The incidence and risk factors of dog bite injuries requiring hospitalisation in New Zealand

Jonathan Mair, Natasha Duncan-Sutherland, Zachary Moaveni

ABSTRACT

AIM: This retrospective cohort study aims to describe the incidence of dog bite injuries requiring hospitalisation across New Zealand in the 10-year period between 2004 and 2014.

METHOD: The National Minimum Dataset (NMDS) was used to collate information from public and private hospital discharges for publicly funded events in New Zealand with the external cause of injury code W54.0 (Bitten by Dog) during the period of 1 July 2004 to 30 June 2014. Information regarding potential risk factors and indicators of severity was also collected.

RESULTS: From 2004 to 2014 there were 4,958 dog bites requiring hospitalisation in New Zealand, giving an overall incidence of 11.3 (11.0–11.6) per 100,000 people per annum, representing 496 events per year on average. The average length of stay in hospital was 2.5 days (SD = 3.5 days). The overall incidence has been rising during this period from 9.7 (8.8–10.7) per 100,000 population per annum in 2004 to a peak of 12.3 (11.3–13.4) per 100,000 in 2013/14. The highest risk factors were identified as children under the age of 10 years, Māori and those with a higher deprivation score. In cases where the scene of injury was recorded, 69% occurred at a private residence or property. Head and neck bites were increasingly common in younger age groups, with 78% of the 0–4 year age group and 63% of the 5–9 year age group injured in the head/neck region. Upper and lower limb bites were increasingly common in older age groups.

CONCLUSIONS: The incidence of dog bite injuries requiring hospitalisation has continued to rise in comparison with previously published rates in New Zealand. Additionally, more vulnerable population subgroups have been identified who are most likely to require hospitalisation.

In 2014 there were 531,158 registered dogs in New Zealand.1 There are many potential benefits of dog ownership,2,3 however, dog bite injuries can cause significant morbidity, and be difficult to treat.4 International studies show a significant burden of disease from dog bites in the US,5,6 UK7 and Australia.8 Additionally, the physical and emotional impact can be long-lasting,9,10 particularly in children who are over-represented as victims of dog bite injuries.11,12

Figures from the Accident Compensation Corporation (ACC) show that there were 99,003 claims for dog-related injuries in New Zealand during the period 1 July 2005 to 30 June 2014.13 However, rates of dog bite injuries requiring hospitalisation in New Zealand have not been monitored since a study by Marsh et al in 2004.14 This study aims to describe the incidence of dog bite injuries requiring hospitalisation in New Zealand between July 2004 and June 2014.

Methods

Search strategy
Data was obtained from the New Zealand Ministry of Health (NMDS).15 This is a collection of public and private hospital discharge information for publicly funded events in New Zealand. It includes discharges from hospital admissions, stays in an emergency department for three hours or more, or when a patient dies in an emergency department. We identified all hospital claims with an external cause of injury code W54.0 (Bitten by Dog) for the period of 1 July 2004 to 30 June 2014. This dataset contains demographic information, the number of episodes of stay, the number of days spent in hospital and cause of injury.
discharges with the primary external cause of injury code W54.0 (Bitten by Dog), as per the Australian Modification of the 10th revision of the International Classification of Diseases, during the period of 1 July 2004 to 30 June 2014. All discharge records with a W54.0 external cause of injury code were included. The code W54.8 (Other Contact with Dog) was introduced on 1 July 2002. Therefore, we have assumed that patients with the code W54.0 were bitten by a dog as opposed to sustaining other types of dog-related injuries. In cases in which there was more than one event submitted against an individual patient identification number, all events apart from the earliest submission were removed.

Differences in reporting of short stay emergency department (SSED) events from district health boards around the country prior to 2012/13 meant that the incidence rates could not be reliably reported with these included. Therefore, all SSED events were removed from the entire study period as per Ministry of Health recommendations.16

Short stay events are defined as any hospital discharge where both the length of stay is zero or one midnight spent in hospital, and the hospital specialty code is M05, M06, M07 or M08, which refer to emergency medicine or adult intensive care.

Data extraction

Information regarding potential risk factors was collected for each unique event, including patient demographic information (ethnicity, age, gender, domicile) as well as the scene of injury and the season in which it occurred. Information regarding dog breed was not included, as it was rarely recorded, and can be inaccurate. Information about the incidence per DHB was not included, as it was difficult to get population data for the DHBs to calculate incidence.

Patient ethnicity was recognised as an important risk factor, and was defined as Māori, Pacific Peoples, Asian or Other.

