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# Effects of perinatal conditions and local area socioeconomic status on early childhood mortality in New South Wales: linked data analysis

Summary report

Prepared by the Australian Institute of Health and Welfare  
for the Child Death Review Team, NSW Ombudsman

A report under section 34H  
Community Services (Complaints, Reviews and Monitoring) Act 1993



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ISBN 978-1-922802-47-7 (Online)

ISBN 978-1-922802-48-4 (Print)

### **Suggested citation**

Australian Institute of Health and Welfare (2022) *Effects of perinatal conditions and local area socioeconomic status on early childhood mortality in New South Wales: linked data analysis – Summary report*. Prepared by the Australian Institute of Health and Welfare for the Child Death Review Team, NSW Ombudsman. Catalogue number IHW 269, AIHW, Australian Government.

### **Australian Institute of Health and Welfare**

Board Chair

Mrs Louise Markus

Chief Executive Officer

Mr Rob Heferen

Any enquiries about or comments on this publication should be directed to:

Australian Institute of Health and Welfare

GPO Box 570

Canberra ACT 2601

Tel: (02) 6244 1000

Email: [info@aihw.gov.au](mailto:info@aihw.gov.au)

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## Executive summary

This summary report briefly describes the scope of, and presents key findings from, a separately published full report that uses linked data to analyse the effects of selected perinatal characteristics and area-level socioeconomic status conditions on early child mortality in New South Wales. Full results from this study, including the methods used, are published in the [Main report](#).

The study was commissioned by the NSW Child Death Review Team (CDRT) and builds on previous analyses by the Australian Institute of Health and Welfare (AIHW) of the CDRT Register of Child Deaths (NSW CDRT 2014, 2018). Earlier studies focused on analysing data available only for the children who had died. This study extended the scope of analyses by connecting these death records to the birth records of the full cohorts of babies born in New South Wales. This allowed risk factors for child mortality to be better identified by directly comparing the characteristics of babies who have died with those of babies who have survived to specific ages.

This analysis requires data linkage of birth and death records. Hence, its focus has changed slightly – from the analyses done previously of all NSW-registered deaths to the analysis of deaths among all NSW-born babies.

### Study scope and methodology

This study is based on the cohorts of all liveborn babies in New South Wales between 2005 and 2018. This dataset was created by linking the NSW Perinatal Data Collection with the NSW Birth Registration Collection to create the full cohorts of NSW liveborn babies. The births dataset was then linked to death records from 2005 to 2019 compiled from the AIHW National Death Index and the NSW CDRT Register of Child Deaths.

As well, several area-level socioeconomic status indicators based on the usual area of residence of the mother at the time of giving birth were added to the linked dataset from the Australian Bureau of Statistics derived Socio-Economic Indexes for Areas and from the Australian Early Child Development Census.

By placing child deaths within the context of their entire birth cohort, detailed multivariate regression modelling could be conducted to analyse and compare the importance of various risk factors for early childhood mortality. These risk factors were analysed separately by age at death and, where possible, over time in 3 different birth year cohorts: 2005–2010, 2011–2014 and 2015–2018. Separate analysis was also carried out for risk factors related to Aboriginal and Torres Strait Islander children who died under age 1.

## Key findings



Preterm birth was found to be the strongest and most consistently significant risk factor for infant mortality (death under age 1), especially for babies born under 32 weeks gestational age. The preterm effect was less pronounced, although still a consistently significant risk factor, for babies born between 32 and 36 weeks gestational age compared with full term babies (37 weeks or above gestational age).

Other consistently significant risk factors for infant death included being born:



with a birthweight that is small for gestational age



to a teenage mother (aged 19 or under)

The greater risk of dying under age 1 for preterm babies born under 32 weeks gestation is moderated if the preterm birth was a caesarean section delivery. Such preterm babies still had a substantially higher risk of dying than full-term babies, but a lower risk than preterm babies under 32 weeks gestational age delivered by other methods (including vaginal birth).

Indigenous babies were found to have a significantly higher risk of dying under age 1 than other babies only in the first 2 birth cohorts: 2005–2010 and 2011–2014. There was a pronounced narrowing of the gap in infant mortality between Indigenous and non-Indigenous babies across the 15-year period (2005–2019) of death records. This partly explains why the estimated risk of infant death in the regression model results for the most recent 2015–2018 birth cohorts was not higher among Indigenous babies than among other NSW-born babies.

Risk factors for deaths between ages 1 to 4 across the entire 2005–2018 birth cohorts include:



birthweight being small for gestational age



being an Indigenous baby



being a male baby



mother aged 20–25 when giving birth



maternal smoking during pregnancy

Preterm birth in itself did not continue to be a significant risk factor for death between ages 1 to 4, including for the subgroup of babies under 32 weeks gestational age.

*continued*

## Key findings (continued)

In the separate analysis of infant deaths among Indigenous babies only, similar risk factors were identified to those found in the entire infant population, including:



**preterm birth (again, substantially higher risk among babies born under 32 weeks gestational age, but also a higher risk for babies born between 32 and 36 weeks)**



**being born small for gestational age**



**being born to a teenage mother (aged 19 or under)**

The area-level socioeconomic status indicators based on the usual place of residence of the mother when giving birth were not found to be consistently significant risk factors when estimated jointly with the other maternal and baby characteristics being analysed. Similarly, the use and timing of antenatal care was not found to be a significant factor clearly associated with early childhood mortality.

## Study contributions and some suggested extensions

A key strength of this study was the demonstration that perinatal records can be reliably linked to death records to better understand risk factors for early childhood mortality. The results also showed that linking death records to a set of perinatal variables alone provided a clearer understanding of the fundamental risk factors associated with early childhood death in New South Wales, especially for the death of babies under age 1. Perinatal characteristics were shown to have a larger role in explaining death of children under age 1 than in death of children between ages 1 to 4.

Limitations included the small number of Indigenous child deaths identified in the linked data for the selected birth cohorts, and that administrative data collected for a specific purpose (such as the NSW Perinatal Data Collection) may not capture all the relevant risk factors for death at older ages (even within the category of death under age 5 as analysed in this report).

Further research expanding this linked data set is recommended to explore the relationships between early childhood mortality and other factors beyond the perinatal characteristics. This will require additional data linkages to the birth and death records linked for this study.



