

ORIGINAL ARTICLE

Identification of Aboriginal children using linked administrative data: Consequences for measuring inequalities

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Aim: The aim of this study was to examine the identification of Aboriginal children in multiple administrative datasets and how this may affect estimates of health and development.

Methods: Data collections containing a question about Aboriginal ethnicity: birth registrations, perinatal statistics, Australian Early Development Census and school enrolments were linked to datasets recording developmental outcomes: national literacy and numeracy tests (National Assessment Program – Literacy and Numeracy), Australian Early Development Census and perinatal statistics (birthweight) for South Australian children born 1999–2005 ($n = 13\,414\text{--}44\,989$). Six algorithms to derive Aboriginal ethnicity were specified. The proportions of children thus quantified were compared for developmental outcomes, including those scoring above the national minimum standard in year 3 National Assessment Program – Literacy and Numeracy reading.

Results: The proportion of Aboriginal children identified varied from 1.9% to 4.7% when the algorithm incremented from once to ever identified as Aboriginal, the latter using linked datasets. The estimates of developmental outcomes were altered: for example, the proportion of Aboriginal children who performed above the national minimum standard in year 3 reading increased by 12 percentage points when the algorithm incremented from once to ever identified as Aboriginal. Similar differences by identification algorithm were seen for all outcomes.

Conclusions: The proportion of South Australian children identified as Aboriginal in administrative datasets, and hence inequalities in developmental outcomes, varied depending on which and how many data sources were used. Linking multiple administrative datasets to determine the Aboriginal ethnicity of the child may be useful to inform policy, interventions, service delivery and how well we are closing developmental gaps.

Key words: Aboriginal health; administrative data; child development; data linkage.

What is already known on this topic

- 1 Data linkage studies of adult populations show that under-identification of Aboriginal people affects estimates of morbidity and mortality.
- 2 Few linkage studies have examined the identification of Aboriginal children in administrative datasets and how this may affect estimates of health and development.
- 3 A challenge when using administrative data for estimating developmental inequalities is variations in how the ethnicity of the child is derived, whether it be from the ethnicity of the mother, and/or father, or inferred using adult identification of the child.

What this study adds

- 1 The linkage of multiple administrative datasets increased the number of South Australian children identified as Aboriginal.
- 2 We found that using different algorithms to identify Aboriginal children resulted in different estimates of developmental inequalities.
- 3 Linking multiple administrative datasets to determine the Aboriginal ethnicity of the child may be useful to inform policy, interventions, service delivery and how well we are closing developmental gaps.

In 2008, the Council of Australian Governments agreed to six national targets to ‘Close the Gap’ in the areas of life expectancy, child mortality, education and employment between Aboriginal

and non-Aboriginal Australians.¹ Measuring and quantifying the gap in disadvantage rely on government administrative data. In Australia, national best practice guidelines recommend that all people be asked a standard question about whether they self-identify as Aboriginal, Torres Strait Islander or both.² This question applies to self-enumerated or interview-based administrative data collections and can also be used in instances where a third party (e.g. parent) is answering on behalf of the person. However, studies have shown that Aboriginal people are not consistently identified as such in these data.^{3–5} Data linkage

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studies of adult populations have demonstrated that under-identification of Aboriginal people affects estimates of health, and can overestimate or underestimate the health gap between Aboriginal and non-Aboriginal Australians.^{4–10} Few studies have examined the identification of Aboriginal children in multiple administrative datasets^{11–14} and how this may affect estimates of health and development.^{11,14}

A challenge when using administrative data for measuring inequalities in child health and development is that children cannot self-identify. In administrative datasets, the Aboriginal ethnicity of the child is inferred using adult identification of the child or is based on the ethnicity of the mother, and/or father. Prior to 2012–2013, the only population-wide administrative dataset to record Aboriginal and/or Torres Strait Islander ethnicity of the child was at school enrolment. The lack of child Aboriginal ethnicity in many administrative collections in the period before the child enters school may have implications in estimating progress towards reaching 'Closing the Gap' targets.

This study uses data from the South Australian Early Childhood Data Project, which has linked births, perinatal, school enrolment, National Assessment Program – Literacy and Numeracy (NAPLAN) tests and the Australian Early Development Census to examine the identification of Aboriginal children in multiple administrative datasets and how this may affect estimates of perinatal health, development at school entry and year 3 academic achievements.

