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Working towards 2030 road safety targets, the need for specific rural and remote children strategies

Soonho Koh MPH[1] | **Doma Kenji PhD**[2] | **Richard Franklin PhD**[1]

[1]Public Health and Tropical Medicine, James Cook University, Townsville, Queensland, Australia

[2]College of Healthcare Science, Sports and Exercise Science, James Cook University, Townsville, Queensland, Australia

Correspondence
Soonho Koh, James Cook University, Townsville, QLD, Australia.
Email: soonho.koh@my.jcu.edu.au

Abstract

Introduction: Despite the importance of child road traffic death, the knowledge about rural child road traffic death in Australia is limited.

Objective: To explore the difference of child road traffic death between urban and rural areas.

Design: This study was a retrospective analysis of road traffic death in Australia among children and adolescents aged 0–19 registered between 1 January 2009 and 30 June 2019.

Results: During the study period, there were 1757 child road traffic death in Australia, and the crude mortality rate was 2.96 per 100 000 population. The crude mortality rate in remote (8.83 per 100 000 population) and very remote (11.08 per 100 000 population) areas was much higher than major cities (1.83 per 100 000 population), inner regional (5.14 per 100 000 population) and outer regional (5.91 per 100 000 population).

Conclusions: Specific targets are needed to address the burden of child road traffic death in Australia around rurality, as it is a significant risk factor of child road traffic death.

KEYWORDS

child, regional health planning, rural population, traffic accidents, trauma

1 | INTRODUCTION

Road traffic death is one of the most common causes of death worldwide,[1] and children are particularly vulnerable as their physical, cognitive and social capabilities are not fully developed.[2] In Australia, road traffic deaths were ranked as the top cause of death for children aged 0–16 years, and second for those aged 17–25 years from 2016 to 2018.[3] As such, there is a need to address child road death among children in Australia.

Rurality is one of several factors contributing to child road traffic death in Australia.[4] For example, child and adolescent fatality rate per 100 000 population was higher in inner regional (relative risk (RR): 2.55; 95% confidence interval (CI): 1.86–3.48), outer regional (RR: 3.01; 95% CI: 2.06–4.38), remote (RR: 4.39; 95% CI: 2.17–8.89) and very remote (RR: 5.87; 95% CI: 2.83–12.18) compared to major city areas between 2007 and 2016 in Australia. Additionally, socio-economic status is known to have an impact on child road traffic death in Australia,[4] with over

80% of road traffic death occurring in areas classified as low or middle socio-economic status. It is hypothesised that the use of older vehicles with poorer safety standards may be contributing to an increased risk of death, or with higher exposure to traffic.[4]

Gender is also considered as a significant risk factor for road traffic death in Australia, with the number of male road traffic death reported three times higher than females in 2009.[5] This increased risk for young males is thought to be due to greater exposure to traffic, as well as a tendency for boys to take more risks than girls.[2,6]

With respect to the type of road user in Australia, approximately half of all road traffic deaths were drivers, while passengers and motorcyclists comprised another 20%, and pedestrians comprised another 13%.[5] The high proportion of road traffic death of car drivers in Australia is partially due to the high rate of car ownership in Australia in comparison to other countries, particularly low- and middle-income countries.[7]

In the Australian[8] 'National Road Safety Strategy 2021-2030', the aim is to reduce road traffic death and serious injuries by 50% and 30% respectively before 2030. It also aims for zero deaths of children 7 years and under. Rural and remote road safety is one of the priority areas and to decrease Australian road traffic death. It is important to evaluate child road traffic death in rural areas to ensure appropriate programs are used to commit to the goal of this statement. To do this, detailed information about who is dying on Australian roads is required to develop appropriate strategies.

Peden and Franklin[4] explored the impact of rurality on injury-related mortality among children and adolescents including road traffic death and highlighted the burden of road deaths in children by rurality. However, their study focused on all injuries, and the detailed information regarding child road traffic death such as trends over time was not inspected. As such, in this study, we analyse trends over time for child road traffic deaths both rurality, and consider if recent strategies to decrease child road traffic death worked equally in urban and rural areas. Therefore, this study aimed at exploring the impact of age, rurality and road user type on child road traffic death to provide a basis for the development of target areas to achieve the goals of the National Road Strategy 2021–2030.

What is already known on this subject

- Child road traffic death is a significant problem in Australia.
- Living in a rural area is a risk factor for child road traffic death.
- Known strategies such as implementing infrastructure treatment for children or education programs for young drivers are difficult to apply due to a dispersed and small population in rural and remote areas.

What this paper adds

- Rurality and other factors such as gender, road user type, socioeconomic status and Indigenous status are significant risk factors for child road traffic death.
- Unlike urban areas, the rate of child road traffic death did not decrease in outer regional areas and very remote areas across Australia during 2009–2019.

2 | METHODS

This study reports a retrospective total population analysis of road traffic death in Australia among children and adolescents aged 0–19 which was registered between 1 January 2009 and 30 June 2019 (a period of 10 years) and predates COVID-19. The differences of child road injuries across age, rurality and road user were explored by gender, socio-economic status, trends over time, state and territory and season.

2.1 | Data source

The data was collected from the Australian Bureau of Statistics (ABS). The following variables of child road injuries were extracted: age, rurality, gender, date of death, underlying cause of death (which was used to classify types of road user), usual area of residence (which was used to define rurality and socio-economic status via index of socio-economic advantage and disadvantage [IRSAD]), state and territory, Aboriginal and Torres Strait Islander status, and International Classification of Disease (ICD)-10 cause of death code.[9]

2.2 | Population estimation

We calculated crude mortality rate dividing the number of road traffic death by the number of populations. The data of population was also collected from ABS.[10] We were unable to extract data regarding the population of children in rural areas, so this was estimated by multiplying the number of children in each state and the proportion of the population in rural areas. Moreover, we estimated the population of Aboriginal or non-Indigenous from census data in 2016.[11]

2.3 | Case identification and data cleaning

Road traffic death is typically classified as ICD-10 code, or more specifically, 'Road traffic and other land transport'; V00-89. This data was selected on the following: only cases where the incident occurred during the years of 2009–2019, Australian residents who were aged <20 years (i.e., visitors to Australia were excluded).

