



Supporting Information

Supplementary methods and results

**This appendix was part of the submitted manuscript and has been peer reviewed.
It is posted as supplied by the authors.**

Appendix to: O'Reilly GM, Curtis K, Mitra B, et al. Hospitalisations and in-hospital deaths following moderate to severe traumatic brain injury in Australia: a cross-sectional analysis for the Australian Traumatic Brain Injury National Data (ATBIND) project. *Med J Aust* 2023; doi: 10.5694/mja2.52055.

Table 1. Australia New Zealand Trauma Registry (ATR) hospitals included in this study

Australian Capital Territory

- Canberra Hospital

New South Wales

- Children's Hospital Westmead
- John Hunter Children's Hospital
- John Hunter Hospital
- Liverpool Hospital
- Royal North Shore Hospital
- Royal Prince Alfred Hospital
- St George Hospital
- St Vincent's Hospital
- Sydney Children's Hospital
- Westmead Hospital

Northern Territory

- Royal Darwin Hospital

Queensland

- Gold Coast University Hospital
- Queensland Children's Hospital
- Royal Brisbane and Women's Hospital

South Australia

- Flinders' Medical Centre
- Royal Adelaide Hospital
- Women's and Children's Hospital

Victoria

- The Alfred
- Royal Children's Hospital
- Royal Melbourne Hospital

Western Australia

- Perth Children's Hospital
- Royal Perth Hospital

Table 2. Characteristics of moderate to severe traumatic brain injury leading to hospitalisation or in-hospital death, Australia, 2015–20: external cause, by age group and year

| Characteristic | 2015–16 | 2016–17 | 2017–18 | 2018/19 | 2019–20 | All years |
|--------------------------------------|----------------|----------------|----------------|----------------|----------------|------------------|
| All hospitalisations | 3204 | 3271 | 3335 | 3305 | 3235 | 16 350 |
| 0–17 years | 373 | 337 | 321 | 354 | 366 | 1751 |
| Transport | 164 (44.0%) | 138 (40.9%) | 156 (48.6%) | 163 (46.0%) | 172 (47.0%) | 793 (45.3%) |
| Fall | 135 (36.2%) | 131 (38.9%) | 112 (34.9%) | 122 (34.5%) | 130 (35.5%) | 630 (36.0%) |
| Struck* | 34 (9.1%) | 39 (11.6%) | 22 (6.8%) | 32 (9.0%) | 24 (6.6%) | 151 (8.6%) |
| Other | 38 (10.2%) | 27 (8.0%) | 22 (6.8%) | 32 (9.0%) | 32 (8.7%) | 151 (8.6%) |
| Missing data | 2 (0.5%) | 2 (0.6%) | 9 (2.8%) | 5 (1.4%) | 8 (2.2%) | 26 (1.5%) |
| 18–64 years | 1708 | 1762 | 1763 | 1767 | 1684 | 8684 |
| Transport | 799 (46.8%) | 782 (44.4%) | 784 (44.5%) | 819 (46.3%) | 719 (42.7%) | 3903 (44.9%) |
| Fall | 520 (30.4%) | 533 (30.3%) | 578 (32.7%) | 579 (32.8%) | 582 (34.6%) | 2792 (32.1%) |
| Struck* | 265 (15.5%) | 283 (16.1%) | 266 (15.1%) | 262 (14.8%) | 251 (14.9%) | 1327 (15.3%) |
| Other | 106 (6.2%) | 144 (8.2%) | 127 (7.2%) | 96 (5.4%) | 114 (6.8%) | 587 (6.8%) |
| Missing data | 18 (1.1%) | 20 (1.1%) | 8 (0.5%) | 11 (0.6%) | 18 (1.1%) | 75 (0.9%) |
| 65 years or older | 1123 | 1172 | 1251 | 1184 | 1185 | 5915 |
| Transport | 182 (16.2%) | 207 (17.7%) | 212 (16.9%) | 214 (18.1%) | 195 (16.5%) | 1010 (17.1%) |
| Fall | 890 (79.3%) | 910 (77.6%) | 987 (78.9%) | 925 (78.1%) | 935 (78.8%) | 4647 (78.5%) |
| Struck (by person, animal or object) | 22 (1.9%) | 28 (2.4%) | 35 (2.8%) | 31 (2.6%) | 29 (2.5%) | 145 (2.5%) |
| Other | 20 (1.8%) | 13 (1.1%) | 15 (1.2%) | 12 (1.0%) | 23 (1.9%) | 83 (1.4%) |
| Missing data | 9 (0.8%) | 14 (1.2%) | 2 (0.2%) | 2 (0.2%) | 3 (0.3%) | 30 (0.5%) |

* By person, animal, or object.

