Impact of childhood burns on academic performance: a matched population-based cohort study

Nicole Halim,1 Andrew J A Holland,2 Anne McMaugh,3 Cate M Cameron,4,5 Reidar P Lystad,1 Tim Badgery-Parker,1 Rebecca Mitchell 1

ABSTRACT
Objective This study aimed to compare academic performance and high school completion of young people hospitalised for a burn compared with young people not hospitalised for an injury.

Design A retrospective population-based matched case-comparison cohort study.

Participants Young people aged ≤18 years hospitalised for a burn during 2005–2018 in New South Wales, Australia, with age, sex and residential postcode-matched peers not hospitalised for any injury during 1 July 2001 and 31 December 2018.

Main outcome measures Performance below the national minimum standard (NMS) on the National Assessment Plan for Literacy and Numeracy assessments and not completing high school.

Results Young females hospitalised for a burn had a 72% higher risk of poorer reading compared with their peers (adjusted relative risk (ARR) 1.72; 95% CI 1.33 to 2.23), while young males hospitalised with a burn showed no higher risk (ARR 1.14; 95% CI 0.91 to 1.43). Young males (ARR 1.05; 95% CI 0.81 to 1.35) and females (ARR 1.34; 95% CI 0.93 to 1.94) hospitalised with a burn had no higher risk of not reaching the NMS for numeracy compared with peers. Young people hospitalised with a burn had at least twice the risk of not completing year 10 (ARR 3.86; 95% CI 1.68 to 8.86), year 11 (ARR 2.45; 95% CI 1.89 to 3.18) and year 12 (ARR 2.09; 95% CI 1.63 to 2.67) compared with matched counterparts.

Conclusions Young females hospitalised with a burn displayed poorer academic performance for reading compared with matched peers, while males and females were more likely to leave school earlier. Identifying unmet learning support needs of young burn survivors should be investigated.

WHAT IS ALREADY KNOWN ON THIS TOPIC
Burns in childhood are associated with worse academic performance compared with children hospitalised for other health conditions.

WHAT THIS STUDY ADDS
Academic performance in reading is worse for young females hospitalised for a burn compared with matched peers.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY
Indicates a need to monitor academic progression in young people after a burn so where needed ongoing learning support requirements can be met.

INTRODUCTION
Burns are a major public health problem which are among the top five most common causes of non-fatal childhood injuries.1 In Australia, burns resulted in 6000 (1%) of all injury hospitalisations in 2019–2020.2 Consequences of burn injuries can extend beyond the acute healing phase3 with lasting effects on health, including hypermetabolism and an increased risk of chronic disease leading to a reduced life span.4 Additionally, burn injuries may result in worsened social and psychological outcomes such as anxiety, post-traumatic stress, depression and reduced quality of life.5

Educational attainment is a crucial and a modifiable determinant of health and social outcomes,6 which has previously been associated with adverse childhood experiences.7 One previous Australian study found that childhood burn injuries were associated with worse academic performance compared with children hospitalised for other health conditions.8 However, the previous study did not examine all school grades, nor did it consider whether there was a higher risk of young people who had been hospitalised for a burn not completing high school compared with their peers. As studies which investigate the longitudinal impact of burns on academic performance and school completion are scarce, this study aimed to compare academic performance and high school completion of young people hospitalised for a burn compared with matched peers not hospitalised for a burn or any other injury.

METHOD
A retrospective population-level case-comparison matched cohort study of young people hospitalised following a burn aged ≤18 years in New South Wales (NSW), Australia, using linked birth, health, education and mortality data between 1 January 2005 and 31 December 2018.9

Data sources
Emergency department (ED) and hospital admission data provided information on hospital service use. ED visits to public hospitals included data on arrival and departure times, and type of visit. Hospital admissions included admissions to public and private hospitals, demographics and diagnoses.
Mortality data were obtained from the NSW Registry of Births, Deaths and Marriages, and young people who died during the study period were excluded.

