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Incidence and characteristics of dog bites in three remote Indigenous communities in Far North Queensland, Australia, 2006-2011

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ABSTRACT

Dog bites are a worldwide public health concern that can cause serious injury, psychological trauma, disease and death while also affecting animal welfare. This study analyzes dog bite injury data from a clinical file audit performed at Primary Health Care Clinics in three remote Indigenous communities within Far North Queensland, Australia, over the period from 1st January, 2006, to 31st December, 2011. There were 229 dog bite presentations involving 201 individuals. An overall incidence rate of 16.5 per 1,000 population was found across the communities. Incidence rates were highest in 35- to 44-year-olds, did not vary with gender of victim, varied between communities, and significantly decreased after the strengthening of alcohol restrictions midway through the study period. Development of a specific dog bite monitoring system through the Primary Health Care Clinics could enhance knowledge of human-dog interactions, assist in the development of mitigation strategies to reduce dog bites, and determine their effectiveness.

Introduction

Dog bites are a multifaceted public health concern that can result in serious injury, psychological trauma, disease, and death (Morgan and Palmer, 2007). While only a small proportion of dog bite incidents are fatal (Frangakis and Petridou, 2003; Rosado et al., 2009; Sacks et al., 2000), treatment of nonfatal incidents can be expensive (Hoff et al., 2005; Weiss et al., 1998) and result in enduring health-related consequences for the victim (Calkins et al., 2001; Peters et al., 2004). In addition, dog bite incidents contribute to animal welfare issues, with the animals involved potentially relinquished or euthanized (Fatjó et al., 2006).

Information regarding the incidence and characteristics of dog bites in Australia is limited and fragmented, with no comprehensive national or state based reporting systems in place (Australian Companion Animal Council Inc., 2004). Thompson (1997) investigated dog attacks in the city of Adelaide, reporting a rate for medically treated dog attacks of 0.73 per 1,000 population. These results have been used to suggest that annually, more than 100,000 persons nationally are attacked by dogs, with approximately 12,000-14,000 persons seeking treatment for dog injuries and 1,400 of these requiring hospitalization (Australian Companion Animal Council Inc., 2004; Thompson, 1997). A more recent investigation of national hospital data suggests that the incidence of public sector hospitalizations due to dog bites is on average 2,061 persons per year (Rajshekar et al., 2017).

Dogs are a fundamental component of culture and society for Aboriginal and Torres Strait Islander (Indigenous) Australians in rural and remote regions of Australia, contributing to security, companionship, sentimentality, and spirituality (Senior, 2006; Smith and Litchfield, 2009). Household dog populations in remote northern Australian Indigenous communities are over six times higher than the rest of Australia, likely due to high proportions of fertile dogs, roaming dog populations, traditional beliefs and issues surrounding local government animal management (Burleigh et al., 2015). Populations of this magnitude can increase the frequency of interactions between animals and people, potentially resulting in injuries.

In 2002, alcohol management plans (AMPs) were implemented across Queensland Indigenous communities in an attempt to reduce interpersonal violence and improve community safety (Fitzgerald, 2001). In 2011, Queensland Government policy changes led to a review of the AMP system; however, clear evidence on the effectiveness of the AMPs in reducing violence and improving

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safety was lacking. Following the recommendations of Gladman et al. (1997), a clinical file audit was performed at the Primary Health Care Clinics of three Indigenous communities of Far North Queensland for the period 1st January, 2006, to 31st December, 2011. This audit aimed to assess if strengthening alcohol restrictions in the middle of the study period impacted on the incidence of injury (Clough and Bird, 2015; West et al., 2014). The audit captured all injuries presenting to the local Primary Health Care Clinics, and included dog bite presentations. This article uses the dog bite subset of data to (1) describe the incidence and characteristics of all dog bites treated at Primary Health Care Clinics and (2) assess whether the incidence of dog bites decreased after the strengthening of alcohol restrictions.

Method

Setting and location

The three study communities are located on the Cape York Peninsula in Far North Queensland, Australia. All communities experience a similar monsoonal climate with average temperatures ranging from more than 27°C in the dry season to more than 35°C in the wet season (Australian Bureau of Meteorology, 2018). There were 2,263 people living in the communities at the commencement of the study with populations of community A 1,063, community B 578, and community C 621 (Australian Bureau of Statistics, 2011c). The communities are classified as "very remote" according to Australia's remoteness indicators, signifying very little accessibility to goods, services, and opportunities for social interaction (Australian Bureau of Statistics, 2011a). The communities also share a similar rank on the Socio-Economic Indexes for Areas scale with respect to socioeconomic advantage and disadvantage (community A 644.1, community B 713.1, community C 687.1) (Australian Bureau of Statistics, 2011b). The scores are standardized against a mean of 1000 with a standard deviation of 100, indicating high disadvantage for these communities in the areas of income, education, employment, and housing.