Table 3. Annual change in numbers of hospitalisations and deaths in hospital following moderate to severe traumatic brain injury, Australia, 2015–20, by age group and sex: negative binomial regression analyses*

| Characteristic | Incident rate ratio (95% confidence interval) | |
|--------------------------------|---|-----------------------|
| | Primary analysis | Sensitivity analysis† |
| Hospitalisations | 1.00 (0.99–1.02) | 0.99 (0.98–1.0004) |
| Age group (years) ^b | | |
| 0–9 | 0.98 (0.93–1.02) | |
| 10–19 | 1.01 (0.97–1.05) | |
| 20–29 | 0.97 (0.94–1.0008) | |
| 30–39 | 1.01 (0.98–1.05) | |
| 40–49 | 1.01 (0.97–1.04) | |
| 50–59 | 1.00 (0.96–1.03) | |
| 60–69 | 1.04 (1.003–1.07) | |
| 70–79 | 1.02 (0.99–1.05) | |
| 80–89 | 0.98 (0.96–1.02) | |
| 90 or older | 1.07 (1.01–1.13) | |
| Sex | | |
| Male | 1.01 (0.99–1.02) | 0.99 (0.98–1.01) |
| <i>Over 65 years</i> | <i>1.01 (0.99–1.04)</i> | |
| <i>18–64 years</i> | <i>1.00 (0.99–1.02)</i> | |
| <i>0–17 years</i> | <i>0.99 (0.95–1.03)</i> | |
| Female | 1.00 (0.97–1.02) | 0.98 (0.96–1.00) |
| <i>Over 65 years</i> | <i>1.01 (0.98–1.04)</i> | |
| <i>18–64 years</i> | <i>0.97 (0.94–1.00)</i> | |
| <i>0–17 years</i> | <i>1.02 (0.96–1.09)</i> | |
| Deaths | 1.00 (0.97–1.03) | 0.98 (0.96–1.01) |
| Age group (years) ^b | | |
| 0–9 | 0.86 (0.72–1.04) | |
| 10–19 | 0.93 (0.81–1.06) | |
| 20–29 | 0.99 (0.91–1.08) | |
| 30–39 | 1.03 (0.93–1.15) | |
| 40–49 | 1.04 (0.94–1.15) | |
| 50–59 | 1.00 (0.91–1.10) | |
| 60–69 | 0.98 (0.90–1.06) | |
| 70–79 | 1.00 (0.93–1.07) | |
| 80–89 | 0.99 (0.93–1.05) | |
| 90 or older | 1.11 (1.001–1.24) | |
| Sex | | |
| Male | 1.02 (0.97–1.08) | 1.01 (0.96–1.06) |
| Female | 0.99 (0.95–1.02) | 0.97 (0.94–1.01) |

* Primary outcome: log (mean daily number of events), by group.

† Adjusted for estimated change in Australian population, 2015–20, based on estimates of estimated residential population (to closest 100 000) at midpoint of each year (ie, December), source: the Australian Bureau of Statistics (<https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population>).

Table 4. Annual change in numbers of hospitalisations and deaths in hospital following moderate to severe traumatic brain injury, Australia, 2015–20, by nature of injury and sex (hospitalisations only): negative binomial regression analyses*