Academic performance and parental demographics were obtained from annual National Assessment Plan for Literacy and Numeracy (NAPLAN) assessments conducted in May during 2008 to 2018 for all schools. NAPLAN assessments of numeracy and literacy were conducted on young people in primary school grades 3 (7–9 years of age) and 5 (9–11 years of age) and secondary school grades 7 (11–13 years of age) and 9 (13–15 years of age). Each assessment is scored out of 1000, represents the same achievement level over time and is translated into proficiency bands that indicate performed above, at or below the national minimum standard (NMS). Inability to achieve the NMS indicates that a young person will have difficulty progressing in school without additional intervention.

Information on a young person’s attendance, absence, withdrawal (eg, objections to testing) or exemption due to disability was obtained (online supplemental table 1). Young people who were exempt due to severe disability or language difficulties were rated as scoring below NMS.

A young person was identified as having a language background other than English (LBOTE) if either they or their parents or guardians spoke a language other than English at home. Where there were multiple records of the parents’ level of education, the highest level of education of either parent was identified. Information on high school completions at years 10 (15–16 years of age), 11 (16–17 years of age) and 12 (17–18 years of age) was obtained through the Record of School Achievement and the Higher School Certificate.

The Centre for Health Record Linkage (CHeReL) linked the health and education records using probabilistic record linkage and identified the population comparison group. Upper and lower probability cut-offs for a link were 0.75 and 0.25, respectively, and record groups with probabilities between the cut-offs were clerically reviewed.

**Case inclusion criteria**

The burns cohort included young people with a year of birth ≥1997 who were aged ≤18 years at hospital admission with a principal diagnosis of a burn (International Classification of Diseases, 10th Revision, Australian Modification (ICD-10-AM): T20–T31) between 1 January 2005 and 31 December 2018. Cases were included if their hospitalised burn occurred before their NAPLAN assessment date (allocated to 15 May of each year) or school completion date (allocated to 19 December).

The ICD-10-AM external cause codes (ie, X00–X19) were used to describe the burn mechanism. The percentage of total body surface area (%) TBSA affected was derived using ICD-10-AM: T31 in up to 50 diagnosis classifications. Burns sustained to more than 10% TBSA were classified as a major burn.

**Population comparison group criteria**

The comparison cohort included young people who were not hospitalised for a burn or other injury between 1 July 2001 and 31 December 2018 (included a 3.5-year wash-out period). Members of the comparison group were randomly selected from NSW birth records and matched 1:1 on age, sex and residential postcode to their counterpart.

**Socioeconomic status and geographical location**

Socioeconomic status was estimated using the Index of Relative Socioeconomic Disadvantage and postcode of residence. Socioeconomic status was categorised from most (ie, 1) to least disadvantaged (ie, 5). The Australian Statistical Geographical Standard classified residences as either urban (ie, major cities) or rural (ie, inner and outer regional, remote and very remote) based on distance to service centres.

**Chronic health conditions**

Chronic health conditions common for young people were identified. A chronic health condition would reasonably be expected to last 12 months or result in the need for ongoing healthcare and was identified using diagnosis classifications in the hospital admission records (online supplemental table 2) using a 3-year lookback period.

**Data organisation and analysis**

Data analysis was conducted using SAS V.9.4 (SAS Institute). χ² tests of independence and Wilcoxon-Mann-Whitney tests were used to examine the characteristics of young people hospitalised after a burn and their matched peers. The number of ED visits, hospital admissions and hospital length of stay (LOS) in days during and after the index burn admission were identified for both the young person hospitalised after a burn and their counterpart. The calculation of hospital LOS was cumulative and included transfers between hospitals.