Methods

This study involved four administrative collections containing a question about Aboriginal and/or Torres Strait Islander ethnicity for South Australian children born from 1999 to 2005: birth registrations, Perinatal Statistics Collection, Australian Early Development Census (in 2009) and government school enrolments that were linked to datasets recording developmental outcomes: NAPLAN (2008–2012), Australian Early Development Census and Perinatal Statistics Collection (birthweight). The analysis sample consisted of 44 989 children with a birth, perinatal, government school enrolment and valid year 3 NAPLAN reading or numeracy record during 2008–2012 and 13 414 children with a birth, perinatal and valid 2009 Australian Early Development Census record, respectively (Supporting Information Figs S1 and S2). Two analysis samples were drawn as only government enrolled children with a valid year 3 reading or numeracy record were included in the NAPLAN sample, whereas the Australian Early Development Census sample included children enrolled in government and non-government schools. Approval for this study was provided by the human research ethics committees of the University of Adelaide (H-185-2011), SA Health (HREC/15/SAH/61) and Aboriginal Health Council of South Australia (04-11-405).

Definition

The term Aboriginal used in this paper refers to Aboriginal and/or Torres Strait Islander people. This is a preference expressed by the Aboriginal Health Council of South Australia

in recognition that the Kaurna Aboriginal people are the traditional owners of the Adelaide plains in South Australia.

Data sources: Aboriginal ethnicity

The Births data are collected as a part of the Births, Deaths and Marriages registry administered by the South Australian Office of Consumer and Business Affairs. All births are legally required to be registered within 60 days of birth. This dataset included self-reported information about Aboriginal and/or Torres Strait Islander ethnicity of the mother and father (where available).

The parents of a child are jointly responsible for having a child's birth registered and both should be signatories on the Birth Registration Statement, irrespective of their marriage status.

The Perinatal Statistics Collection collates information from the supplementary birth record that is mandatorily completed by a midwife/nurse for each birth in South Australia and administered by the Pregnancy Outcomes Unit, South Australian Department of Health. The Perinatal dataset specifies a mother's Aboriginal and/or Torres Strait Islander ethnicity within the mother's 'race' variable, also consisting of other ethnicities (e.g. Caucasian). The supplementary birth record guidelines states that the question must be asked as follows: 'Are you/Is the person of Aboriginal or Torres Strait Islander origin?'

The Australian Early Development Census is a teacher-reported population measure of early childhood health and development.¹⁵ The Australian Early Development Census is collected for almost every Australian child in their first year of full-time schooling (the average age of students is five years). In this study, we use 2009 Australian Early Development Census data for all children attending school (government and non-government) in South Australia. Teachers are asked to report if the child is of Aboriginal or Torres Strait Islander origin, and this response should be based on official school enrolment records. If the response is yes, the teacher then specifies whether the child is 'Aboriginal', 'Torres Strait Islander', 'both Aboriginal and Torres Strait Islander', 'Aboriginal and Other' or 'Torres Strait Islander and Other'.

The school enrolment census contains data on students enrolled and attending government schools in South Australia and is administered by the South Australian Department for Education and Child Development. The Aboriginal ethnicity of the child is reported by the primary care giver at the time of school enrolment. Aboriginal and Torres Strait Islander are listed separately in the census, as a 'yes/no' variable.

Data sources: developmental outcomes

NAPLAN

Children's reading, writing, language and numeracy skills in years 3, 5, 7 and 9 are routinely assessed through NAPLAN testing. The South Australian Department for Education and Child Development provided individual NAPLAN scores for all children attending a government school in year 3 (the average age of students is 8 years) during 2008–2012. For each domain, children received a score between 0 and 1000, which can be divided into 10 proficiency bands. On average, the scale scores of year 3 children fall in Band 4.¹⁶ Scale scores in Band 1 are said

to be below the national minimum standard, those in Band 2 are at the national minimum standard and those in Bands 3–10 are said to be above the national minimum standard.¹⁶ The outcome used in this study was scoring above the national minimum standard on the reading and numeracy domains.

Birthweight

Perinatal outcomes are recorded on the supplementary birth record form according to established criteria that are documented in its companion manual. Birthweight was directly measured for all children in the analysis. For this study, babies <2500 g were classified as low birthweight.