# 1 Introduction

Child mortality has continued to decline in New South Wales in line with the general decrease across Australia (AIHW 2020a, 2020b; Australian Government 2020). The key risk factors contributing to child mortality are generally understood; however, there is a more limited understanding of the complex relationships between the social determinants of health and specific health-related factors (such as those listed below) (AHMAC 2017; AIHW 2018):

- the conditions of birth (such as preterm birth and low birthweight)
- maternal health and risk factors during pregnancy (such as smoking during pregnancy, and pre-existing maternal chronic conditions such as diabetes and hypertension)
- access to and timely use of antenatal care
- the socioeconomic status of the mother and family, as well as of the area the mother (and baby) resided in at the time of birth (neighbourhood effects).

The NSW Child Death Review Team (CDRT) is a statutory body established to prevent or reduce the deaths of children in New South Wales. To do this, it maintains a register of all child deaths occurring in the state; identifies trends and patterns in the data; and recommends legislation, policies, practices and services to prevent or reduce the likelihood of child deaths (NSW CDRT 2020). Another key function of the CDRT is to identify topics requiring further research and to undertake research projects.

The CDRT has previously commissioned the Australian Institute of Health and Welfare (AIHW) to conduct research on child mortality in New South Wales related to child protection history, and on geographic variation in child mortality (NSW CDRT 2014, 2018). The collaboration continues with this project.

## Study design and methodology

The study population consists of all babies born alive in New South Wales between 2005 and 2018 as recorded in the NSW Perinatal Data Collection (PDC) or the NSW Birth Registration Collection (BRC). These birth data were linked to the NSW CDRT Register of Child Deaths and to National Death Index (NDI) records to identify the children in these birth cohorts who died between 2005 and 2019, and their age at death.

The Perinatal and Birth registration datasets identified 1,393,488 unique records of live-born babies in NSW between 2005 and 2018 (an average of around 99,500 births per year). The PDC records alone identified 1,337,341 unique live-born babies in NSW between 2005 and 2018 (an average of around 95,500 births per year). This latter became the effective total birth cohorts for this study because any subsequent analyses of the effects of perinatal conditions on child mortality can be carried out only for those births that have a full PDC record.

From the total number of births with a PDC record, the data linkage identified 3,715 deaths of children aged under 5, most of which were deaths under age 1 (3,067 or 83% of total under 5 deaths).

The linked data set also added in broader contextual information about the area in which the mother (and child) usually resided at the time of birth. Two of these – the Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socio-Economic Advantage and Disadvantage decile rankings (ABS 2013), and the percentage of children considered developmentally vulnerable on one or more domains of the Australian Early Development Census (AEDC) (DET 2022) – were used in the analyses.

The following statistical methods were used for the data analyses in this report:

- summary tabulations at aggregate level
- bivariate analyses of the differences in selected perinatal characteristics and area-level socioeconomic status indicators between children who have died and children who survived to specific ages
- multivariate analyses using logistic regression models to identify specific risk and protective factors related to child death among all children, along with a separate analysis conducted for Indigenous children.

This Summary report focuses mainly on the results of the multivariate regression modelling in the following 3 categories:

- risk factors for infant mortality (death under age 1) among all NSW-born babies, analysed separately over 3 different birth-year cohorts (2005–2010, 2011–2014 and 2015–2018)
- risk factors for death between ages 1 to 4 among all NSW-born babies, analysed in a single model using a combined 2005–2018 birth cohort (due to the small number of deaths in this age group)
- risk factors related to infant mortality in Aboriginal and Torres Strait Islander children, using the combined NSW-born cohorts of 2005–2018 (again, due to the small number of deaths in this category). This separate analysis was conducted to better document and understand the factors behind the known disparities in the mortality rate and causes of death between Indigenous and non-Indigenous Australian children.

In the first 2 subcategories of analyses (see above), where the regression model is estimated over the full population of all NSW-born babies, Indigenous status of the baby is one of the explanatory variables included in the model.

Children in the linked file were identified as Indigenous if any of the following criteria were met among the variables reported in the data collections linked to a particular child:

- mother is identified as Indigenous in the NSW perinatal data
- child is identified as Indigenous in the NSW perinatal data (this variable is collected from 2011 onwards only)
- among children who have died, the child is identified as Indigenous in the CDRT data
- among children who have died, the child is identified as Indigenous in the NDI.

The linked data file identified around 60,300 children with Indigenous status as defined above; among them, 383 had died before age 5, of whom 309 (81%) had died under age 1.

The Indigenous status of children who have not died can be based only on the first 2 criteria from the perinatal data; the Indigenous status of those children who have died can be derived from any of the 4 criteria listed above. Some children were identified as Indigenous only in the birth records but not in either source of the death records, and vice versa. Since there is no clear basis to assess which of the different sources for Indigenous status are more reliable, the approach taken was to assign Indigenous status to a birth record in the linked file if any of the above 4 criteria applied. The reasonableness of this approach was not further tested in this study.

The full list of the explanatory variables used in the multivariate regression analyses – drawn from the Perinatal Data Collection and the additional area-level socioeconomic status variables added to the linked data – is presented in Box S.1.

The final set of variables included in the regression models was mainly based on the results of the initial bivariate analyses. The maternal and baby characteristics that differed most between children who had died and those who had survived to specific ages were considered for inclusion in the models. The selected variables also reflect the findings of previous AIHW analyses of the risk factors for child death using national-level linked data on births and deaths (AIHW 2021b), analyses of neonatal deaths from the Perinatal National Minimum Data Set (AIHW 2021a), and analyses of child deaths in New South Wales based on the CDRT Register of Child Deaths without any additional data linkage (NSW CDRT 2018).

#### **Box S.1: Explanatory variables used in the logistic regression models**

Demographic and geographic variables:

- birth cohort period (2005–2010, 2011–2014, 2015–2018, or a combined 2005–2018 cohort)
- age category of mother (under 20 years, 20–25 years, 26–30 years, 31–35 years, over 35 years)
- remoteness of mother’s usual place of residence at the time of birth using a 3-way classification: *Major cities*, *regional area* (combining *Inner/Outer regional*) and *remote area* (combining *Remote/Very remote*)
- Indigenous status of the baby (based on Indigenous status in any source in linked data)

Variables likely to be present at the ***onset of pregnancy***:

- pre-existing maternal diabetes
- chronic maternal hypertension
- the birth is the mother’s first pregnancy

Variables likely to arise ***during pregnancy***:

- sex of baby
- antenatal care (no antenatal care, timely first antenatal care, or late antenatal care after 13 weeks gestational age)
- mother smoked during pregnancy
- baby was part of non-singleton births