Patient domicile codes were used to assign a Deprivation score, based on the New Zealand Deprivation Score 2006 (NZDep 2006). The NZDep 2006 score considers dimensions of deprivation for areas in New Zealand including income, home ownership, employment, qualifications, living space and access to a telephone and car.17 Population estimates for incidence calculations were taken from Statistics New Zealand.18–20

Information regarding the severity of the events was also collected, including the length of hospital stay, location of injury on the body and the number of general anaesthetics used. We were unable to obtain data regarding local anaesthetic procedures. The location of injury on the body was determined using the diagnosis codes relating to head/neck, upper limb, thorax/abdomen, lower limb or multiple (two or more body regions).

Statistical analysis

Given the difference in age distribution between different ethnicities in New Zealand, annual incidence rates for the total population and individual ethnicities were age-standardised to allow comparison. World Health Organization recommendations were used for this standardisation.21 Relative risk was calculated to compare the age-adjusted annual incidence rates for each ethnicity group to the Other (reference) category. The incidence rates per year in the study as well as per age group were also calculated. The Mid-P exact test was used to calculate 95% confidence intervals. The subsequent relative risk calculations were then performed using the year of 04/05 and the 25–59 year-old age group as the respective reference groups. The Byar method was used to calculate the 95% confidence intervals.

The programmes OpenEpi (Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version. www.openepi.com, updated 2014/09/22), SPSS version 19 (SPSS, Chicago, IL), and Microsoft Excel version 14.0 (2010 Microsoft Corporation) were used for statistical analysis. The level of significance was set at p<0.05.

Results

From 2004 to 2014 there were 4,958 dog bites requiring hospitalisation in New Zealand, with an overall incidence rate of 11.31 (10.98–11.64) per 100,000 people per annum. The incidence rates per financial year is given in Figure 1.
The incidence in 2004/2005 was 9.72 (8.79–10.71) per 100,000 people. This was relatively stable until 2010/2011 when the incidence was significantly higher at 11.83 (10.85–12.88) per 100,000 people, RR = 1.22 (1.07–1.39). The incidence remained elevated after 2010/2011 and peaked in 2013–2014 [12.29 (11.29–13.35) per 100,000 people; RR = 1.27 (1.11–1.44)].

We found a seasonal variation in dog bite admissions with 1,425 (30.9%) injuries occurring in the summer and 956 (20.7%) occurring in the winter months. Similar numbers of injuries occurred during the spring (1,110, 24.1%) and autumn (1,122, 24.3%) months.

**Risk factors**

Māori had the highest incidence [21.28 (20.716–22.40) per 100,000 people per annum], with significantly greater relative risk [RR = 2.21 (2.04–2.40)] than for the Other ethnicity [9.62 (9.23–10.01) per 100,000 people per annum]. The age-adjusted incidence rate was lowest for Asians [1.81 (1.38–2.24) per 100,000 people per annum; RR = 0.19 (0.17–0.21)].

The incidence rates for each gender are demonstrated in Table 2. Male patients were more commonly admitted to hospital with a dog bite injury [RR = 1.43 (1.35–1.52)].

**Table 1:** Age adjusted incidence rates per 100,000 people per annum (95% Confidence Interval) by ethnicity.

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Count (%)</th>
<th>Age-adjusted incidence rate per 100,000 people per annum (CI)</th>
<th>Relative risk (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>4,613</td>
<td>11.31 (10.98–11.64)</td>
<td>---</td>
</tr>
<tr>
<td>Māori</td>
<td>1,466 (31.78)</td>
<td>21.28 (20.16–22.40)</td>
<td>2.21 (2.04–2.40)</td>
</tr>
<tr>
<td>Asian</td>
<td>76 (1.65)</td>
<td>1.81 (1.38–2.24)</td>
<td>0.19 (0.17–0.21)</td>
</tr>
<tr>
<td>Pacific Peoples</td>
<td>364 (7.89)</td>
<td>12.72 (11.39–14.05)</td>
<td>1.32 (1.17–1.50)</td>
</tr>
<tr>
<td>Other</td>
<td>2,631 (57.03)</td>
<td>9.62 (9.23–10.01)</td>
<td>1.00 (Ref)</td>
</tr>
</tbody>
</table>

**Table 2:** Incidence rates per 100,000 people per annum (95% Confidence Interval) by gender.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Count (%)</th>
<th>Incidence rate per 100,000 people per annum (CI)</th>
<th>Relative risk (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>2,672 (57.9)</td>
<td>12.68 (12.20–13.17)</td>
<td>1.43 (1.35–1.52)</td>
</tr>
<tr>
<td>Female</td>
<td>1,941 (42.1)</td>
<td>8.86 (8.48–9.26)</td>
<td>1.00 (Ref)</td>
</tr>
</tbody>
</table>
Figure 2 demonstrates incidence rates for each age group. We found that the 0–4 year [22.69 (21.03–24.44) per 100,000 people per annum] and 5–9 year [18.45 (16.94–20.06) per 100,000 people per annum] age groups were at the highest risk for dog bites requiring hospital admission. The incidence rate plateaued after 10 years of age.