Generalised linear mixed modelling (GLMM) was conducted of NAPLAN performance below the NMS (ie, binary variable – Y/N below NMS) for each assessment for young people and their matched peer who completed multiple school grades. For each assessment, PROC GLIMMIX was used with a binary distribution, log link function, and Kenward and Roger approximation to df in the denominator. To account for within-student correlation in the longitudinal data and repeated measurements, an autoregressive AR(1) covariance structure on the residuals was used. This allows for within-student correlation between assessments that decreases as the time between assessments increases. Adjusted relative risks (ARRs) and 95% CIs were generated. Variables were included in the model that had previously been associated with school performance and forward selection was used to sequentially add covariates to the models, with significance assessed using p values (p<0.05). The final model included burn status, NAPLAN grade (ie, 3, 5, 7 or 9), sex, comorbidity status (Y/N), LBOTE, socioeconomic status of residential area, highest level of education for any parent/guardian (ie, bachelor or higher degree or other), log of hospital LOS and school sector (ie, government, Catholic, independent).

Factors associated with high school completion at either year 10, 11 or 12 for young people hospitalised after a burn compared with their matched peers were examined using generalised linear regression with binomial distribution and a log link function. ARR and 95% CIs were calculated. The selection of variables for inclusion in the models was informed by previous studies and forward selection was used to sequentially add covariates, with significance assessed at p<0.05. The final models included burn status, sex, comorbidity status (Y/N), LBOTE, socioeconomic status of residential area, highest level of education for any parent/guardian and geographical location of residence.

**RESULTS**

During 2005–2018, there were 2148 young people hospitalised after a burn for whom a matched comparison was identified and who completed the NAPLAN assessments in grade 3; 1661 in grade 5; 1077 in grade 7; and 476 in grade 9. There were 663 young people hospitalised after a burn with a matched peer...
Table 1 Demographic and hospital use characteristics of young people hospitalised after a burn and their matched comparison by grade