Road users were classified into five categories according to the ICD-10, which included 'pedestrian' (V00-09), 'cyclists' (V10-19), 'motorcycle or three-wheeler' (V20-39), 'car occupant' (V40-49), 'pickup truck or Van or heavy transport or bus' (V50-79) and 'other' (V80-89).[12] As such, trends over time were explored based on the Australian financial years, from 1 July 2009 to 30 June 2019.

2.4 | Coding of determinants of health

The impact of determinants of health on child injury risk was explored by remoteness and the IRSAD derived from the usual area of residence. The rurality of child road traffic death was calculated by matching the nine-digit statistical local area (SLA) code to the corresponding Australian Standard Geographical Classification (ASGC) category (i.e., major cities, inner regional, outer regional, remote and very remote).[13] The IRSAD informs statistical local areas using a ranking method (1–10), with areas ranked 1 being the most disadvantaged. In order to compare to previous data, socio-economic status was subsequently separated into three groups: low (IRSAD: 1–3), middle (IRSAD: 4–7) and high (IRSAD: 8–10).[4] Victims' current residential IRSAD postcode was used as a proxy for their socio-economic status.[14] The IRSAD dociles were coded to low (docile 1–3), middle (docile 4–7) and high (docile 8–10) for ease of analysis.

2.5 | Ethics

This study received ethics approval from the ethics committee in our university. The need for informed consent was waived, given that data was provided from the relevant ABS data.

2.6 | Statistical analysis

Crude rates per 100 000 population of child road traffic death and RR with a 95% CI across rurality and other variables were calculated by R version 4.2.2 in order to demonstrate the relationship between conditions. Crude rates were calculated using the population from June of each year.[15] Additionally, chi-square test of independence and chi-square test for trend was conducted to evaluate the impact of each variable on child road traffic death, and a p value <0.05 was considered statistically significant. Univariate analysis was conducted using a statistical software package (SPSS, v25, IBM, Illinois, USA).

3 | RESULTS

During the study period, there were 1757 child (0–19 years) road traffic death in Australia, of which two-thirds (65.5%) were aged 15–19 years. The crude mortality rate of child road traffic death in Australia during the study period was 2.96 per 100 000 population. Children aged 15–19 years old had the highest crude mortality rate followed by 0–4 years, 10–14 years and 5–9 years. The crude mortality rate of female child road traffic death was approximately half as high as male's (RR: 0.49; 95% CI: 0.45–0.55). The type of road users with the highest crude mortality rate of child road traffic death were car occupants, followed by pedestrians, and over 70% of child road traffic death consisted of car occupants and pedestrians. The crude mortality rate among non-Indigenous people was much lower than Indigenous people, and the RR was 0.39 (95% CI: 0.34–0.45). The crude mortality rate in areas classified as low IRSAD docile was the highest, followed by middle docile and high docile (Table 1).

3.1 | Characteristics by age group

The difference in crude mortality rate between male and female was bigger in older age groups and the difference was statistically significant ($p < 0.001$). Except for the 0–4 age group, the crude mortality rate of car occupants was the highest within the type of road user, and that of pedestrians was the highest among the 0–4 age group, and the difference was statistically significant ($p < 0.001$). In all age groups, the crude mortality rate in non-Indigenous people was half that of the Indigenous people. Furthermore, the RR of non-Indigenous people compared to Indigenous people was lower, particularly in the younger age group, and the difference was statistically significant ($p < 0.001$). The crude mortality rate in areas classified as high IRSAD docile was the lowest in all age groups, and the difference was statistically significant ($p = 0.042$) (Table 1).

3.2 | Characteristics by rurality

The crude mortality rate of child road traffic death was the highest in the 15–19 years age group in all remote areas, and the difference was statistically significant ($p < 0.001$).

TABLE 1 Characteristics of child road traffic death among each age group.