The incidence rates expressed across the NZ Dep 2006 deprivation scale are displayed in Figure 3. The areas with the highest deprivation score (most deprived areas) had a significantly higher incidence [22.63 (21.23–24.10) per 100,000 people per annum, RR = 4.56 (3.94–5.28)] in comparison to the areas with the lowest deprivation score [4.97 (4.34–5.66) per 100,000 people per annum].

The scene of injury was recorded in 54% of instances, and of these 69% occurred while the patient was at a private residence or property.

Figure 3: Incidence rates per 100,000 people per annum expressed across New Zealand deprivation 2006 (NZ Dep 2006) scores.
Severity of events
The average length of hospital stay was 2.47 days (SD = 3.50 days), with 66% of patients requiring a general anaesthetic, and 15% of these requiring more than one.

The location of injury on the patient’s body shows clear patterns based on age group (Figure 4). Seventy-eight percent of the 0–4 year age group and 63% of the 5–9 year age group were injured in the head/neck region. This figure declines to 40% in the 10–14 year age group and 13% in the 15–19 year age group. Only 9% and 5% of the 20–59 year and 60+ year age groups were bitten on the head/neck, respectively. As the injuries to the head/neck region decline with increasing patient age, the injuries to the limbs increase. The upper limb is the most common site of injury in the 25–59 year (55%) and 60+ year age groups (55%). The upper limb was the second most common site of injury in the 0–4 year (12%) and 5–9 year (15%) age groups. The thorax/abdomen was rarely bitten with only 45 (1%) patients in total injured here. There were 23 (0.5%) patients in which a location was not recorded.

Discussion
We found an overall incidence of 11.31 (10.98–11.64) per 100,000 people per annum admitted to hospital with a dog bite injury in New Zealand. This represents on average, 496 events per year, and is a rate higher than previously published New Zealand data, and in comparison to the inpatient rates for dog bite injuries in the UK, US and Australia. While this may be partly due to differences in data collection and reporting, there is clearly a high burden of care created by dog bite injuries in New Zealand.

We have focused on dog bite injuries severe enough to require hospital-level admission and treatment. Other studies have shown dog bite injuries requiring hospitalisation represent a small proportion of all dog-related injuries. Therefore while the current study population represents the most serious bites, the true incidence of dog bites in New Zealand is likely to be much higher than is shown here. Data from ACC shows the number of people registered for medical attention after injury by a dog (“bitten/kicked/b utted”) was 99,003 over the last nine years. A further limitation of our study is that only one discharge per patient was chosen, again likely under-representing the true incidence of dog bite hospitalisations. The incidence increase may also be due to an increase in the number of dogs owned, however it was not possible to ascertain this, as dog control statistics have only been recorded from 2013.

The incidence of dog bite injuries admitted to hospital is highest in younger patients. This is in line with international studies. Children were more likely to be bitten on the head/neck, whereas adults were more likely to be bitten on their limbs. This is very concerning, given that injuries to the head and neck are likely to be more serious and
life-threatening than limb injuries. It also suggests that dog bite prevention strategies should focus on children.

Dog bite injuries were more likely to occur at a private residence or property. It is therefore likely that dog bite injuries are inflicted by dogs known to the victims. This is also a factor to be considered when dog bite prevention strategies are being explored.

The NZ Dep 2006 score was referenced against each patient's domicile area, showing a strong association between higher depravity score and incidence of dog bite injuries (Figure 3). This is similar to international findings with areas of lower socioeconomic status experiencing a higher incidence of dog bite injuries.24,27 Strong trends are also present in ethnicity group analysis, with Māori having the highest incidence and Asian patients the lowest. The reasons for this are unclear and may represent different dog ownership rates or attitudes towards education and behaviour around dogs. We did not explore the relationship between ethnicity and socioeconomic status. Further study in this area would be helpful and intervention to lower dog bite rates might be best targeted to those most at risk of dog bite injuries.

To address this concerning issue, a comprehensive review of our national legislation of dog control is required, along with a review of what other dog bite prevention strategies might be effective.

Conclusions

We have found that the rate of people being admitted to hospital in New Zealand with a dog bite injury is high. Children under the age of 10 years are most at risk as are Māori, males and those from areas with a higher deprivation score. We are highlighting an ongoing and growing public health issue to prompt meaningful conversation and action to reduce this preventable and devastating injury.

Competing interests:
Nil.

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