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Grade 3* (n=2148)</th>
<th>Burn case</th>
<th>Comparison (n=2148)</th>
<th>Burn case</th>
<th>Comparison (n=2148)</th>
<th>Burn case (n=1661)</th>
<th>Comparison (n=1661)</th>
<th>Burn case (n=1077)</th>
<th>Comparison (n=1077)</th>
<th>Burn case (n=476)</th>
<th>Comparison (n=476)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1197</td>
<td>55.7</td>
<td>940</td>
<td>56.6</td>
<td>606</td>
<td>56.3</td>
<td>262</td>
<td>55.0</td>
<td>262</td>
<td>55.0</td>
<td>141</td>
</tr>
<tr>
<td>Female</td>
<td>951</td>
<td>44.3</td>
<td>721</td>
<td>43.4</td>
<td>721</td>
<td>43.7</td>
<td>214</td>
<td>45.0</td>
<td>214</td>
<td>45.0</td>
<td>141</td>
</tr>
<tr>
<td>Location of residence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>1546</td>
<td>72.0</td>
<td>1176</td>
<td>70.8</td>
<td>768</td>
<td>71.3</td>
<td>335</td>
<td>70.4</td>
<td>335</td>
<td>70.4</td>
<td>141</td>
</tr>
<tr>
<td>Rural</td>
<td>602</td>
<td>28.0</td>
<td>485</td>
<td>29.2</td>
<td>485</td>
<td>29.2</td>
<td>287</td>
<td>28.7</td>
<td>287</td>
<td>28.7</td>
<td>141</td>
</tr>
<tr>
<td>Not known</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most disadvantaged</td>
<td>625</td>
<td>29.1</td>
<td>480</td>
<td>28.9</td>
<td>300</td>
<td>27.9</td>
<td>136</td>
<td>28.6</td>
<td>136</td>
<td>28.6</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>561</td>
<td>26.1</td>
<td>426</td>
<td>25.7</td>
<td>261</td>
<td>24.2</td>
<td>105</td>
<td>21.1</td>
<td>105</td>
<td>21.1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>444</td>
<td>20.7</td>
<td>344</td>
<td>20.7</td>
<td>233</td>
<td>21.6</td>
<td>98</td>
<td>20.6</td>
<td>98</td>
<td>20.6</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>197</td>
<td>9.2</td>
<td>148</td>
<td>8.9</td>
<td>98</td>
<td>9.1</td>
<td>58</td>
<td>12.2</td>
<td>58</td>
<td>12.2</td>
<td></td>
</tr>
<tr>
<td>Least disadvantaged</td>
<td>320</td>
<td>14.9</td>
<td>262</td>
<td>15.8</td>
<td>185</td>
<td>17.2</td>
<td>79</td>
<td>16.6</td>
<td>79</td>
<td>16.6</td>
<td></td>
</tr>
<tr>
<td>Not known</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBOTE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-LBOTE</td>
<td>1502</td>
<td>69.9</td>
<td>1171</td>
<td>70.5</td>
<td>777</td>
<td>72.3</td>
<td>348</td>
<td>73.3</td>
<td>356</td>
<td>75.0</td>
<td></td>
</tr>
<tr>
<td>LBOTE</td>
<td>637</td>
<td>29.7</td>
<td>485</td>
<td>29.2</td>
<td>298</td>
<td>27.7</td>
<td>127</td>
<td>26.7</td>
<td>119</td>
<td>25.1</td>
<td></td>
</tr>
<tr>
<td>Not known</td>
<td>9</td>
<td>0.4</td>
<td>5</td>
<td>0.3</td>
<td>5</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic health condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>2136</td>
<td>99.4</td>
<td>1651</td>
<td>98.3</td>
<td>1070</td>
<td>98.1</td>
<td>471</td>
<td>99.0</td>
<td>467</td>
<td>98.1</td>
<td></td>
</tr>
<tr>
<td>≥1</td>
<td>12</td>
<td>0.6</td>
<td>10</td>
<td>0.7</td>
<td>7</td>
<td>0.7</td>
<td>20</td>
<td>1.9</td>
<td>1</td>
<td>1.1</td>
<td>9</td>
</tr>
<tr>
<td>Parent highest level of education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 11 or year 12 high school or equivalent</td>
<td>349</td>
<td>16.3</td>
<td>343</td>
<td>20.7</td>
<td>209</td>
<td>19.4</td>
<td>89</td>
<td>18.7</td>
<td>70</td>
<td>14.7</td>
<td></td>
</tr>
<tr>
<td>Certificate I-V, trade, diploma or advanced diploma</td>
<td>1037</td>
<td>48.3</td>
<td>801</td>
<td>48.2</td>
<td>544</td>
<td>50.5</td>
<td>242</td>
<td>50.8</td>
<td>241</td>
<td>50.6</td>
<td></td>
</tr>
<tr>
<td>Bachelor degree or higher</td>
<td>604</td>
<td>28.1</td>
<td>476</td>
<td>28.7</td>
<td>310</td>
<td>28.8</td>
<td>138</td>
<td>29.0</td>
<td>159</td>
<td>33.4</td>
<td></td>
</tr>
<tr>
<td>Not stated/not known</td>
<td>158</td>
<td>7.4</td>
<td>41</td>
<td>2.5</td>
<td>14</td>
<td>1.3</td>
<td>7</td>
<td>1.5</td>
<td>6</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Healthcare use</td>
<td>Median</td>
<td>IQR</td>
<td>Median</td>
<td>IQR</td>
<td>Median</td>
<td>IQR</td>
<td>Median</td>
<td>IQR</td>
<td>Median</td>
<td>IQR</td>
<td>Median</td>
</tr>
<tr>
<td>ED visits</td>
<td>5.0</td>
<td>6.0</td>
<td>6.0</td>
<td>5.0</td>
<td>6.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Hospital admissions</td>
<td>3.0</td>
<td>5.0</td>
<td>3.0</td>
<td>5.0</td>
<td>3.0</td>
<td>5.0</td>
<td>3.0</td>
<td>5.0</td>
<td>3.0</td>
<td>5.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Hospital length of stay (days)</td>
<td>4.0</td>
<td>7.0</td>
<td>4.0</td>
<td>7.0</td>
<td>4.0</td>
<td>7.0</td>
<td>4.0</td>
<td>7.0</td>
<td>4.0</td>
<td>7.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