| Characteristic | Incident rate ratio (95% confidence interval) | | |
|------------------------------|---|--------------------------|-------------------------|
| | All patients | Male patients | Female patients |
| Hospitalisations | | | |
| Time of injury | | | |
| 00:00–07:59 | 1.02 (0.99–1.04) | 1.02 (0.99–1.04) | 1.02 (0.99–1.06) |
| 08:00–15:59 | 0.99 (0.97–1.01) | 0.99 (0.97–1.02) | 0.98 (0.95–1.02) |
| 16:00–23:59 | 1.00 (0.98–1.02) | 1.01 (0.99–1.03) | 0.98 (0.94–1.02) |
| Dominant cause | | | |
| Blunt | 1.00 (0.99–1.02) | 1.01 (0.99–1.02) | 1.00 (0.97–1.02) |
| Penetrating | 1.01 (0.92–1.09) | 1.01 (0.92–1.11) | 0.98 (0.73–1.31) |
| Other | 1.38 (1.04–1.85) | 1.39 (1.01–1.91) | 1.37 (0.71–2.64) |
| External cause | | | |
| Transport | 0.99 (0.97–1.02) | 1.00 (0.98–1.03) | 0.98 (0.94–1.01) |
| Fall | 1.02 (0.99–1.03) | 1.02 (0.997–1.04) | 1.01 (0.99–1.04) |
| Struck | 0.98 (0.95–1.02) | 1.00 (0.96–1.03) | 0.89 (0.81–0.98) |
| Other | 0.98 (0.93–1.03) | 0.98 (0.92–1.04) | 0.99 (0.90–1.09) |
| Location of injury | | | |
| Home | 1.01 (0.99–1.03) | 1.02 (0.99–1.05) | 1.00 (0.96–1.04) |
| Residential care institution | 1.06 (0.99–1.13) | 1.07 (0.96–1.17) | 1.05 (0.96–1.16) |
| Street or highway | 1.05 (1.02–1.07) | 1.05 (1.02–1.08) | 1.05 (1.01–1.10) |
| Workplace | 1.03 (0.99–1.08) | 1.01 (0.96–1.07) | 1.13 (1.01–1.25) |
| Other | 0.91 (0.88–0.94) | 0.90 (0.86–0.94) | 0.92 (0.86–1.00) |
| Intent of injury | | | |
| Unintentional | 1.02 (1.004–1.04) | 1.03 (1.004–1.05) | 1.02 (0.98–1.05) |
| Self-harm | 1.01 (0.92–1.12) | 1.02 (0.91–1.14) | 0.99 (0.82–1.20) |
| Assault | 1.02 (0.96–1.07) | 1.04 (0.98–1.10) | 0.84 (0.72–0.97) |
| Other | 0.79 (0.53–1.18) | 0.95 (0.61–1.48) | 0.25 (0.04–1.43) |
| Deaths | | | |
| Time of injury | | | |
| 00:00–07:59 | 1.02 (0.97–1.07) | | |
| 08:00–15:59 | 1.01 (0.96–1.05) | | |
| 16:00–23:59 | 0.97 (0.92–1.02) | | |
| Dominant cause | | | |
| Blunt | 0.99 (0.97–1.03) | | |
| Penetrating | 1.01 (0.84–1.21) | | |
| Other | 0.36 (0.02–0.71) | | |
| External cause | | | |
| Transport | 0.97 (0.93–1.03) | | |
| Fall | 1.03 (0.99–1.07) | | |
| Struck | 1.09 (0.98–1.23) | | |
| Other | 0.88 (0.78–0.99) | | |
| Location of injury | | | |
| Home | 0.97 (0.93–1.04) | | |
| Residential care institution | 1.06 (0.93–1.22) | | |
| Street or highway | 1.01 (0.48–1.07) | | |

| Characteristic | Incident rate ratio (95% confidence interval) | | |
|------------------|---|---------------|-----------------|
| | All patients | Male patients | Female patients |
| Workplace | 1.17 (1.02–1.35) | | |
| Other | 0.84 (0.76–0.93) | | |
| Intent of injury | | | |
| Unintentional | 1.01 (0.97–1.06) | | |
| Self-harm | 1.01 (0.85–1.19) | | |
| Assault | 0.96 (0.80–1.14) | | |
| Other | 0.77 (0.28–2.15) | | |

* Primary outcome: log (mean daily number of events), by group.