*continued*

### **Box S.1 (continued): Explanatory variables used in the logistic regression models**

Variables determined at the *end of pregnancy*:

- preterm birth (in two sub-categories by gestational age: under 32 and 32 to 36 weeks; the under 32 weeks combines 'extreme' and 'very early' preterm, and 32 to 36 weeks combines 'moderate' and 'late' preterm sub-categories as conventionally defined (WHO 2012))
- small for gestational age (birthweight at the tenth percentile or below, relative to all Australian liveborn babies born between 2004–2013, by sex (AIHW 2022))
- caesarean delivery
- postpartum haemorrhage (PPH) developed by mother that required a blood transfusion

Additional area-level socioeconomic status indicators at the Statistical Area Level 2 (SA2), based on the region of the usual residence of the mother at the time of giving birth:

- percentage of children in mother's usual SA2 of residence considered developmentally vulnerable on one or more domains (using the AEDC collections of 2009, 2012, 2015 and 2018)
- SEIFA Index of Relative Socio-Economic Advantage and Disadvantage decile ranking for the SA2 in which the mother usually resided at the time of giving birth.

## 2 Mortality rates and time trends

The study population in the linked data of all liveborn babies in New South Wales between 2005 and 2018 was around 1.34 million. Of these, the linkage identified 3,715 deaths of children under age 5, of which 3,067 (83%) were deaths under age 1; and among deaths under age 1, 1,664 (54%) were deaths before 7 days old.

The child mortality rates that can be computed for these NSW liveborn cohorts (cohort-specific mortality rates) are different from the calendar year(s) based mortality rates that are usually reported – for instance, by the CDRT (NSW CDRT 2019, 2021).

The cohort-specific infant mortality (died under age 1, calculated as a rate per 1,000 live births) from the linked data for this study declined from 2.6 deaths per 1,000 live births in the 2005–2010 birth cohorts to 1.9 deaths per 1,000 in the most recent 2015–2018 birth cohort. The cohort-specific mortality rate for deaths between ages 1 to 4 was considerably lower, at around 0.5 deaths per 1,000 live births, and it was consistent across the birth cohorts that could be followed up to age 5.

Overall, child mortality under age 5 (ages 0 to 4) in New South Wales has fallen, from 3.2 deaths per 1,000 in 2005–2010 to 2.9 deaths per 1,000 in 2011–2014.

When cohort-specific mortality rates are compared for Indigenous and non-Indigenous children by even narrower birth year sub-groupings, a larger reduction is seen in the Indigenous death rate. For the 2005 and 2006 birth cohorts, the Indigenous under-5 mortality rate was 4 times the rate for non-Indigenous children. For the latter birth cohorts of 2013 and 2014, the Indigenous under-5 rate dropped considerably and was 2.5 times the rate for non-Indigenous children – a considerable narrowing of the gap.

### Cause of death

Causes of death in the linked data for this project are based on the *International Statistical Classification of Diseases and Related Health Problems, 10th revision* (WHO 2014). The dominant cause of death of children under age 1 was ‘conditions originating in the perinatal period’ for both Indigenous and non-Indigenous children (accounting for 44% and 51% of total deaths under age 1, respectively). Examples of cause of death classified as ‘conditions originating in the perinatal period’ include being small for gestational age, extremely low birthweight, congenital viral diseases and bacterial sepsis of the newborn.

The most common cause of death in children aged 1 to 4 was ‘accidents, injuries and other external causes’. This cause accounted for 50% of all Indigenous child deaths for ages 1 to 4 and 26% of non-Indigenous deaths. Conditions originating in the perinatal period accounted for a small proportion of total deaths between ages 1 to 4 – less than 3% for both Indigenous and non-Indigenous children.

Indigenous children were more likely than non-Indigenous children to die due to ‘accidents, injuries and other external causes’ at all ages, including at ages older than 5 (AIHW 2020b).

### 3 Risk factors from bivariate analyses

This section presents a simple comparison of the characteristics of children who died and of those who survived to specific ages, using a set of the perinatal characteristics and the selected area-level socioeconomic indicators. The bivariate analyses are based on comparing a single risk factor (such as preterm birth or smoking during pregnancy) without considering the relationships between the full set of the different risk factors related to the risk of dying by specific ages. Bivariate analysis was conducted for each of the birth cohorts, but results are presented here only for the 2015–2018 birth cohort. For more detail on the results for earlier cohorts, see Main report Appendix Table A4.1.

The bivariate analyses were carried out separately for each of the 3 birth cohorts. Some examples of the significant risk factors seen in the 2015–2018 cohort (factors that were more common among children in the 2015–2018 cohort who died under age 1 than among those who survived to age 1) were, respectively:

- being male (57% among died under age 1 versus 51% among survived)
- being Indigenous (9.8% versus 5.9%)
- non-singleton births (11% versus 2.8%)
- preterm birth (60% versus 7.0%)
- birthweight small for gestational age (20% versus 11%)
- teenage mother (4.2% versus 2.1%)
- mother experiencing postpartum haemorrhage requiring blood transfusion (4.2% versus 1.0%).

Some other characteristics were found to be significant in the bivariate analysis of the earlier birth cohorts. These separate bivariate analyses helped to identify the risk factors that were subsequently included in the multivariate regression analysis described in Section 4.

Significant risk factors that were more common among children who died between ages 1 to 4 in the 2011–2014 cohort than among those who survived to age 5 were, respectively:

- being Indigenous (11% versus 5.3%)
- preterm birth (9.4% versus 7.0%)
- small for gestational age (16% versus 11%)
- mother smoked during pregnancy (18% versus 10%).

## 4 Risk factors from multivariate analyses

Multivariate regression analyses adjust for the role of other potential risk or protective factors on child death. This type of analysis is a more robust method to identify the key factors contributing directly to child death.

This section presents results of multivariate logistic regression analyses of the factors associated with child death at different ages (under age 1, or between ages 1 to 4) and for both the full study cohort of all NSW-born babies (where Indigenous status is one of the explanatory variables in the model) and the subgroup of only NSW-born Indigenous babies.

### Deaths under age 1 – all babies

Preterm birth was the most significant risk factor for deaths under age 1, with the risk of dying being 211 to 280 times as likely among babies born under 32 weeks gestational age compared with full-term babies. Among babies born at 32 to 36 weeks gestational age, the risk of dying under age 1 was roughly 5 times as likely compared with full-term babies.