*Grade 3 \( \chi^2 \) tests: LBOTE p=0.6; health conditions p<0.05; parent highest level of education p<0.001; and Wilcoxon-Mann-Whitney tests: ED visits p<0.001; hospital admissions p<0.001; and hospital length of stay p<0.0001.
†Grade 5 \( \chi^2 \) tests: LBOTE p=0.2; health conditions p<0.01; parent highest level of education p<0.001; and Wilcoxon-Mann-Whitney tests: ED visits p<0.001; hospital admissions p<0.001; and hospital length of stay p<0.0001.
‡Grade 7 \( \chi^2 \) tests: LBOTE p=0.1; health conditions p<0.05; parent highest level of education p<0.001; and Wilcoxon-Mann-Whitney tests: ED visits p<0.001; hospital admissions p<0.001; and hospital length of stay p<0.0001.
§Grade 9 \( \chi^2 \) tests: LBOTE p=0.6; health conditions p=0.3; parent highest level of education p=0.3; and Wilcoxon-Mann-Whitney tests: ED visits p<0.001; hospital admissions p<0.001; and hospital length of stay p<0.0001.
ED, emergency department; LBOTE, Language background other than English.
The young people hospitalised for a burn were of the same gender, age and lived in the same residential area to their matched peer. Across school grades 3 to 9, there was a higher proportion of males (55.0–56.6%) compared with females (43.4–45.0%), and a higher proportion of young people living in urban areas (70.4–72.0%) compared with rural areas (28.0–29.6%) hospitalised after a burn. Two-thirds of young people (≥69.9%) were from an English-speaking background and almost all (≥98.1%) had no other chronic health conditions identified. Young people hospitalised after a burn had a higher median ED visits, hospitalisations, school absenteeism caused by time spent undergoing rehabilitative programmes,26 or psychosocial anxieties due to lower self-esteem and stigmatisation. 5 Additionally, poor sleep quality 27 was identified between hospitalisation for a burn injury and the risk of not achieving the NMS for reading among young females hospitalised for a burn (ARR 1.72; 95% CI 1.33 to 2.23) when compared with their matched peers, no such increase was observed among males (ARR 1.43; 95% CI 0.91 to 1.43) (figure 1; online supplemental table 4A–C).

High school completion
All young persons hospitalised after a burn had nearly four times the risk of not completing year 10 (ARR 3.86; 95% CI 1.68 to 8.86) and over twice the risk of not completing year 11 (ARR 2.45; 95% CI 1.89 to 3.18) or year 12 (ARR 2.09; 95% CI 1.63 to 2.67), compared with matched peers (figure 2 and online supplemental table 5).

DISCUSSION
This large retrospective population-level cohort study compared the academic performance and school completion rates of young people hospitalised for a burn and young people not hospitalised for an injury and found an association between young females hospitalised with a burn injury and the risk of not achieving the NMS for reading. No association was identified between hospitalisation for a burn injury and the risk of not achieving the NMS for numeracy assessments compared with matched counterparts. Compared with matched peers, young persons hospitalised with a burn had a higher risk of not completing the last 3 years of high school.

Worse academic performance among young people hospitalised after sustaining a burn compared with young people hospitalised for other conditions has been demonstrated in a previous Australian study for grades 3, 5 and 7, although the authors did not disaggregate by sex.8 There are several possible reasons for worsened academic performance among young people with burns, including reduced learning opportunities, school absenteeism caused by time spent undergoing rehabilitative programmes,26 or psychosocial anxieties due to lower self-esteem and stigmatisation.5 Additionally, poor sleep quality27 comparing who could have completed year 10; 629 in year 11; and 520 in year 12 of high school.