	0–4		5–9		10–14		15–19		Total		
	Rate	RR (95% CI)	Rate	RR (95% CI)	Rate	RR (95% CI)	Rate	RR (95% CI)	Rate	RR (95% CI)	*p*-Value
Total	1.60		1.20		1.25		11.93		2.96		
Gender											
Male	1.73	1.00	1.46	1.00	1.72	1.00	10.86	1.00	3.92	1.00	<0.001*
Female	1.46	0.85 (0.66–1.09)	0.93	0.63 (0.47–0.86)	0.76	0.44 (0.32–0.61)	4.60	0.42 (0.37–0.48)	1.94	0.49 (0.45–0.55)	
State											
NSW	1.08	1.00	1.17	1.00	1.01	1.00	7.00	1.00	2.54	1.00	0.069
VIC	0.99	0.92 (0.61–1.39)	0.89	0.77 (0.50–1.18)	0.92	0.91 (0.58–1.43)	6.62	0.95 (0.80–1.12)	2.36	0.93 (0.81–1.07)	
QLD	2.26	2.09 (1.47–2.99)	1.39	1.19 (0.80–1.76)	1.34	1.33 (0.87–2.02)	8.35	1.19 (1.01–1.40)	3.32	1.30 (1.14–1.49)	
SA	2.29	2.12 (1.30–3.46)	1.29	1.11 (0.61–2.02)	1.42	1.41 (0.77–2.56)	7.85	1.12 (0.88–1.43)	3.26	1.28 (1.06–1.56)	
WA	2.21	2.04 (1.34–3.11)	1.60	1.37 (0.86–2.19)	2.01	2.00 (1.27–3.15)	10.25	1.46 (1.21–1.77)	3.96	1.56 (1.34–1.81)	
TAS	2.93	2.71 (1.34–5.50)	0.63	0.54 (0.13–2.21)	1.57	1.56 (0.62–3.91)	10.73	1.53 (1.08–2.17)	4.02	1.58 (1.18–2.11)	
NT	5.82	5.39 (2.81–10.32)	3.35	2.87 (1.24–6.66)	6.10	6.05 (3.05–11.99)	20.01	2.86 (1.98–4.13)	8.44	3.32 (2.53–4.36)	
ACT	1.13	1.04 (0.33–3.33)	0.41	0.35 (0.05–2.52)	0.45	0.45 (0.06–3.25)	3.23	0.46 (0.23–0.93)	1.32	0.52 (0.30–0.90)	
Remoteness											
Major cities	0.91	1.00	0.71	1.00	0.75	1.00	4.98	1.00	1.83	1.00	<0.001*
Inner regional	2.22	2.45 (1.78–3.37)	1.99	2.80 (1.98–3.97)	2.04	2.73 (1.93–3.88)	14.37	2.88 (2.53–3.29)	5.14	2.81 (2.52–3.14)	
Outer regional	4.61	5.08 (3.69–6.99)	2.60	3.65 (2.44–5.47)	2.23	2.99 (1.94–4.61)	14.28	2.86 (2.42–3.39)	5.91	3.23 (2.83–3.69)	
Remote	5.01	5.52 (2.88–10.57)	4.60	6.46 (3.24–12.90)	5.36	7.17 (3.71–13.87)	20.76	4.17 (3.01–5.77)	8.83	4.83 (3.77–6.18)	
Very remote	9.89	10.9 (6.23 to 19.07)	5.79	8.13 (3.93–16.85)	9.91	13.28 (7.37–23.91)	19.18	3.85 (2.58 to 5.75)	11.08	6.06 (4.66–7.88)	
Type of road user											
Pedestrian	0.83	1.00	0.33	1.00	0.24	1.00	0.67	1.00	0.52	1.00	<0.001*
Cyclists	0.01	0.01 (0.00–0.06)	0.07	0.20 (0.10–0.39)	0.10	0.40 (0.22–0.74)	0.08	0.12 (0.07–0.22)	0.06	0.12 (0.08–0.17)	
Motorcycle or 3 wheeler	0.03	0.03 (0.01–0.09)	0.03	0.10 (0.04–0.25)	0.13	0.54 (0.31–0.95)	0.97	1.44 (1.12–1.87)	0.29	0.55 (0.46–0.66)	
Car occupant	0.67	0.80 (0.62–1.04)	0.61	1.84 (1.30–2.60)	0.62	2.54 (1.72–3.76)	5.75	8.56 (6.95–10.54)	1.90	3.63 (3.20–4.12)	

(Continues)

TABLE 1 (Continued)

	0–4		5–9		10–14		15–19		Total		
	Rate	RR (95% CI)	Rate	RR (95% CI)	Rate	RR (95% CI)	Rate	RR (95% CI)	Rate	RR (95% CI)	*p*-Value
Pickup truck or Van or heavy transport or bus	0.01	0.02 (0.00–0.06)	0.05	0.14 (0.06–0.31)	0.02	0.09 (0.03–0.28)	0.08	0.12 (0.07 to 0.22)	0.04	0.08 (0.05–0.12)	
Other land transport	0.06	0.07 (0.04–0.14)	0.11	0.34 (0.20–0.59)	0.14	0.57 (0.33–0.99)	0.26	0.38 (0.26–0.56)	0.14	0.27 (0.21–0.34)	
Indigenous status											
Aboriginal	7.30	1.00	3.78	1.00	3.88	1.00	15.90	1.00	7.51	1.00	<0.001*
Non-Indigenous	1.44	0.2 (0.15 to 0.27)	1.11	0.29 (0.20–0.44)	1.21	0.31 (0.21–0.47)	7.99	0.5 (0.41–0.62)	2.92	0.39 (0.34–0.45)	
Not stated	0.50	0.07 (0.02–0.19)	0.39	0.10 (0.03–0.34)	0.14	0.04 (0.01–0.27)	3.25	0.2 (0.13–0.32)	1.06	0.14 (0.10–0.20)	
IRSAD											
Low	2.57	1.00	1.86	1.00	2.25	1.00	10.25	1.00	4.29	1.00	0.042*
Mid	1.56	0.61 (0.46–0.79)	1.27	0.68 (0.50–0.94)	1.21	0.54 (0.39–0.74)	9.57	0.93 (0.82–1.06)	3.33	0.78 (0.70–0.86)	
High	0.70	0.27 (0.19–0.40)	1.33	0.72 (0.52–0.99)	0.53	0.23 (0.15–0.36)	3.63	0.35 (0.30–0.42)	1.55	0.36 (0.32–0.41)	

Abbreviations: ACT, Australian Capital Territory; IRSAD, index of socio-economic advantage and disadvantage; NSW, New South Wales; NT, Northern Territory; QLD, Queensland; SA, South Australia; TAS, Tasmania; VIC, Victoria; WA, Western Australia.

*Denotes significant difference within descriptor.

In all age groups (0–19 years), the crude mortality rate in remote and very remote areas was higher than in major cities, inner regional and outer regional (Table 1). The RR of rural areas compared to major cities was similar in both sexes, and all of them were significantly higher than 1. The crude mortality rate of car occupants was the highest followed by pedestrians in each remote area, and almost all the RR of rural areas compared to major cities were higher than 1 in every type of road user, and the difference was statistically significant ($p = 0.006$). The crude mortality rate of Indigenous children in remote and very remote areas was much higher than in major cities, inner regional and outer regional areas, and the RR of rural areas compared to major cities in Indigenous children was much higher than non-Indigenous children, and the difference was statistically significant ($p < 0.001$). Similarly, the crude mortality rate in areas classified as low IRSAD docile was much higher in remote and very remote areas than in major cities, inner regional and outer regional areas, and the RR of rural areas compared to major cities was much higher in low IRSAD group than high IRSAD group, and the difference was statistically significant ($p < 0.001$) (Table 2).