This risk of dying among preterm babies under 32 weeks gestational age, however, was reduced considerably if the delivery was by caesarean section rather than via other methods, including vaginal birth. Babies under 32 weeks gestational age delivered by caesarean section were still more likely to die (40 to 58 times as likely as full term babies), but their relative risk of dying was lower if they had a caesarean delivery compared to any other delivery method.

Caesarean delivery was never estimated to be a significantly protective factor among preterm babies in the 32 to 36 weeks gestational age category. It was not significantly related to the risk of dying for preterm babies in this gestational age category in the models estimated in this study.

The role of caesarean delivery was very different among full-term births (37 weeks gestational age or more). It was consistently found to be a significant risk factor, with full-term babies delivered by caesarean section more likely to die under age 1 than full-term babies delivered by other methods.

Why the apparent protective effect of caesarean delivery occurs only among early gestational age preterm babies (represented by the under 32 weeks sub-category in this study) and not in any other gestational age sub-categories needs further investigation. A few international studies find similar protective effects of caesarean delivery for very low birthweight infants (Al Qurashi 2020), but the more general result is mixed on whether caesarean delivery is protective or risky. The effect of caesarean delivery has also been found to differ depending on whether it is medically indicated or an elective choice of the mother (Yang and Sun 2017), but it was not feasible to investigate this distinction using the NSW PDC data extract used in this project.

Selected regression model results on the odds ratios associated with specific significant risk factors for death under age 1 in the estimated models for each of the 3 birth cohort periods are shown later in this report, in Figure S.1.

As well as preterm birth, other significant risk factors for dying under age 1 were:

- baby's birthweight being small for gestational age (2.6 to 2.7 times as likely)
- being born to a teenage mother (1.4 to 1.7 times as likely compared with babies born to mothers aged 26–30)
- mother experienced postpartum haemorrhage requiring a blood transfusion (1.6 to 2.7 times as likely in periods 2 and 3 only)
- being male (1.2 times as likely as female babies in periods 1 and 2 only).

The additional risk of dying under age 1 for Indigenous babies relative to non-Indigenous babies had a clear time trend:

- the highest additional risk (1.8 times as likely) was estimated for babies born between 2005 and 2010
- a lower level of additional risk (1.5 times as likely) was found among babies born between 2011 and 2014
- in the most recent birth cohort period (2015–2018), no significant difference was found in the risk of dying for Indigenous babies compared with non-Indigenous babies.

When deaths occurring within the first 7 days of life were excluded in the analyses of deaths under age 1:

- the risks associated with preterm birth under 32 weeks and between 32 and 36 weeks were both reduced, but remained as significant risk factors (32 to 40 times as likely to die among preterm babies under 32 weeks, and around 3 times as likely to die among those between 32 and 36 weeks gestational age)
- there were increased risks associated with birthweight being small for gestational age (to 2.2 to 3.1 times as likely to die), and being born to a teenage mother (to around 2 times as likely)
- smoking during pregnancy became a significant risk factor (in periods 1 and 3, with babies born to mothers who smoked 1.5 to 1.7 times as likely to die)
- mother experiencing postpartum haemorrhage was no longer a significant risk factor.

These results are presented later in this Summary report, in Figure S.2.

## Deaths between ages 1 to 4 – all children

Due to the small number of deaths in this age group, the records of all birth cohorts from 2005 to 2018 were pooled and a single model was estimated for this whole period. Several maternal and baby characteristics continued to be significant in explaining death of babies between ages 1 to 4.

These included:

- baby's birthweight being small for gestational age (1.7 times as likely)
- being an Indigenous baby (2.2 times as likely)
- being a male baby (1.3 times as likely).

Preterm birth did not continue to be a significant risk factor for death between ages 1 to 4, including for the under 32 weeks gestational age sub-category.



Other significant risk factors associated with child death between ages 1 to 4 were young maternal age (1.4 times as likely among mothers aged 20–25 compared with mothers aged 26–30) and maternal smoking during pregnancy (1.3 times as likely).

The significant odds ratio results associated with the risk factors of death between ages 1 to 4 are presented later in this Summary report, in Figure S.3.

## Deaths under age 1 – Indigenous babies

The risk factors for death under age 1 among Indigenous children were analysed separately for a single birth cohort model (combined 2005 to 2018 births). Similar risk factors were identified for death under age 1 among Indigenous children (Figure S.4) to those among the overall infant population (Figure S.1). For example, the risk associated with these specific characteristics among Indigenous babies, which were also risk factors for all babies, were:

- born preterm (103 times as likely to die if born under 32 weeks gestational age, and 2.3 times as likely between 32 and 36 weeks gestational age, compared with a full-term baby)
  - caesarean delivery reduced the risk of death for babies born under 32 weeks gestational age to 23 times as likely, compared with a full-term baby
- small for gestational age (2.0 times as likely)
- born to a teenage mother (1.6 times as likely).

Risk factors previously identified in the overall analyses of death under age 1 for all children that were not found to be significant in the analysis of the subset of Indigenous children included being a male baby and born to a mother experiencing postpartum haemorrhage requiring a blood transfusion.

One maternal characteristic found to be a significant risk factor for deaths under age 1 for Indigenous babies (but not consistently for deaths among all babies under age 1) was being born to mothers residing in *Major cities* at time of giving birth (compared with residing in regional or remote areas of New South Wales). This is an unexpected result requiring further investigation. To our knowledge similar results have not been reported in other studies.

Previous AIHW analyses of perinatal outcomes at the national level for Indigenous babies did not find this relationship for the risk of neonatal death (under 28 days), or even for stillbirth. Indeed, some of the associated risk factors – such as low birthweight and preterm birth – were more likely occur in other remoteness areas than *Major cities* (AIHW 2021b). Since access to medical and allied health services before and after birth might ordinarily be expected to be easier in *Major cities*, the result in this report may indicate some unobserved differences between Indigenous babies and their families living in *Major cities* relative to other families living in *Major cities*.

More analyses will be needed to confirm the extent of, and reasons for, the difference in identified risk factors for death under age 1 between Indigenous children and all children. Some of the differences noted in this report could be related to the very large difference between the small number of deaths of children classified as Indigenous compared with the large number of deaths classified as non-Indigenous. The relatively small total number of deaths of Indigenous babies (even when pooled for all birth cohorts from 2005 to 2018) make it difficult to reliably estimate the risks associated with factors specific to Indigenous children.