Table 5. Annual change in numbers of hospitalisations and deaths in hospital following moderate to severe traumatic brain injury, Australia, 2015–20, by injury severity and sex (hospitalisations only): negative binomial regression analyses*

| Characteristic | Incident rate ratio (95% confidence interval) | | |
|---|---|-------------------------|-------------------------|
| | All patients | Male patients | Female patients |
| Hospitalisations | | | |
| Injury Severity Score [†] | | | |
| < 13 (or death) | 1.06 (0.88–1.29) | 1.02 (0.79–1.30) | 1.14 (0.84–1.54) |
| 13–14 | 1.01 (0.98–1.04) | 1.02 (0.98–1.06) | 0.98 (0.93–1.04) |
| 16–24 | 0.99 (0.97–1.01) | 0.99 (0.97–1.01) | 1.00 (0.97–1.03) |
| 25–40 | 1.01 (0.99–1.03) | 1.01 (0.99–1.04) | 0.99 (0.96–1.03) |
| 41–75 | 1.01 (0.96–1.05) | 1.01 (0.97–1.06) | 0.98 (0.90–1.06) |
| Isolated traumatic brain injury | | | |
| Yes [‡] | 0.99 (0.97–1.01) | 0.99 (0.97–1.01) | 1.01 (0.97–1.04) |
| No | 1.01 (0.99–1.02) | 1.02 (0.998–1.03) | 0.99 (0.96–1.01) |
| Abbreviated Injury Scale: head score [†] | | | |
| 3 | 1.01 (0.98–1.02) | 1.01 (0.99–1.03) | 0.98 (0.94–1.01) |
| 4 | 1.01 (0.99–1.03) | 1.00 (0.98–1.03) | 1.01 (0.98–1.04) |
| 5 | 1.01 (0.98–1.02) | 1.00 (0.98–1.03) | 0.99 (0.96–1.03) |
| 6 | 0.92 (0.69–1.22) | 0.86 (0.63–1.18) | 1.42 (0.60–3.37) |
| Glasgow Coma Scale [†] | | | |
| 3–8 | 1.06 (1.04–1.09) | 1.07 (1.04–1.10) | 1.06 (1.01–1.11) |
| 9–12 | 1.01 (0.97–1.06) | 1.03 (0.97–1.08) | 0.99 (0.92–1.07) |
| 13–15 | 1.02 (1.0004–1.03) | 1.02 (0.998–1.04) | 1.01 (0.99–1.04) |
| Illegitimate: endotracheal tube | 0.89 (0.84–0.95) | 0.90 (0.85–0.97) | 0.88 (0.79–0.99) |
| Shock index [†] | | | |
| Normal (≤ 1.0) | 0.99 (0.96–1.03) | 1.01 (0.97–1.05) | 0.98 (0.92–1.04) |
| Abnormal (> 1.0) | 1.00 (0.99–1.01) | 1.01 (0.99–1.02) | 1.00 (0.98–1.02) |
| Deaths | | | |
| Injury Severity Score [†] | | | |
| < 13 (or death) | 1.06 (0.88–1.29) | | |
| 13–14 | 1.07 (0.83–1.38) | | |
| 16–24 | 1.03 (0.95–1.11) | | |
| 25–40 | 0.99 (0.96–1.03) | | |
| 41–75 | 0.98 (0.92–1.04) | | |
| Isolated traumatic brain injury | | | |
| Yes [‡] | 1.02 (0.98–1.07) | | |
| No | 0.98 (0.94–1.01) | | |
| Abbreviated Injury Scale: head score [†] | | | |
| 3 | 1.05 (0.97–1.15) | | |
| 4 | 1.01 (0.95–1.08) | | |
| 5 | 0.99 (0.95–1.02) | | |
| 6 | 0.93 (0.69–1.26) [§] | | |
| Glasgow Coma Scale [†] | | | |
| 3–8 | 1.05 (1.01–1.09) | | |
| 9–12 | 0.99 (0.91–1.09) | | |
| 13–15 | 1.07 (0.99–1.14) | | |

| Characteristic | Incident rate ratio (95% confidence interval) | | |
|------------------------------------|---|--|--|
| Illegitimate: endotracheal tube | 0.98 (0.89–1.08) | | |
| Shock index [†] | | | |
| Normal (≤ 1.0) | 0.94 (0.88–0.998) | | |
| Abnormal (> 1.0) | 1.02 (0.99–1.05) | | |

* Primary outcome: log (mean daily number of events), by group.

[†] On arrival at the definitive hospital.

[‡] Abbreviated Injury Scale head score > 2 and no other body region > 1 .

[§] Results of Poisson regression, as convergence was not reached in negative binomial regression model.