3.3 | Trend over time

The crude mortality rate of child road traffic death slightly decreased from 3.57 per 100 000 population in 2010 to 2.53 per 100 000 population in 2019 (Figure 1a). Among children aged 15–19 years, the crude mortality rate of road traffic death declined from 9.72 per 10 000 population in 2010 to 6.52 per 10 000 population in 2019 (Figure 1e). However, this downward trend of crude mortality rate was not evident among children in other age groups during the study period (Figure 1b–d).

The crude mortality rate of child road traffic death in major cities, inner regional and remote areas showed downward trends during the study period, and it dropped from 2.47 per 100 000 in 2010 to 1.53 per 100 000 in 2019 in major cities, 6.05 per 100 000 in 2010 to 4.35 per 100 000 in 2019 in inner regional and from 10.04 per 100 000 to 5.43 per 100 000 in 2019 in remote areas (Figure 2a,b,d). However, these trends were not clear in outer regional and very remote areas, and the crude mortality rate of child road traffic death was 5.63 per 100 000 in 2010 and 6.63 per 100 000 in 2019 in outer regional, and 7.11 per 100 000 in 2010 and 5.81 per 100 000 in 2019 in very remote areas (Figure 2c,e).

4 | DISCUSSION

Australia has an aim to reduce road fatalities to 50% by 2030 and for zero deaths of children under 7 years of age.[8] To contribute to this agenda, there is a need to focus on rural populations, especially children, who have higher rates of deaths.[8] In this study, the crude mortality rate of child road traffic death in remote and very remote areas was higher than in major cities, consistent with previous findings.[4,16] Furthermore, a recent review exploring child road death in high-income countries by rurality found 13 studies, and all of them found that the mortality rate was significantly higher on rural road than on urban road and from 1.6 times to 15 times higher incidence of road traffic death in rural areas.[17] Hence, child road death in rural areas is an important problem not only in Australia but also in other high-income countries. Unfortunately, the crude mortality rate of child road traffic death in outer regional and very remote population was stable compared to the decreases seen in the urban population, suggesting the need for targeted programs aimed at children in rural and remote locations. Consequently, it can be postulated that the National Road Safety Strategy seems to be having an impact in urban areas, but not too so in rural areas.

One reason why the crude mortality rate was high in rural areas was consistent over time in outer regional areas and the downward trend being unclear in very remote areas during 10 years may be attributed to the lack of infrastructure and public transport in these geographical locations.[18] For example, rural communities have low-quality road networks with high speed limits and travel more kilometres, which have led to road users in rural areas including children having a higher risk of traffic incidents than urban areas.[18] Developing better public transportation such as buses, rail and airplane may contribute to decreasing the amount of traffic and thus road traffic death in local areas. Unfortunately, this is a costly exercise, especially where there are smaller numbers of people, and other solutions will need to be explored including addressing unlicensed drivers, appropriate fitment of car seats, drunk driving, fatigue and speed.[8]

Unlicensed drivers have been reported as being higher in rural areas,[19] for example, Kallail et al.[19] reported that the proportion of young unlicensed drivers involved in fatal crashes was significantly higher in rural counties than in urban counties in Kansas, and another study alleged that the increased unlicensed drivers augmented crude mortality rate on the road.[20] In Australia, the Department of Planning, Transport and Infrastructure reported that the proportion of fatal crashes involving unlicensed drivers was higher for under 19 years old, and the proportion of fatal crashes involving unlicensed drivers occurred in rural areas was also higher than fatal crashes in general between 2009 and 2013 in South Australia.[21] Therefore, unlicensed drivers are a serious problem both in children and rural areas, and the National Road Safety Strategy tries to reduce them

TABLE 2 Characteristics of child road traffic death by rurality.