## Interpretation of results on the Indigenous status variable in regression models on the risks of dying among all children

Several of the multivariate regression models estimated over the full population of all NSW born children show a result that Indigenous children have an associated higher risk of dying than non-Indigenous children. These results should not be interpreted, however, to mean that being an Indigenous child is itself a separate risk factor. The Indigenous status variable is typically a proxy for differences between Indigenous children and non-Indigenous children in other important factors related to child mortality.

Differences in some of these other important factors affecting the risk of dying are already accounted for in the estimated models in this report, such as smoking during pregnancy (41% among Indigenous mothers versus 8.3% among non-Indigenous mothers, on average over the 2005–2018 period), preterm births (11% versus 6.8%), and teenage motherhood (16% versus 2.4%), all of which are higher among Indigenous mothers.

But not all factors that vary systematically between Indigenous children and non-Indigenous children and that are associated with the risk of dying are captured in the variables available in the perinatal data collection. These additional potentially relevant factors could not be included in the regression models estimated in this study.

The estimated model results on the Indigenous status variable should therefore be treated with caution because it likely reflects the effect on the risk of dying of other unobserved factors not included in the model that may vary between Indigenous and non-Indigenous babies.

## Socioeconomic status variables

Compared with the effects of the perinatal characteristics, the effects of the different area-level socioeconomic status indicators (such as the SEIFA decile rank of the area the mother lived in, or the proportion of children in that area assessed as being developmentally vulnerable on the AEDC) were not found to have consistently significant effects when the regression models were estimated jointly with the perinatal characteristics.

This is also an unexpected finding and requires further investigation. Socioeconomic status, even when measured as an area-level average, is expected to affect health and mortality outcomes, including overall life expectancy (AIHW 2017).

The instances where the area-level socioeconomic indicators were found to be statistically significant (in 3 of 8 estimated models) are noted in Table S.1 in the next section of the report.

The proportion of children assessed as being developmentally vulnerable on one or more AEDC domains is usually a strong indicator of the average socioeconomic status of the overall population that live in that area (DET 2022). In the results of this study, the AEDC variable was found to have a significant effect, with the risk of dying increasing with higher levels of developmental vulnerability, only in the following model:

- the 2015–2018 birth cohort for deaths under age 1 that exclude deaths in the first week after birth.

(This variable was not used in the separate subgroup analyses of Indigenous infant deaths because SA2 level data on AEDC derived developmental vulnerability among Indigenous children are not published).

Living in the lowest ranked bottom 3 SEIFA deciles (compared with the highest 3) was found to be a significant risk factor in only one model:

- the 2005–2010 birth cohort for deaths under age 1.

Living in the middle ranked 4 SEIFA deciles (compared with the highest 3) was found to be a significant risk factor in two model results:

- the 2005–2010 birth cohort for deaths under age 1, and
- the 2005–2010 birth cohort for deaths under age 1 that exclude deaths in the first week after birth

In the second instance the result is not logically consistent, showing a higher risk of child death for those living in the middle deciles only, but without any greater risk for those living in the bottom 3 decile areas (when compared with the top 3 deciles).

In the separate analyses of Indigenous infant deaths another area-level socioeconomic status indicator was included in the regression models as an alternative to the SEIFA index. This was the Indigenous Relative Socioeconomic Outcomes (IRSEO) index, developed by Biddle (2013). It is an Indigenous-specific index of socioeconomic indicators that reflects the average level of socioeconomic disadvantage for the Indigenous population of that area (as opposed to the overall population, reflected in the SEIFA indices).

The results showed that the IRSEO area-level rankings for 2011 and 2016 were not related in any way to the risk of Indigenous babies dying under age 1 in those areas, whether the IRSEO ranking was used as an additional variable or as a replacement to the SEIFA ranking of areas. No results related to IRSEO are presented in this Summary report but are available in the Appendices to the Main report.

## 5 'Top 8' significant perinatal characteristics

Table S.1 summarises the results obtained from the several different regression models presented in this report for:

- the 8 perinatal characteristics that had the most consistent effect across all the estimated models
- the 2 area-level socioeconomic status indicators examined.

Being born small for gestational age was the most consistent risk factor significantly increasing the risk of dying in the results for each of the 8 different models analysed (from the different combinations of birth cohort period, age at death and Indigenous subgroup).

This was followed by preterm birth (both under 32 weeks gestational age and for 32 to 36 weeks gestational age), and being born to a teenage mother, both of which are identified as significant risk factors in 7 of these 8 instances (the exception was in the results for death between ages 1 to 4).

Caesarean delivery among full-term births was an identified risk factor in 5 of the 8 models. Caesarean delivery, however, had a different role among preterm births under 32 weeks gestational age: the combination of preterm birth and caesarean delivery still had a higher risk of dying than among full-term caesarean babies, but a lower risk of dying than among preterm babies in this gestational age category with non-caesarean deliveries (including normal vaginal delivery).

The effects captured by Indigenous status were significant in 5 of the 8 models, followed by the higher risk of dying for male children (in 4 of the 8 models).

From the results on the area-level socioeconomic status variables, living in the lowest ranked socioeconomic status areas, as represented by the SEIFA decile rankings, and living in areas with a higher proportion of children assessed as developmentally vulnerable when starting school were both shown to have the least persistent effect – these categories were associated with an increased risk of dying in only 1 of the 8 sets of model results.

**Table S.1: Effects of the most consistently identified perinatal risk factors for child death, by age at death, birth cohorts and Indigenous status, and effects of the 2 area-level socioeconomic status variables**

Risk factor	All children										Indigenous children		
	Under age 1			Under age 1, excluding first 7 days			Ages 1-4		Under age 1		Under age 1		
	2005-2010	2011-2014	2015-2018	2005-2010	2011-2014	2015-2018	2005-2018	2005-2018	2005-2018	2005-2018	2005-2018	2005-2018	
Preterm birth:													
- under 32 weeks gestational age	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
- 32 to 36 weeks gestational age	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Small for gestational age in birthweight	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Teenage mother aged 19 or under when giving birth (compared to a mother aged 26 to 30)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Caesarean delivery (for full-term births)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Indigenous baby	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	n.a.
Male baby	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
Mother smoked during pregnancy	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
Mother developed postpartum haemorrhage requiring a blood transfusion	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Percentage of children vulnerable on one or more AEDC domain in mother's SA2 of usual residence	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗
Mother's usual residence was in (using 2011 SA2 rankings):													
- lowest 3 SEIFA deciles (versus highest 3 deciles)	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
- middle 4 SEIFA deciles (versus highest 3 deciles)	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗

✓ Indicates a statistically significant risk factor (at the 5% test level).