### Characteristics of young people

#### Table 2 School and NAPLAN assessment characteristics of young people hospitalised after a burn and their matched comparison by grade

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Grade 3*</th>
<th></th>
<th></th>
<th></th>
<th>Grade 5†</th>
<th></th>
<th></th>
<th></th>
<th>Grade 7‡</th>
<th></th>
<th></th>
<th></th>
<th>Grade 9§</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Catholic</td>
<td></td>
<td>1541</td>
<td>71.7</td>
<td>1469</td>
<td>68.4</td>
<td>1210</td>
<td>72.9</td>
<td>1131</td>
<td>68.1</td>
<td>689</td>
<td>64.0</td>
<td>631</td>
<td>58.6</td>
</tr>
<tr>
<td>Independent</td>
<td></td>
<td>386</td>
<td>18.0</td>
<td>455</td>
<td>21.2</td>
<td>280</td>
<td>16.9</td>
<td>346</td>
<td>20.8</td>
<td>235</td>
<td>21.8</td>
<td>280</td>
<td>26.0</td>
</tr>
<tr>
<td>Home</td>
<td></td>
<td>221</td>
<td>10.3</td>
<td>223</td>
<td>10.4</td>
<td>171</td>
<td>10.3</td>
<td>184</td>
<td>11.1</td>
<td>153</td>
<td>14.2</td>
<td>166</td>
<td>15.4</td>
</tr>
<tr>
<td>Remoteness area of school</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major city</td>
<td></td>
<td>1489</td>
<td>69.3</td>
<td>1478</td>
<td>68.8</td>
<td>1133</td>
<td>68.2</td>
<td>1111</td>
<td>66.9</td>
<td>755</td>
<td>70.1</td>
<td>753</td>
<td>69.9</td>
</tr>
<tr>
<td>Inner regional</td>
<td></td>
<td>460</td>
<td>21.4</td>
<td>477</td>
<td>22.2</td>
<td>354</td>
<td>21.3</td>
<td>400</td>
<td>24.1</td>
<td>246</td>
<td>22.8</td>
<td>261</td>
<td>24.2</td>
</tr>
<tr>
<td>Outer regional/remote</td>
<td></td>
<td>199</td>
<td>9.3</td>
<td>192</td>
<td>8.9</td>
<td>174</td>
<td>10.5</td>
<td>150</td>
<td>9.0</td>
<td>76</td>
<td>7.1</td>
<td>63</td>
<td>5.9</td>
</tr>
<tr>
<td>Not known</td>
<td></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>NAPLAN assessment</td>
<td></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Numeracy (below NMS)</td>
<td></td>
<td>163</td>
<td>7.6</td>
<td>100</td>
<td>4.7</td>
<td>146</td>
<td>8.8</td>
<td>89</td>
<td>5.4</td>
<td>79</td>
<td>7.3</td>
<td>34</td>
<td>3.2</td>
</tr>
<tr>
<td>Reading (below NMS)</td>
<td></td>
<td>187</td>
<td>8.7</td>
<td>113</td>
<td>5.3</td>
<td>176</td>
<td>10.6</td>
<td>116</td>
<td>7.0</td>
<td>91</td>
<td>8.5</td>
<td>68</td>
<td>6.3</td>
</tr>
</tbody>
</table>

*Grade 3 χ² tests: School sector p<0.05; remoteness area of school p=0.8; all NAPLAN assessments p<0.0001.†Grade 5 χ² tests: School sector p<0.01; remoteness area of school p=0.1; all NAPLAN assessments p<0.001.‡Grade 7 χ² tests: School sector p<0.05; remoteness area of school p=0.4; NAPLAN numeracy p<0.0001; NAPLAN reading p=0.1.§Grade 9 χ² tests: School sector p=0.5; remoteness area of school p=1.0; all NAPLAN assessments p<0.01.

NAPLAN, National Assessment Plan for Literacy and Numeracy; NMS, national minimum standard.
Female paediatric burn survivors have also shown higher levels of help-seeking, mental health conditions, including anxiety, and externalising negative behaviours (eg, irritability, somatic seeking, mental health conditions, including anxiety, and externalising negative behaviours (eg, irritability, somatic and chronic pain, which can be sustained well beyond the acute recovery phase following a burn, may disrupt young people’s ability to learn and engage with learning curricula.