	Major cities		Inner regional		Outer regional		Remote		Very remote		Total	
	Rate	RR (95% CI)	Rate	RR (95% CI)	Rate	RR (95% CI)	Rate	RR (95% CI)	Rate	RR (95% CI)	Rate	*p*-Value
Gender												
Male	2.44	1.00	6.81	2.79 (2.44–3.18)	7.62	3.12 (2.65–3.66)	12.39	5.07 (3.78–6.79)	14.73	6.02 (4.38–8.28)	3.92	0.901
Female	1.18	1.00	3.38	2.86 (2.35–3.47)	4.10	3.47 (2.76–4.37)	5.07	4.29 (2.69–6.85)	7.23	6.11 (3.83–9.75)	1.94	
State												
NSW	1.74	1.00	4.72	2.72 (2.23–3.30)	5.98	3.44 (2.62–4.52)	9.09	5.23 (2.47–11.09)	20.02	11.52 (3.67–35.96)	2.59	<0.001*
VIC	1.53	1.00	5.24	3.43 (2.75–4.29)	5.00	3.27 (2.22–4.82)	0.00	4.28 (0.27–68.66)			2.36	
QLD	2.11	1.00	4.91	2.32 (1.84–2.93)	5.87	2.78 (2.17–3.55)	4.56	2.16 (1.10–4.22)	8.18	3.87 (2.16–6.96)	3.32	
SA	2.05	1.00	7.00	3.41 (2.26–5.14)	6.42	3.13 (1.99–4.92)	6.55	3.19 (1.46–6.97)	2.93	1.43 (0.20–10.30)	3.26	
WA	2.30	1.00	8.90	3.87 (2.77–5.41)	8.83	3.84 (2.69–5.47)	11.74	5.10 (3.33–7.81)	11.87	5.16 (3.27–8.14)	3.96	
TAS			3.75	1.00	4.88	1.30 (0.74–2.30)	0.00	0.66 (0.04–10.86)	0.00	2.13 (0.13–34.82)	4.02	
NT					4.25	1.00	13.56	3.19 (1.66–6.14)	14.99	3.53 (1.87–6.64)	8.44	
ACT	1.33	1.00	0.00	23.15 (1.38–389.28)							1.32	
Type of road user												
Pedestrian	0.41	1.00	0.61	1.48 (1.11–1.97)	0.99	2.41 (1.77–3.30)	1.56	3.81 (2.12–6.83)	1.85	4.51 (2.38–8.53)	0.52	0.006*
Cyclists	0.04	1.00	0.08	1.87 (0.84–4.13)	0.12	2.58 (1.03–6.47)	0.00	1.41 (0.08–23.30)	0.55	12.32 (3.65–41.64)	0.06	
Motorcycle or 3 wheeler	0.18	1.00	0.49	2.73 (1.92–3.89)	0.72	4.04 (2.72–5.99)	0.52	2.93 (1.07–8.00)	0.55	3.12 (0.98–9.90)	0.29	
Car occupant	1.12	1.00	3.57	3.20 (2.80–3.66)	3.58	3.21 (2.71–3.80)	6.10	5.46 (4.05–7.37)	7.94	7.11 (5.20–9.71)	1.90	
Pickup truck or van or heavy transport or bus	0.02	1.00	0.07	3.07 (1.14–8.23)	0.14	6.37 (2.37–17.09)	0.13	6.10 (0.77–48.11)	0.00	4.11 (0.24–70.57)	0.04	
Other land transport	0.06	1.00	0.33	5.52 (3.30–9.22)	0.37	6.22 (3.43–11.30)	0.52	8.78 (3.05–25.22)	0.18	3.12 (0.42–23.04)	0.14	
Indigenous status												
Aboriginal	2.31	1.00	8.93	3.86 (2.53–5.91)	13.51	5.85 (3.88–8.81)	34.91	15.11 (9.30–24.56)	67.74	29.31 (19.24–44.65)	7.51	<0.001*
Non-Indigenous	1.93	1.00	5.28	2.74 (2.44–3.07)	5.84	3.03 (2.62–3.50)	6.52	3.38 (2.45–4.66)	3.25	1.69 (0.97–2.92)	2.92	
Not stated	0.52	1.00	2.76	5.36 (2.46–11.67)	1.10	2.14 (0.60–7.67)	4.85	9.41 (2.09–42.47)	3.29	6.38 (0.82–49.42)	1.06	
IRSAD												
Low	1.86	1.00	7.95	4.27 (3.57–5.12)	10.49	5.63 (4.61–6.88)	12.88	6.92 (4.72–10.13)	31.01	16.65 (12.22–22.71)	4.29	<0.001*
Mid	2.07	1.00	6.39	3.10 (2.64–3.63)	5.96	2.89 (2.34–3.55)	11.23	5.44 (3.80–7.78)	3.41	1.65 (0.78–3.49)	3.33	
High	1.54	1.00	0.68	0.44 (0.29–0.68)	0.87	0.56 (0.32–0.99)	2.06	1.34 (0.55–3.24)	2.25	1.46 (0.54–3.92)	1.36	

Abbreviations: ACT, Australian Capital Territory; IRSAD, index of socio-economic advantage and disadvantage; NSW, New South Wales; NT, Northern Territory; QLD, Queensland; SA, South Australia; TAS, Tasmania; VIC, Victoria; WA, Western Australia.

*Denotes significant difference within descriptor.