✗ Indicates a characteristic that was not statistically significant at the 5% test level for a given model and birth period.

SEIFA = Socio-Economic Indexes for Areas

n.a. = not applicable; AEDC= Australian Early Development Census; SA2 = Statistical area, Level 2

**Figure S.1: Selected regression results for child deaths under age 1: estimated odds ratios<sup>(a,b)</sup> (or how much more likely a baby with the specified characteristic or risk factor was likely to die by age 1, compared with a baby without that specified characteristic), by birth cohort periods**

Maternal/baby characteristic	2005–2010	2011–2014	2015–2018	
Preterm birth under 32 weeks gestational age (vaginal delivery) (compared with a full-term birth and vaginal delivery baby)	211	280	268	times as likely
Preterm birth between 32 and 36 weeks gestational age (vaginal delivery) (compared with a full-term birth and vaginal delivery baby)	4.8	4.6	4.9	times as likely
Preterm birth under 32 weeks gestational age (caesarean delivery) (compared with a full-term birth and caesarean delivery baby)	58.2	39.5	51.1	times as likely
Preterm birth between 32 and 36 weeks gestational age (caesarean delivery) (compared with a full-term birth and caesarean delivery baby)	6.4	4.9	5.7	times as likely
Small for gestational age in birthweight (compared with a normal birthweight baby by gestational age)	2.7	2.7	2.6	times as likely
Indigenous baby (based on mother's or baby's Indigenous status) (compared with a non-Indigenous baby)	1.8	1.5	1.1	times as likely
Mother was a teenager at time of giving birth (age 19 or under) (compared with a mother aged 26 to 30)	1.5	1.4	1.7	times as likely
Mother was aged 20 to 25 years at time of birth (compared with a mother aged 26 to 30)	1.2	1.2	1.2	times as likely
Caesarean delivery for a full-term baby (compared with a vaginal delivery full-term baby)	1.3	2.0	1.3	times as likely
Male baby (compared with a female baby)	1.2	1.2	1.1	times as likely
Postpartum haemorrhage (PPH) developed by mother that required blood transfusion (compared with a baby born to a mother who did not develop PPH requiring a blood transfusion)	1.5	1.6	2.7	times as likely
Mother smoked during pregnancy (compared with a mother who did not smoke)	1.1	0.9	1.0	times as likely
Use and timing of antenatal care (compared with a mother who had first visit by 13 weeks)				
Late first antenatal care visit (after 13 weeks gestation)	1.1	1.0	1.0	times as likely
No antenatal care received	0.6	1.1	0.7	times as likely
Antenatal care status not stated	1.5	1.2	0.6	times as likely
SEIFA index of mother's SA2 of usual residence in lowest 3 deciles (compared with a mother residing in an SA2 in the highest 3 deciles)	1.2	1.1	1.1	times as likely
SEIFA index of mother's SA2 of usual residence in middle 4 deciles (compared with a mother residing in an SA2 in the highest 3 deciles)	1.5	1.1	1.0	times as likely
Percentage of children vulnerable on one or more AEDC domain in mother's SA2 of usual residence	1.0	1.0	1.0	times as likely

 Statistically significant risk factors (with odds ratios greater than 1) at least at the 5% test level.

 Factors that are not statistically significant at the 5% test level.

(a) Estimates of the odds ratio are from the full model with area-level variables and specific interactions terms from Appendix Table A5.1. Some values reported in above table may differ due to rounding.

(b) Tests of significance on whether the estimated odds ratio is significantly different from 1 is done at the 5% test level.

Source: AIHW analyses of the linked NSW PDC and Deaths data (Appendix Table A5.1 in Main report).

**Figure S2: Selected regression results for child deaths under age 1 (but excluding deaths within 7 days after birth): estimated odds ratios<sup>(a,b)</sup>, by birth cohort period**

Maternal/baby characteristic	2005–2010	2011–2014	2015–2018	
Preterm birth under 32 weeks gestational age (vaginal delivery) (compared with a full-term birth and vaginal delivery baby)	31.7	34.7	40.4	times as likely
Preterm birth between 32 and 36 weeks gestational age (vaginal delivery) (compared with a full-term birth and vaginal delivery baby)	3.6	3.3	3.4	times as likely
Preterm birth under 32 weeks gestational age (caesarean delivery) (compared with a full-term birth and caesarean delivery baby)	32.3	20.5	34.3	times as likely
Preterm birth between 32 and 36 weeks gestational age (caesarean delivery) (compared with a full-term birth and caesarean delivery baby)	4.9	3.5	5.4	times as likely
Small for gestational age in birthweight (compared with a normal birthweight baby by gestational age)	2.8	3.1	2.2	times as likely
Indigenous baby (based on mother's or baby's Indigenous status) (compared with a non-Indigenous baby)	1.6	1.4	1.4	times as likely
Mother was a teenager at time of giving birth (age 19 or under) (compared with a mother aged 26 to 30)	2.3	2.2	1.9	times as likely
Mother was aged 20 to 25 years at time of giving birth (compared with a mother aged 26 to 30)	1.5	1.4	1.1	times as likely
Caesarean delivery for a full-term baby (compared with a vaginal delivery full-term baby)	1.3	1.8	1.3	times as likely
Male baby (compared with a female baby)	1.2	1.2	1.0	times as likely
Postpartum haemorrhage (PPH) developed by mother that required blood transfusion (compared with a baby born to a mother who did not develop PPH requiring a blood transfusion)	0.9	0.8	1.3	times as likely
Mother smoked during pregnancy (compared with a mother who did not smoke)	1.7	1.3	1.5	times as likely
<b>Use and timing of antenatal care</b> (compared with a mother who had first visit by 13 weeks)				
Late first antenatal care visit (after 13 weeks gestation)	1.2	1.2	1.1	times as likely
No antenatal care received	0.9	1.9	0.3	times as likely
Antenatal care status not stated	2.0	0.6	n.a.	times as likely

Legend for indicating statistical significance of estimated odds ratios (significantly different from a value of 1):

- Statistically significant risk factors (with odds ratios greater than 1) at least at the 5% test level.
- Factors that are not statistically significant at the 5% test level.

(a) Estimates of the odds ratio are from the full model with area-level variables and specific interactions terms from Appendix Table A5.3. Some values reported in above table may differ due to rounding.

(b) Tests of significance on whether the estimated odds ratio is significantly different from 1 is done at the 5% test level.