Australian Early Development Census

The Australian Early Development Census is a 95-item, teacher-completed questionnaire measuring five domains of child development: physical health and wellbeing, language and cognitive skills, emotional maturity, social competence, and communication skills and general knowledge. Teachers complete the Australian Early Development Census for each child in their class on the basis of their knowledge of the children. The Australian Early Development Census was not completed for children whose parent/guardian opted out or where the teacher had known the child for less than one month.¹⁵

Scores for each domain range from 0 to 10 and are age-standardised. Higher scores indicate a higher level of development for that domain. Children are defined as 'developmentally vulnerable' on a domain if they score in the lowest 10% of responses with all other children categorised as 'developmentally on track' for that domain. The outcome measure used in this study was children developmentally on track on ≥ 1 domain.

Data linkage

Data linkage was conducted by SA-NT DataLink. Data matching was conducted on personal identifiers including name, date of birth and address. Data custodians provided identifiers to SA-NT DataLink, who developed a probabilistic linkage algorithm to match individuals from different datasets based on identifying information. Individuals from each dataset were paired and assigned a probability of being a match, with the highest probability being the most likely match. Quality assurance checks and clerical review were conducted to minimise mismatches. Each individual was then assigned a unique Project Specific Linkage Key, and the datasets were returned to the custodians. The custodians extracted the approved data, removed all identifying information and forwarded the de-identified information with the Project Specific Linkage Keys to the researcher for analysis.

The linkage process is probabilistic, and subsequently, a small percentage of error or false links is to be expected. While false linkage rates have not yet been calculated in South Australia, other states using similar methods, estimate rates of 0.1%¹⁷ and 0.3%.¹⁸

Algorithms to derive Aboriginal ethnicity

Six algorithms to derive Aboriginal ethnicity of the child were specified as follows:

- 1 Births only: the mother and father's self-report of their Aboriginal ethnicity.
- 2 Perinatal only: the midwife or nurse recorded ethnicity of the mother.
- 3 Australian Early Development Census only: the teacher reported ethnicity of the child.
- 4 School enrolment only: the primary care giver reported ethnicity of the child.
- 5 Identified at least twice: the child was considered Aboriginal if recorded as such in ≥ 2 records, on any dataset.
- 6 Ever identified: the child was considered Aboriginal if recorded as such in at least one record, on any dataset.

The analyses were restricted to children born in South Australia for whom the information about Aboriginal ethnicity was non-missing for all four datasets. For the NAPLAN analysis sample there were 13 937 children with a missing record of Aboriginal and/or Torres Strait Islander ethnicity in the births, perinatal or school enrolment datasets. Of the 13 937 missing there were 115 children with no record of Aboriginal and/or Torres Strait Islander ethnicity in any of the three datasets (births, perinatal and school enrolment). Of the 13 822 who were not missing on at least one indicator of ethnicity, 7.7% (1070) were recorded as Aboriginal and/or Torres Strait Islander on at least 1 dataset. For the Australian Early Development Census analysis sample there were 3370 children with a missing record of Aboriginal and/or Torres Strait Islander ethnicity in the births, perinatal or Australian Early Development Census datasets. All children had a record of Aboriginal and/or Torres Strait Islander ethnicity in at least one of the three datasets. Of the 3370 children, 7.8% (262) were recorded as Aboriginal and/or Torres Strait Islander on at least 1 dataset. An analysis comparing the characteristics of included and excluded children in the two analysis samples showed a higher proportion of children from non-English speaking backgrounds in the excluded group but similar proportions of children represented at each level of socio-economic disadvantage (data available from the authors).

To compare how different algorithms affect developmental outcomes, these algorithms were then applied to the proportion of children scoring above the national minimum standard in year 3 NAPLAN reading and numeracy domains, the proportion of children with a birthweight <2500 g and the proportion of children developmentally on track on ≥ 1 Australian Early Development Census domain. Sensitivity analyses were conducted to explore the effects of defining the population denominator differently (e.g. including individuals with missing Aboriginal ethnicity in the algorithms).