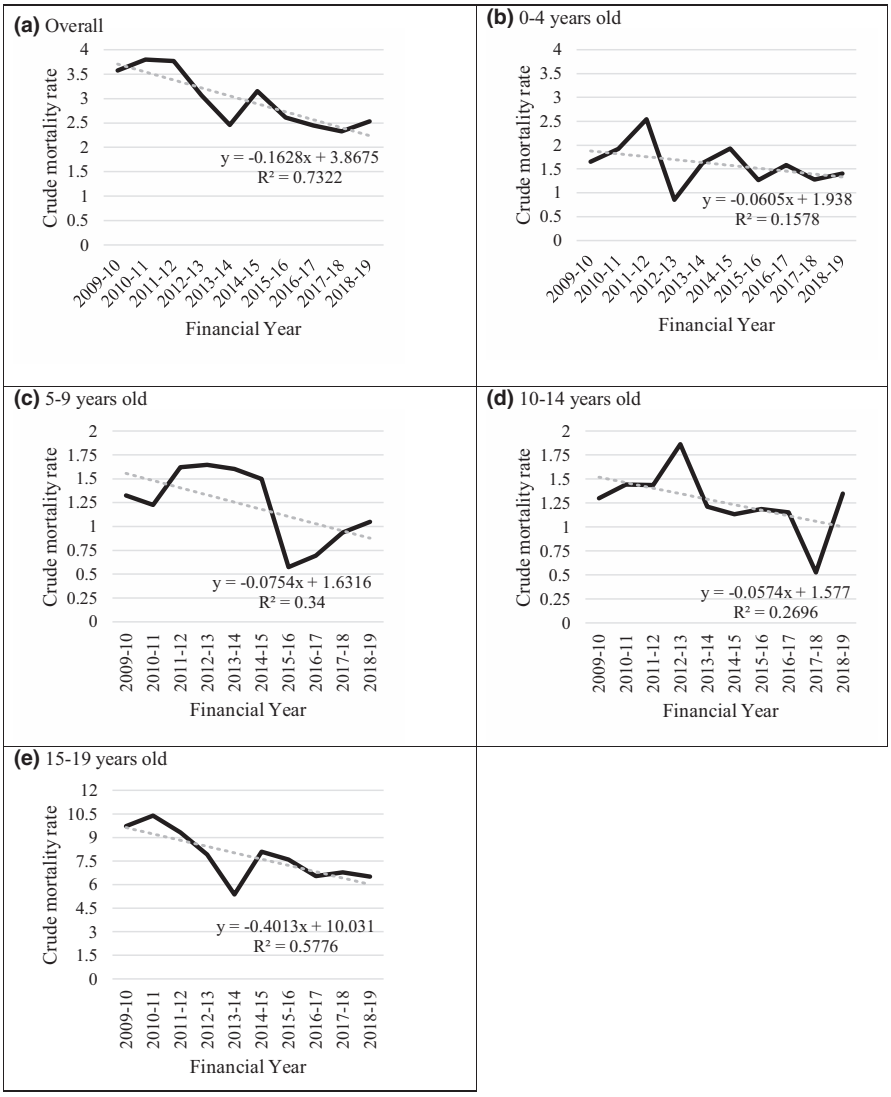

FIGURE 1 Trend of crude mortality rate by age group.

by developing and implementing educational program.[8] Challenges exist with low population density, preventing local government from extending educational programs such as fitting and checking of car seats for children and babies; however, new technology such as the Internet may help to show children the importance of acquiring driver's licence and following traffic laws and informing parents about safety strategies for their children.

4.1 | Gender

In this study, the number of child road traffic death and crude mortality rate of males was approximately twice as high as females and was consistent across all remote locations. These findings align with previous reports, whereby males were more vulnerable to traffic death compared to females.[2,6] Additionally, the gap between males and females was augmented in the older age groups, consistent with the findings by James et al.,[22] where the incidence rate of road traffic injury was higher in males globally, and this gap increased from the 0–9 years age groups to the 10–19 years age group. It has been postulated that the road traffic death of boys is higher than girls due to greater exposure to risks, as males are more likely to go outside or drive their cars compared to females.[6] This hypothesis needs to be explored further for rural locations.

4.2 | Type of road user

In Australia, over 80% of the child deaths on roads are either pedestrians (17.7%) or car occupants (64.3%), which is consistent across rural and remote locations, however motorcycles, other vehicles proportions vary by rurality. This result is similar in high-income countries for road traffic death by road user group with cars (60%) and pedestrians (18%) as the most common groups of users.[7]

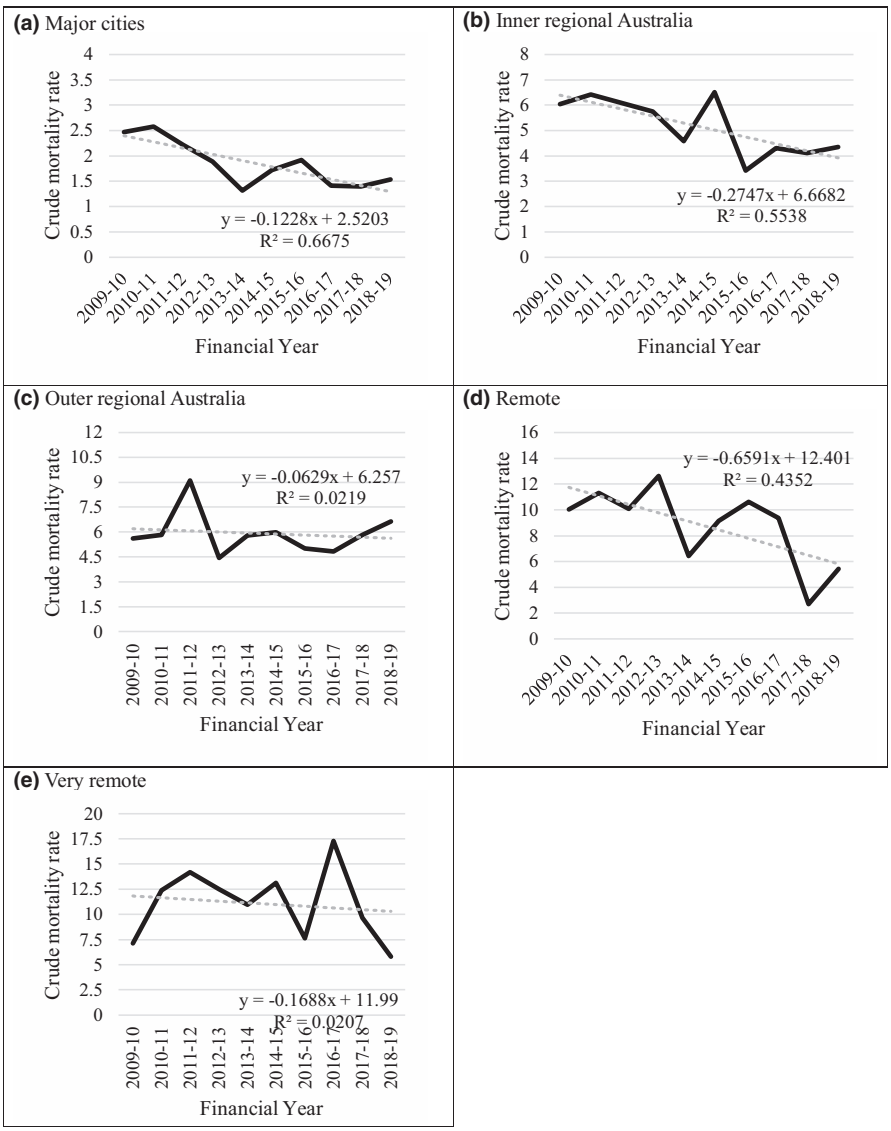

FIGURE 2 Trend of crude mortality rate by rurality.

Also noted fact is the lower rate of cyclist deaths in rural areas, RR of cyclist in outer regional areas, remote areas and very remote areas are 2.58 (95% CI: 1.03–6.47), 1.41 (95% CI: 0.08–23.30), 4.51 (95% CI: 2.83–8.53), respectively, which may be due to less cyclists and should be explored further.