Source: AIHW analyses of the linked NSW PDC and Deaths data (Appendix Table A5.3 in Main report).

**Figure S3: Selected regression results for child deaths between ages 1 to 4, estimated odds ratios<sup>(a,b)</sup>, all birth cohorts combined, 2005–2018**

Maternal/baby characteristic	2005–2018	
Preterm birth under 32 weeks gestational age (vaginal delivery) (compared with a full-term birth and vaginal delivery baby)	1.2	times as likely
Preterm birth between 32 and 36 weeks gestational age (vaginal delivery) (compared with a full-term birth and vaginal delivery baby)	1.3	times as likely
Small for gestational age in birthweight (compared with a normal birthweight baby by gestational age)	1.7	times as likely
Indigenous baby (based on mother's or baby's Indigenous status) (compared with a non-Indigenous baby)	2.2	times as likely
Mother was a teenager at time of giving birth (age 19 or under) (compared with a mother aged 26 to 30)	1.3	times as likely
Mother was aged 20 to 25 years at time of giving birth (compared with a mother aged 26 to 30)	1.4	times as likely
Caesarean delivery for a full-term baby (compared with a vaginal delivery full-term baby)	1.0	times as likely
Male baby (compared with a female baby)	1.3	times as likely
Postpartum haemorrhage (PPH) developed by mother that required blood transfusion (compared with a baby born to a mother who did not develop PPH requiring a blood transfusion)	0.8	times as likely
Mother smoked during pregnancy (compared with a mother who did not smoke)	1.3	times as likely
Use and timing of antenatal care (compared with a mother who had first visit by 13 weeks)		
Late first antenatal care visit (after 13 weeks gestation) or no antenatal care received	1.0	times as likely
Antenatal care status not stated	1.5	times as likely
SEIFA index of mother's SA2 of usual residence in lowest 3 deciles (compared with a mother residing in an SA2 in the highest 3 deciles)	1.1	times as likely
SEIFA index of mother's SA2 of usual residence in middle 4 deciles (compared with a mother residing in an SA2 in the highest 3 deciles)	1.0	times as likely
Percentage of children vulnerable on one or more AEDC domain in mother's SA2 of usual residence	1.0	times as likely

 Statistically significant risk factors (with odds ratios greater than 1) at least at the 5% test level.

 Factors that are not statistically significant at the 5% test level.

(a) Estimates of the odds ratio are from the full model with area-level variables and specific interactions terms from Appendix Table A5.4. Some values reported in above table may differ due to rounding.


(b) Tests of significance on whether the estimated odds ratio is significantly different from 1 is done at the 5% test level.

Source: AIHW analyses of the linked NSW PDC and Deaths data (Appendix Table A5.4 in Main report).



**Figure S4: Selected regression results for child deaths under age 1 among NSW-born Indigenous babies, estimated odds ratios<sup>(a,b)</sup>, all birth cohorts combined, 2005–2018**

Maternal/baby characteristic	2005–2018	
<b>Preterm birth under 32 weeks gestational age (vaginal delivery)</b> (compared with a full-term birth and vaginal delivery baby)	<b>103</b>	times as likely
<b>Preterm birth between 32 and 36 weeks gestational age (vaginal delivery)</b> (compared with a full-term birth and vaginal delivery baby)	<b>2.3</b>	times as likely
<b>Preterm birth under 32 weeks gestational age (caesarean delivery)</b> (compared with a full-term and caesarean delivery baby)	<b>23.3</b>	times as likely
<b>Preterm birth between 32 and 36 weeks gestational age (caesarean delivery)</b> (compared with a full-term and caesarean delivery baby)	<b>4.3</b>	times as likely
<b>Small for gestational age in birthweight</b> (compared with a normal birthweight baby by gestational age)	<b>2.0</b>	times as likely
<b>Mother was a teenager at time of giving birth (age 19 or under)</b> (compared with a mother aged 26 to 30)	<b>1.6</b>	times as likely
<b>Mother was aged 20 to 25 years at time of birth</b> (compared with a mother aged 26 to 30)	<b>1.3</b>	times as likely
<b>Mother lived in a Major city at time of delivery</b> (compared with a mother living in a regional area)	<b>1.4</b>	times as likely
<b>Postpartum haemorrhage (PPH) developed by mother that required blood transfusion</b> (compared with a baby born to a mother who did not develop PPH requiring a blood transfusion)	<b>1.5</b>	times as likely
<b>Caesarean delivery for a full-term baby</b> (compared with a vaginal delivery full-term baby)	<b>1.0</b>	times as likely
<b>Male baby</b> (compared with a female baby)	<b>1.0</b>	times as likely
<b>Mother smoked during pregnancy</b> (compared with a mother who did not smoke)	<b>0.7</b>	times as likely
<b>Use and timing of antenatal care</b> (compared with a mother who had first visit by 13 weeks)		
<b>Late first antenatal care visit (after 13 weeks gestation) or no antenatal care received</b>	<b>0.8</b>	times as likely
<b>Antenatal care status not stated</b>	<b>1.5</b>	times as likely
<b>SEIFA index of mother's SA2 of usual residence in lowest 3 deciles</b> (compared with a mother residing in an SA2 in the highest 3 deciles)	<b>0.7</b>	times as likely
<b>SEIFA index of mother's SA2 of usual residence in middle 4 deciles</b> (compared with a mother residing in an SA2 in the highest 3 deciles)	<b>0.7</b>	times as likely

 Statistically significant risk factors (with odds ratios greater than 1) at least at the 5% test level.

 Factors that are not statistically significant at the 5% test level.

(a) Estimates of the odds ratio are from the full model with area-level variables and specific interactions terms from Appendix Table A6.1. Some values reported in above table may differ due to rounding.

(b) Tests of significance on whether the estimated odds ratio is significantly different from 1 is done at the 5% test level.

Source: AIHW analyses of the linked NSW PDC and Deaths data (Appendix Table A6.1 in Main report).

## 6 Study strengths, some limitations, and extensions

The key methodological innovation of this project was to quantify the risk factors contributing to early childhood mortality in New South Wales by placing the deaths observed in the death registration records in that state within the context of the relevant full birth cohorts. Examining the factors that contribute to child death using linked data in this way greatly expands the scope of the feasible analyses – beyond the customary analyses based only on data of children who have died.