Results

Table 1 shows that the proportion of children identified as Aboriginal varied depending on the algorithm. For example, using ethnicity of the mother from the perinatal dataset to define ethnicity of the child resulted in an undercount (1.9% and 2.6% identified as Aboriginal for Australian Early Development

Table 1 Proportion of children identified as Aboriginal according to different identification algorithms

2008–2012 Year 3 NAPLAN children (<i>n</i> = 44 989)			
Dataset	Collection method	Yes Aboriginal (% <i>n</i>)	Not Aboriginal (% <i>n</i>)
Births	Mother and father ethnicity self-report	4.2 (2048)	95.7 (46 234)
Perinatal	Mother's ethnicity recorded by midwife/nurse	2.6 (1257)	97.4 (47 025)
School enrolment	Child ethnicity recorded by primary care giver	3.9 (1905)	96.0 (46 377)
Identified at least twice	Combining Births, Perinatal and school enrolment Aboriginal ethnicity	3.7 (1783)	96.3 (46 499)
Ever identified	Combining Births, Perinatal and school enrolment Aboriginal ethnicity	4.7 (2294)	95.2 (45 988)
2009 Australian Early Development Census Children (<i>n</i> = 13 414)			
Dataset	Collection method	Yes Aboriginal (% <i>n</i>)	Not Aboriginal (% <i>n</i>)
Births	Mother and father ethnicity self-report	3.0 (406)	97.0 (13 008)
Perinatal	Mother's ethnicity recorded by midwife/nurse	1.9 (257)	98.1 (13 157)
Australian Early Development Census	Child ethnicity recorded by teacher	2.7 (363)	97.3 (13 051)
Identified at least twice	Combining Births, Perinatal and Australian Early Development Census Aboriginal ethnicity	2.6 (350)	97.4 (13 064)
Ever identified	Combining Births, Perinatal and Australian Early Development Census Aboriginal ethnicity	3.4 (454)	96.6 (12 960)

NAPLAN, National Assessment Program – Literacy and Numeracy.

Census and NAPLAN samples, respectively) compared with the births dataset, which uses both the mother and father's ethnicity to inform the child's (3.0% and 4.2% identified as Aboriginal for Australian Early Development Census and NAPLAN samples, respectively). Identification algorithms that seek concurrence of Aboriginal ethnicity through data linkage were intermediate in identification ($\geq 2.6\%$ and $\geq 3.7\%$ identified as Aboriginal for Australian Early Development Census and NAPLAN samples, respectively). Linking the perinatal, births and the Australian Early Development Census or school enrolment dataset to create an 'ever-identified' algorithm provided a higher proportion of children identified as Aboriginal (3.4% and 4.7% identified as Aboriginal for the Australian Early Development Census and NAPLAN samples, respectively) than recorded in any single dataset.

NAPLAN inequalities

Analyses using the different identification algorithms altered the proportion of Aboriginal children with reading and numeracy scores above the national minimum standard. For example, as shown in Figure 1, the proportion of Aboriginal children scoring above the national minimum standard in year 3 reading, in 2012 ranged from 43% using the perinatal data to 55% using the ever-identified algorithm. Similarly, the proportion of Aboriginal children scoring above the national minimum standard in year 3 numeracy, in 2012 ranged from 34% using the perinatal data to 45% using the ever-identified algorithm (Supporting Information Fig. S3).

We also estimated the gap between Aboriginal and non-Aboriginal children scoring above the national minimum standard in reading according to the different identification algorithms. Figure 2 provides an example of the proportion of children scoring above the national minimum standard in reading for two algorithms: child identified as Aboriginal at school enrolment compared with the ever-identified algorithm. As shown in Figure 2, the inequality between Aboriginal and non-Aboriginal children scoring above the national minimum standard in reading was 3 percentage points higher in 2012 using the school enrolment dataset compared with the ever algorithm (28% vs. 25%, respectively).

Perinatal health inequalities

We next examined how different algorithms affect estimates of perinatal health. Of the sample that had a valid NAPLAN reading and numeracy record, there was a higher proportion of Aboriginal babies of low birthweight using the perinatal dataset, which only captures mothers' ethnicity, compared with datasets containing the ethnicity of the child or his/her mother and father, or algorithms that linked multiple sources of information. For instance, 14.8% of Aboriginal babies were of low birthweight using the perinatal dataset compared with 11.6% using the births dataset, 12.5% using the school enrolment dataset, 12.1% identified at least twice and 11.4% ever identified as Aboriginal. Comparable results were seen for the Australian Early Development Census analysis sample (data available from the authors).