The crude mortality rate of car occupants was higher in older age groups, which may be attributed to cars being driven by young drivers, a scenario that is more likely in rural areas where there is limited public transport options. A study in the USA reported that the presence of teenager occupants caused increasing mortality rate of child road traffic death.[23] The higher number of motorcycle-related deaths also needs further investigation, especially as this group has been found to be more vulnerable than people in cars on roads.[24] Development of prevention programs need to continue to focus on car driver and occupants; however, to continue to reduce the fatality rate, pedestrian, motorcycle and other vehicle programs will be required and need to be targeted at rural populations.

4.3 | Socio-economic status

The number of child road traffic death in areas classified as low and middle IRSAD docile was higher than in areas classified as high IRSAD docile. Previous reports in Australia have suggested that residents of low socio-economic areas have higher exposure to traffic,[25] and there is less investment in transport-related infrastructure in low socio-economic areas[26] as well as older vehicles.[27] Therefore, it is reasonable to assume that these factors may have also contributed to higher child road traffic death in areas classified as low and middle IRSAD docile in Australia, noting that there are more low docile IRSADs in rural areas. Programs focusing on low socio-economic areas are required to help address child road fatalities.

4.4 | Aboriginal and Torres Strait Islander status

The crude mortality rate of child road traffic death of Aboriginal and Torres Strait Islander peoples was much higher than non-Indigenous people, which was consistent with a previous report.[28] A 2009 report[27] exploring Indigenous road safety reported a complex mix of factors which impact safety across human, vehicle and post-crash risk factors, and is an area which needs greater exploration of road safety among Aboriginal and Torres Strait Islander children.

4.5 | Strength and limitations

This study provided critical information regarding the association between child road traffic death and rurality, and identified that socio-economic status, type of road user and Indigenous status were also important risk factors of child road traffic death.

However, there are some limitations associated with this study. Firstly, there are significant differences in the social, developmental and behavioural influences on early, mid and late childhood, and adolescence. Our study focused on children from 0 to 19 years old for most of the analysis (noting higher rates in older age groups), and this broad age range analysis may hide these potentially important differences. Secondly, the crude mortality rate in rural areas of our study was based on the estimation of the proportion in all age groups, so the difference in the distribution of age groups in rural areas may distort our results. Additionally, we use data between 2009 and 2019 to avoid COVID, noting that COVID changed driving behaviour which is returning to normal. We recommend using more recent data post COVID to clarify recent association between rurality and child road traffic deaths. Thirdly, this study only explored fatalities, and further research is needed to explore all types of road traffic incidents involving children. Fourthly, ABS data is based on usual area of residence, so some deaths may have occurred outside of their local area; further work on where the child lived and where they died is needed. Finally, in this study, we did not examine other factors which may have influenced road traffic death, such as helmets or child restraints, speed, use of alcohol and the availability of trauma centres. Therefore, more work is required to expand on factors that may moderate the association between child road traffic death and rurality in Australia.

5 | CONCLUSION

This study explored the association between child road traffic death and rurality. Our study showed that rurality was a significant risk factor of child road traffic death and the number of child road traffic death did not decrease in outer regional areas and very remote areas. The lack of infrastructure, such as fewer public transports options, and unlicensed young driver may contribute to rural child road traffic death added to the poor availability of prevention policies. Proper investment in local public transport or implementation of education programs including the provision of fitting and checking of car seats for children in local areas may decrease child road traffic death in local areas.

AUTHOR CONTRIBUTIONS

Soonho Koh: Investigation; methodology; visualization; writing – original draft; conceptualization; data curation. **Doma Kenji:** Validation; writing – review and editing; supervision; conceptualization; data curation; formal analysis; visualization. **Richard Franklin:** Validation; writing – review and editing; supervision; conceptualization; formal analysis; data curation; visualization.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest associated with this manuscript.

ETHICAL APPROVAL

This study received ethics approval from the James Cook University Human Research Committee (H6136). The need for informed consent was waived, given that data was provided from the relevant ABS data.

ABORIGINAL AND TORRES STRAIT ISLANDER

In our data, about 12% of Aboriginal and Torres Strait Islander people were unfortunately among the child road traffic death statistics in Australia. However, our study focused on the difference of child road traffic death in Australia nationwide. Therefore, we did not target Aboriginal and Torres Strait Islander people, and this is purely incidental.

ORCID

Soonho Koh https://orcid.org/0009-0002-8558-5011

Doma Kenji https://orcid.org/0000-0002-8903-0067
Richard Franklin https://orcid.org/0000-0003-1864-4552