This study has shown that perinatal records can be reliably linked to death records to enable conceptually more robust estimates of child mortality rates from a whole birth cohort perspective. This, in turn, allows specific risk and protective factors to be more reliably estimated among the perinatal and socioeconomic variables available in the linked data.

This study also found a clear pattern of declining under-5 mortality for Indigenous children born in New South Wales between 2005 and 2018, and a considerable narrowing of the gap with non-Indigenous cohort-specific under-5 mortality rates.

A primary issue in the analyses of any linked data is that the strength of the findings depends critically on the quality of the linkage. The quality of the linkage, in turn, is affected most by the accuracy and completeness of the same personal identifying variables found in the data sources being linked. The data linkage for this project was based on full names and full dates of birth for babies and their mothers from the NSW Perinatal Data Collection, and the full name and date of birth available in the death records. The assessment made was that the quality of these linkage variables was good.

Indigenous status, however, was not consistently recorded across the data sources and was not used as one of the linkage variables. The approach taken was to assign Indigenous status if any component of the data sources linked had an Indigenous identifier for that child or birth mother. This approach was adopted to increase the number of Indigenous children (and deaths recorded among them) that could be analysed in the linked data; but it may not have been an accurate imputation of Indigenous status in all instances. Hence, some care must be exercised in interpreting all the results based on Indigenous status in this report.

A further limitation is that the separate subgroup analyses of Indigenous child deaths (as well as of deaths of all children aged 1 to 4) are based on a small number of total deaths in these categories, even when data are combined over the full 2005 to 2018 birth cohorts. Multivariate regression modelling results for deaths in these categories are less reliably estimated and should be interpreted with greater caution. This also makes it difficult to assess the reasons why the effect of some risk factors differ in relation to deaths of Indigenous children compared with deaths among all children.

Another limitation of this study is that the content variables available for analyses come from a single source – the NSW Perinatal Data Collection. This is a valuable collection, used for many other linkage projects; but it is collected at a specific time for specific purposes related to documenting pregnancy and birth-related behaviour and outcomes. It does not capture all relevant risk factors for child deaths, even when restricted to deaths under age 1 or under 5. As well, some data items in it were incomplete or collected in different ways over time.

This study has shown, however, that even linkage to a set of perinatal variables alone provides a clearer understanding of the fundamental risk factors associated with early childhood mortality, such as preterm birth and birthweight being small for gestational age – especially in the category of deaths under age 1.

Further research investigating linkages to additional data sources with important variables missing from this study – such as parental education and income, and child protection history for the full birth cohorts – could be useful extensions of this data linkage approach to provide a fuller perspective on additional key risk factors and preventive strategies that could be adopted to reduce child deaths in New South Wales.

## References

- Al Qurashi MA (2020) Impact of Mode of Delivery on the Survival Rate of Very Low Birth Weight Infants: A Single-Center Experience. *Cureus*, 12(12), e11918, <https://doi.org/10.7759/cureus.11918>.
- ABS (Australian Bureau of Statistics) (2013) *Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia 2011*, ABS catalogue number 2033.0.55.001, ABS, Canberra.
- Australian Government (2020) *Closing the Gap Report 2020*, Australian Government.
- AHMAC (Australian Health Ministers' Advisory Council) (2017) *Aboriginal and Torres Strait Islander Health Performance Framework 2017 Report*, AHMAC, Canberra.
- AIHW (Australian Institute of Health and Welfare) (2017) *Life expectancy and potentially avoidable deaths in 2013–2015*, AIHW, Canberra.
- AIHW (2018) *Closing the Gap targets: 2017 analysis of progress and key drivers of change*, catalogue number IHW 193, AIHW, Canberra.
- AIHW (2020a) *Aboriginal and Torres Strait Islander Health Performance Framework Summary Report 2020*, AIHW, Canberra.
- AIHW (2020b) *Australia's children*, catalogue number CWS 69, AIHW, Canberra.
- AIHW (2021a) *Infant and child mortality rates for Indigenous Australians using linked and unlinked data: Linked Perinatal, Birth, Death Data set*, catalogue number IHW 240, AIHW, Canberra.
- AIHW (2021b) *Pregnancy and birth outcomes for Aboriginal and Torres Strait Islander women 2016–2018*, catalogue number IHW 234, AIHW, Canberra.
- AIHW (2022) *Australia's mothers and babies* [web report], catalogue number PER 101, AIHW, Canberra, accessed 18 October 2022. ([Australia's mothers and babies](#), accessed 18/10/2022).
- Biddle N (2013) 'Socioeconomic outcomes', paper 13, *Indigenous population project: 2011 Census report*, Centre for Aboriginal Economic Policy Research, The Australian National University, Canberra.
- DET (Department of Education and Training) (2022) *Australian Early Development Census National Report 2021: early childhood development in Australia*, DET, Canberra.
- NSW CDRT (New South Wales Child Death Review Team) (2014) *Causes of death of children with a child protection history 2002–2011*, NSW Ombudsman, Sydney.
- NSW CDRT (2018) *Spatial analysis of child deaths in New South Wales*, NSW Ombudsman, Sydney.
- NSW CDRT (2019) *Biennial report of the deaths of children in New South Wales: 2016 and 2017, Incorporating reviewable deaths of children*, NSW Ombudsman, Sydney.
- NSW CDRT (2020) *CDRT Charter*, NSW Ombudsman, Sydney.
- NSW CDRT (2021) *Biennial report of the deaths of children in New South Wales: 2018 and 2019, Incorporating reviewable deaths of children*, NSW Ombudsman, Sydney.

Yang, XJ., Sun, SS (2017) Comparison of maternal and fetal complications in elective and emergency caesarean section: a systematic review and meta-analysis, *Archives of Gynaecology and Obstetrics*, 296:503-512. <https://doi.org/10.1007/s00404-017-4445-2>.

WHO (World Health Organization) (2012) *Born Too Soon: the global action report on preterm birth*, WHO, Geneva.

WHO (2014) *International Statistical Classification of diseases and related health problems, 10th revision (ICD-10)*, WHO, Geneva.

# Abbreviations

ABS	Australian Bureau of Statistics
AEDC	Australian Early Development Census
AIHW	Australian Institute of Health and Welfare
BRC	Birth Registration Collection
CDRT	Child Death Review Team
IRSEO	Indigenous Relative Socioeconomic Outcomes
NDI	National Death Index
NSW	New South Wales
PDC	Perinatal Data Collection
PPH	postpartum haemorrhage
SA2	Statistical Area Level 2
SEIFA	Socio-Economic Indexes for Areas





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