Several plausible explanations exist for worse academic achievement among young females found in the current study. These include poorer health-related quality of life among young female burn patients compared with males, which may have a direct, negative impact on schooling attendance and experience. Female paediatric burn survivors have also shown higher levels of help-seeking, mental health conditions, including anxiety, and externalising negative behaviours (eg, irritability, somatic complaints) compared with males. Additionally, poorer body image perceptions and worsened scarring outcomes (eg, increased physical pain) among young female burn survivors may also hamper their motivation and/or ability to attend school and participate in activities. The deprivation of a normal school experience may result in poorer academic performance among young female burn survivors.

To date, there has been a dearth of studies examining the association between burns and school completion among young people. The current results could, in part, be explained by factors associated with a school goers’ intention to leave school early, including poor academic performance, lack of intrinsic motivation and poor coping with stressful events. It is possible that burn injuries could indirectly pose a greater risk for high school dropout among young people. However, as school attendance in NSW is only compulsory until year 10, non-completion of high school in the final 3 years may be attributed to factors unrelated to a previous burn injury, such as completion of an apprenticeship, or employment.

This study had several strengths. It was a large population-based study which linked health and educational outcomes over a 1.3-year period and was able to adjust for key factors that may affect academic performance, such as socioeconomic status, parental education and LBOTE. Limitations include only young people who had been hospitalised for a burn were studied, omitting young people treated solely at other healthcare settings (eg, primary care). Additionally, no information was collected on other potential mediating factors such as scar quality together with medium-term and longer-term complications following the initial burn injury (eg, chronic pain issues, utilisation of health services in the post-burn phase, familial adjustment and support).

Factors related to burn injury causation were not considered and effects of principal type of burn were not disaggregated and examined separately due to low sample size or were not able to be disaggregated (eg, facial burns).
Only health conditions relevant to a hospital admission were examined: it is therefore probable that some comorbidities were not identified, despite the 3-year lookback period. Data on visits to private hospital EDs were not able to be accessed for this study but would likely represent a very small number of patients. A higher proportion of young people with a burn injury were absent for NAPLAN assessments compared with their matched counterparts and the current study was not able to account for school clustering. Additionally, no information was available regarding supplementary educational services that a young person may have received (eg, tutoring).

CONCLUSION
Burn injuries may affect the physical, psychological and social domains of the lives of young people. Consequently, burn injuries may have a detrimental impact on academic trajectories of some young people, ultimately leading to poorer health and social outcomes in later life. There is a...
need to assess and monitor influencers of academic progression in young people after a burn so that, where needed, ongoing learning support requirements can be met.

Twitter Reidar P Lystad @Rjlystad

Acknowledgements The authors wish to thank the NSW Ministry of Health for providing access to the ED visit, hospitalisation, and mortality data, NSW Department of Education for providing access to school enrolment and completion information, the NSW Education Standards Authority for providing access to the NAPLAN data, and the Centre for Health Record Linkage for conducting the data linkage.

Contributors RM, CC and AM conceived the study, RM and TB-P performed the analyses. NH drafted the manuscript. RM is guarantor for the overall content. All authors revised the manuscript and approved the final version.

Funding This work was supported by a philanthropic donor to Macquarie University.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Ethical approval and a waiver of consent was obtained from the NSW Population and Health Services Research Ethics Committee (2018HRE0040).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. The data that support the findings of this study are available from the NSWS Health Department, NSW Department of Education and NSW Education Standards Authority. Restrictions apply to the availability of these data, which were used under licence for the current study, so are not publicly available.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iDs Andrew J A Holland http://orcid.org/0000-0003-3745-8704 Reidar P Lystad http://orcid.org/0000-0003-0506-0902 Rebecca Mitchell http://orcid.org/0000-0003-1939-1761

REFERENCES


14 NSW Agency for Clinical Innovation. ACI statewide burn injury service NSW burn transfer guidelines version 3; 2014.


