support services, incarceration during adolescence should be implemented only when a community-based order is not feasible, and for the shortest time possible. If adolescents serve a community-based order or are admitted to a detention facility, they should retain the fundamental right to access all necessary clinical, preventive, and restorative services and programmes to meet their needs.

Young people with a history of contact with the criminal justice system might have increased difficulty engaging with primary and preventive care when in the community due to the high prevalence of substance use disorders, mental illness, stigma, and unstable accommodation in this population.[10,12,27] Therefore, youth justice agencies and community support services have an important role to play in facilitating timely and continuous access to appropriate health care, and supporting behaviour changes that might reduce the risk of early NCD onset and progression.

This study has some limitations. Our ascertainment of causes of death was restricted to recorded information about underlying causes of death. Therefore, we did not consider the burden of non-fatal NCDs (which represents 56% of all disability-adjusted life years in adolescents)[5] as a contributor to other causes of death (eg, overdose or self-harm). Consistent with GBD coding, our cause-of-death hierarchy included self-harm in the first-level group of injuries rather than as an NCD. Although our definition of NCD death[15] included deaths caused by substance use disorders, the definition did not capture deaths caused by drug overdose, which would have been categorised as an injury death. The absence of usable information on causes of death for almost 35% of the cohort probably resulted in the underestimation of counts and rates of deaths caused by NCDs.

Nearly a quarter of all deaths in the cohort did not have an attributable cause of death, mostly because these deaths were assigned to causes that cannot be directly responsible for the death of a person, such as milder forms of infection or NCDs.[15] Inadequate death ascertainment could have explained the much lower rate of deaths by respiratory conditions among individuals with a history of involvement with the youth justice system compared with matched peers in the general population. We did not attempt to redistribute the non-attributable causes of death in our study, as the practice of redistribution of non-attributable causes of death in administrative data can lead to bias and inefficient public health decision-making processes depending on how the information is used.[24]

Information about Indigenous status in our datasets was represented in a single binary indicator of at least one self-report of being Indigenous in any of the youth justice or adult correctional records. As such, we might have under-ascertained Indigenous status in the study. Approximately 38% of young people who were under youth supervision at any point in the study (ie, served a community-based order or detention) were Indigenous, consistent with what has been reported for the Queensland population.[11]

Given the potential under-ascertainment of Indigenous status from administrative data,[28] the true relative burden of NCD mortality for Indigenous people with a history of youth justice system involvement compared with that of the general Australian population is likely to be higher than we have reported. Nonetheless, the inadequacy of existing data structures and systems for the collection, application, ownership, and sovereignty of administrative data from Indigenous peoples in Australia is well documented.[29] Comparisons of mortality rates between Indigenous and non-Indigenous people in our study are unlikely to fully represent health disparities faced by Indigenous people in Australia.

In conclusion, young people who come into contact with the youth justice system are at increased risk of death due to NCDs compared with the general population, with cardiovascular and digestive diseases being responsible for the greatest relative mortality burden, especially among those who are Indigenous and male. Improved health data surveillance, prevention efforts, and health care for young people with a history of involvement with the justice system, including during detention, is crucial to stopping a cycle of amplified social exclusion and disadvantage.

Contributors

LC-F and SAK designed the study and the methodology. LC-F conducted the statistical analysis and produced all drafts of the manuscript. JTY, KF, MW, RB, SMS, and GCP contributed to the study design and methodology. L-CF, JTY, and SAK directly accessed and verified the underlying data reported in the manuscript. AC, MJS, RB, SMS, and SAK acquired financial support for the collection of data used in this study. All authors contributed intellectually, interpreted findings, revised, edited, and approved the final version, and were responsible for the decision to submit this manuscript for publication.

Declaration of interests

AB is Co-chair of the Indigenous Cardiovascular Council, Cardiac Society of Australia and New Zealand. All other authors declare no competing interests.

Data sharing

The datasets generated or analysed for this study are not publicly available, and the participants of this study did not agree for their data to be shared publicly. Access to these administrative data is contingent on approvals from relevant ethics committees and data custodians. Queries can be directed to the corresponding author. The analytical code for the statistical analyses can be found online at https://github.com/lcferreira01/YJ-Mort_NCD.

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