REFERENCES

1. World Health Organization. Global status report on road safety 2018. Geneva: World Health Organization; 2018 [cited 2022 Jul 16]. Available from: https://www.who.int/publications/i/item/9789241565684
2. World Health Organization. Ten strategies for keeping children safe on the road. Geneva, Switzerland: World Health Organization; 2015 [cited 2022 Jul 16]. Available from: https://apps.who.int/iris/bitstream/handle/10665/162176/WHO_NMH_NVI_15.3_eng.pdf?sequence=1&isAllowed=y
3. Australian Institute of Health and Welfare. Deaths in Australia. Canberra, Australia: Australian Institute of Health and Welfare; 2020 [cited 2022 Jul 16]. Available from: https://www.aihw.gov.au/reports/australias-health/causes-of-death
4. Peden AE, Franklin RC. Exploring the impact of remoteness and socio-economic status on child and adolescent injury-related mortality in Australia. Children. 2020;8(1):5.
5. Department of Infrastructure, Transport, Regional Development and Communication. Road trauma Australia 2019 statistical summary. Canberra, Australia: Department of Infrastructure, Transport, Regional Development and Communication; 2020 [cited 2022 Jul 16]. Available from: https://www.bitre.gov.au/sites/default/files/documents/road_trauma_australia_2019_statistical_summary.pdf
6. Mannocci A, Saulle R, Villari P, La Torre G. Male gender, age and low income are risk factors for road traffic injuries among adolescents: an umbrella review of systematic reviews and meta-analyses. J Public Health. 2019;27(2):263–72.
7. Naci H, Chisholm D, Baker TD. Distribution of road traffic deaths by road user group: a global comparison. Inj Prev. 2009;15(1):55–9.
8. Commonwealth of Australia. National road safety strategy 2021–2030. 2021.
9. Australian Bureau of Statistics. Cause of death, Australia. Canberra, Australia: Australian Bureau of Statistics; 2020 [cited 2022 Jul 16]. Available from: https://www.abs.gov.au/statistics/health/causes-death/causes-death-australia/2019#data-downloads
10. Australian Bureau of Statistics. Regional population. Canberra, Australia: Australian Bureau of Statistics; 2020 [cited 2022 Jul 23]. Available from: https://www.abs.gov.au/statistics/people/population/regional-population/2018-19
11. Australian Bureau of Statistics. Census. Canberra, Australia: Australian Bureau of Statistics; 2021 [cited 2022 Jul 23]. Available from: https://www.abs.gov.au/census
12. World Health Organization. ICD-10 version:2019. Geneva, Switzerland: World Health Organization; 2019 [cited 2022 Jul 16]. Available from: https://icd.who.int/browse10/2019/en#/
13. Australian Bureau of Statistics. Australian standard geographical classification (ASGC). Canberra, Australia: Australian Bureau of Statistics; 2011 [cited 2022 Jul 16]. Available from: https://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/32FBEDE1EA4C5800CA25791F000F2E1C/$File/att98dqt.pdf
14. Australian Bureau of Statistics. Socio-economic indexes for areas (SEIFA). Canberra, Australia: Australian Bureau of Statistics; 2013 [cited 2022 Jul 16]. Available from: https://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/22CEDA8038AF7A0DCA257B3B00116E34/$File/2033.0.55.001%20seifa%202011%20technical%20paper.pdf
15. Australian Bureau of Statistics. Population. Canberra, Australia: Australian Bureau of Statistics; 2020 [cited 2022 Jul 16]. Available from: https://www.abs.gov.au/statistics/people/population
16. Chang S, Symons R, Ozanne-Smith J. Child road traffic injury mortality in Victoria, Australia (0–14 years), the need for targeted action. Injury. 2018;49(3):604–12.
17. Koh S, Doma K, Franklin RC. The impact of rurality on child road traffic death in high-income countries. Aust J Rural Health. 2023;31(3):408–16.
18. Infrastructure Australia. An assessment of Australia's future infrastructure needs. Sydney, Australia: Infrastructure Australia; 2019 [cited 2022 Jul 16]. Available from: https://www.infrastructureaustralia.gov.au/sites/default/files/2020-10/Audit%202019_Full%20pdf_Updates%20September%202020.pdf
19. Kallail KJ, Johnston SC, Melhorn KJ, Boyce MC, Golbeck AL, Frisch LE. The influence of licence status on Kansas child fatalities due to motor vehicle crashes. Int J Inj Control Saf Promot. 2008;15(2):77–82.
20. Notrica DM, Sayrs LW, Krishna N. The effect of verified pediatric trauma centers, state laws, and crash characteristics on time trends in adolescent motor vehicle fatalities, 1999–2015. J Trauma Acute Care Surg. 2018;85(5):944–52.
21. Government of South Australia Department for Infrastructure and Transport. Unlicensed drivers involved in road crashes in South Australia. Adelaide, Australia: Government of South Australia Department for Infrastructure and Transport; 2014 [cited 2023 Nov 6]. Available from: https://www.dit.sa.gov.au/__data/assets/pdf_file/0013/112333/Unlicensed_Drivers.pdf
22. James SL, Lucchesi LR, Bisignano C, Castle CD, Dingels ZV, Fox JT, et al. Epidemiology of injuries from fire, heat and hot substances: global, regional and national morbidity and mortality estimates from the Global Burden of Disease 2017 study. Inj Prev. 2020;26(Suppl 2):i36–i45.
23. Hamann C, Price M, Peek-Asa C. Characteristics of crashes and injuries among 14 and 15 year old drivers, by rurality. J Saf Res. 2020;73:111–8.
24. Pym AJ, Wallis BA, Franklin RC, Kimble RM. Unregulated and unsafe: the impact of motorcycle trauma on Queensland children. J Paediatr Child Health. 2013;49(6):493–7. https://doi.org/10.1111/jpc.12204
25. Rachele JN, Learnihan V, Badland HM, Mavoa S, Turrell G, Giles-Corti B. Neighbourhood socioeconomic and transport disadvantage: The potential to reduce social inequities in health through transport. J Transp Health. 2017;7:256–63.
26. Wiesel I, Liu F, Buckle C. Locational disadvantage and the spatial distribution of government expenditure on urban infrastructure and services in metropolitan Sydney (1988–2015). Geogr Res. 2018;56(3):285–97.
27. Australian Indigenous HealthInfoNet. Summary of road safety among indigenous people. Mount Lawley, Australia: Australian Indigenous HealthInfoNet; 2009 [cited 2022 Jul 16]. Available

from: https://healthinfonet.ecu.edu.au/healthinfonet/getContent.php?linkid=590635&title=Summary+of+road+safety+among+Indigenous+peoples

28. Australian Institute of Health and Welfare. Rural, regional and remote health: a study on mortality. 2nd ed. Canberra, Australia: Australian Institute of Health and Welfare; 2007 [cited 2022 Jul 16]. Available from: https://www.aihw.gov.au/reports/rural-remote-australians/rural-regional-remote-mortality-study-2nd-edition/contents/table-of-contents

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