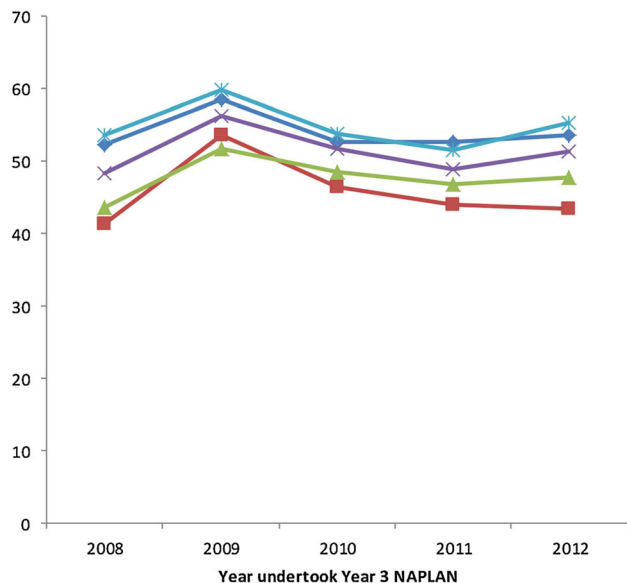


Fig. 1 Proportion of Aboriginal children scoring above the national minimum standard on year 3 National Assessment Program – Literacy and Numeracy (NAPLAN) reading domain, according to identification algorithm. ◆, Births only; ■, perinatal only; ▲, school enrolment only; ✕, identified at least twice; ✦, ever identified.

Australian Early Development Census inequalities

When looking at the effect of algorithms on the proportion of Aboriginal children developmentally on track on ≥1 census domain, 55.2% and 55.7% of children were developmentally on track using the perinatal or Australian Early Development Census datasets separately compared with 59.4% that used the births dataset and 59.5% that used the ever-identified algorithm.

Similar results were obtained from sensitivity analyses that used individuals with missing Aboriginal ethnicity in the identification algorithms (data available from the authors).

Discussion

We found that the linkage of multiple administrative datasets increased the number of South Australian children identified as Aboriginal, with estimates increasing, from 1.9% to 4.7%. When these algorithms were applied to developmental outcomes, the estimates of inequalities for Aboriginal children showed improvements, including the proportion of children scoring above the national minimum standard in year 3 NAPLAN reading and numeracy domains, the proportion of low birthweight babies and the proportion of children developmentally on track on one or more Australian Early Development Census domain. One of the notable results of our analysis was the ever-identified algorithm that used multiple administrative datasets to determine child ethnicity provided the highest proportion of children identified as Aboriginal, and revealed better developmental outcomes, than any single dataset, albeit only slightly better than the births dataset. The births dataset eclipsed the perinatal in this regard because it used parental self-identification rather than third-party report, and identified

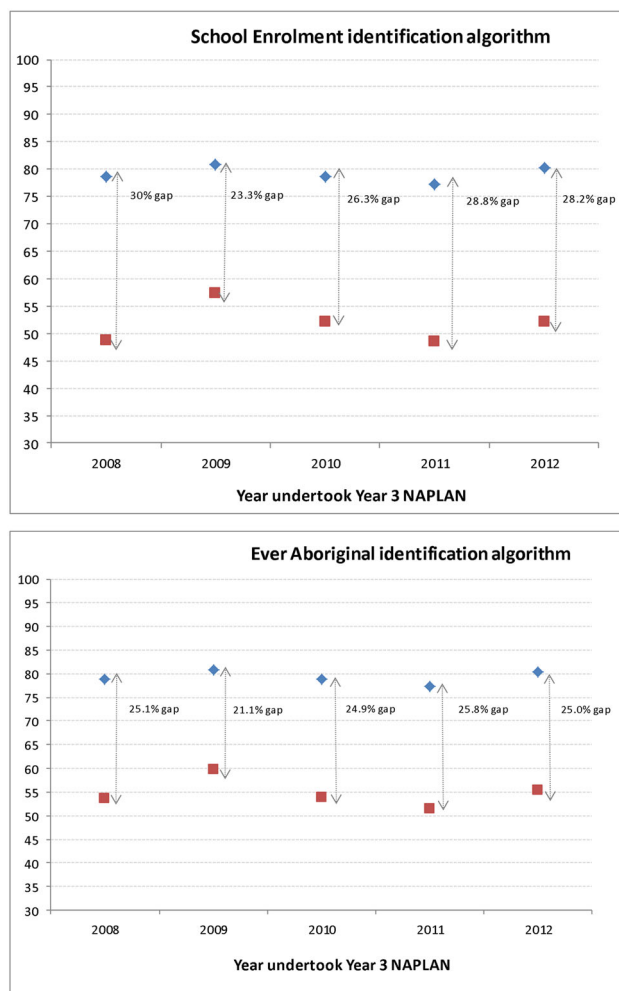


Fig. 2 Proportion of Aboriginal and non-Aboriginal children scoring above the national minimum standard in the year 3 National Assessment Program – Literacy and Numeracy (NAPLAN) reading domain using school enrolment and ever-identified identification algorithms. ◆, Above national minimum standard reading + non-Aboriginal; ■, above national minimum standard reading + Aboriginal.

as Aboriginal, children whose father was identified as being Aboriginal and/or Torres Strait Islander origin and the mother was not.

Research to date has focused on how under-identification of Aboriginal children from only using the ethnicity of the mother has affected the assessment of Aboriginal perinatal health. Our study extends this literature by being the first to have linked perinatal, births and education data to evaluate the identification of Aboriginal children in multiple administrative datasets and how this may affect not only estimates of perinatal health, but also developmental outcomes at school. Our analysis showed that 3.9% of children were identified as Aboriginal from the school enrolment dataset; however, linking multiple datasets to create an ever-identified algorithm resulted in 4.7% of children identified as Aboriginal. The different algorithms resulted in variations in educational outcomes with the proportion of Aboriginal children performing above the national minimum

standard in year 3 reading varying up to 12 percentage points depending on which identification algorithm was used. The finding that 55.3% (197) of Aboriginal children scored above the national minimum standard in reading using the ever-identified algorithm compared with 47.7% (229) using the school enrolment dataset is heartening. Nationally, 51.7% (12 584) of Aboriginal and/or Torres Strait Islander children scored above the national minimum standard in reading in the same period.¹⁹ The results from our study suggest that if more datasets were used to identify Aboriginal children, the proportion scoring above the national minimum standard in reading could change by 12 percentage points to 63.7%.

The use of algorithms in data linkage studies for deriving a better estimate of Aboriginal ethnicity has increased over recent years. Data custodians are striving to implement a national approach to collecting and recording Aboriginal and/or Torres Strait Islander origin,² and the mandatory inclusion of the baby's Indigenous status was introduced in the Perinatal Minimum Dataset in the 2012–2013 reference year. In 2012, a systematic appraisal of Australian studies concluded that until the validity of Aboriginal identification improves consistently, data linkage can provide sensitivity ranges in which true parameters lie.¹⁰ Our study illustrates the relevance of this conclusion by identifying that health and education estimates vary depending on which and how many datasets are used to identify Aboriginal children. Our findings should be interpreted within the context of the study limitations. There is anecdotal evidence that non-registration of births of Aboriginal and/or Torres Strait Islander Australians may be a significant problem. Further research is required to assess the magnitude of the problem in South Australia. For the purposes of our study, children were defined as Aboriginal based on parental ethnicity or primary care giver/teacher report. The three-part definition of Aboriginal identity determines a person of Aboriginal and/or Torres Strait Islander descent, to be one who identifies as such and who is accepted as such by the community with which the person associates. Aboriginal children cannot exercise their right to self-identify; therefore, we acknowledge that the propensity to identify as Aboriginal may change across the life course.

Conclusion

In conclusion, this study demonstrates that the number of South Australian children identified as Aboriginal and hence inequalities in developmental outcomes varied depending on which and how many administrative data sources were used. Ascertaining the size of the child Aboriginal population is challenging as the ethnicity of the child is inferred using adult identification of the child or is based on the ethnicity of the mother, and/or father. Linking multiple administrative datasets to determine the Aboriginal ethnicity of the child may be useful to inform policy, interventions, service delivery and how well we are closing developmental gaps.

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