Alcohol management plans

AMPs were operational in all three communities for the duration of the study period. Full details of the development and implementation of the AMP system can be found in the study by Clough and Bird (2015). At the commencement of the study period, communities A and C were subjected to zero carriage limits, effectively restricting the possession and consumption of alcohol to a community canteen/tavern. In community B, a carriage limit was in place that provided limited personal possession and consumption of alcohol in addition to the community canteen. By 2009, communities A and C were "dry", with zero carriage limits and closure of the tavern/canteen, whereas in community B, a zero carriage limit was implemented and further restrictions placed on the local canteen.

Primary Health Care Clinics

Each community contains a Primary Health Care Clinic, which provides the only access to health care services. The clinics are generally staffed by nurses, with no general practice, pharmacy, or inpatient services available. Medical health provision is via telecommunication, fly in fly out services or aeronautical retrieval. Over-the-counter medication at community stores is prohibitively expensive, which encourages community members to use the clinic.

Data collection

A clinical file audit was performed at the Primary Health Care Clinic of each community following the recommendations of an earlier injury study by Gladman et al. (1997). There were 5,689 records connected to 1,862 patients from 1st January, 2006, to 31st December, 2011. Details of the method of data extraction can be found in the study by West et al. (2014). In summary, a secure deidentified database of patient files was constructed; containing age at presentation, gender, and date of presentation for each injury. A hierarchical approach to presentation classification was taken using diagnosis, site of injury, and external cause, guided by the ICD-10-CM: 2014 Classification of Diseases ~ Injury Classification System (World Health Organisation, 1992).

Presentations for dog bite injuries were recorded where there was clear evidence documented by the treating clinician that a dog bite was the cause of the patient's presentation to the clinic. The affected region of the body was recorded and classified as head (including head and neck), upper limbs (upper arm, forearm, wrist, and hand), lower limbs (thigh, lower leg, ankle, and foot), trunk (chest, back, and abdomen), and other. Presentations were classified as "other" if the bite was nonspecific (such as affecting multiple areas of the body) or was one of multiple injuries requiring treatment during a single visit to the clinic.

Data analysis

Descriptive statistics were used to describe the population of individuals who presented with dog bite injuries at the clinics during the study period. Incidence rates per 1,000 population were calculated with 95% confidence intervals (95% CIs). Community population data, including age and gender breakdowns, were derived from community local government areas, obtained from the Australian Bureau of Statistics for each year of the study period (Australian Bureau of Statistics, 2011c). Populations at risk for gender, age categories, year of presentation, and pre and post alcohol restrictions were complied. Rate ratios with 95% CIs were calculated using Poisson regression with the exposure variable input as the population at risk. A multivariate Poisson regression was performed for community and age category. A statistical significance threshold value of $P < 0.05$ was used. All analyses were performed using Stata 13 software package (Stata Corp, College Station, Texas, USA).

Results

Across the three Primary Health Care Clinics between 2006 and 2011, there were 229 dog bite presentations involving 201 individuals. Table 1 shows that the overall incidence of dog bites per 1,000 population was 16.5 (95% CI 14.4-18.7). Over half the dog bite injuries were located on the lower limbs of patients (n = 143, 62.4%), followed by "Other" (n = 55, 24%), the upper limbs (n = 18, 7.9%), the head (n = 7, 3.1%), and finally, the trunk (n = 6, 2.6%).

Incidence rates between genders were comparable; 15.8 (95% CI 12.8-18.7) and 17.3 (95% CI 14.2-20.4) for females and males, respectively. Compared with the youngest age category (<15 years), there was a significantly higher rate of dog bites for the category 35-44 years of age (IRR 2.0, 95% CI 1.4-2.9, $P < 0.001$), while all other age categories were not significant. Dog bite presentations were 0.5 (95% CI 0.3-0.8, $P = 0.002$) times less likely to occur in 2009 and 0.6 (95% CI 0.4-0.9, $P = 0.024$) times less likely to occur in 2011 when compared with 2006, with some evidence that it was 0.7 (95% CI 0.4-1.0) times less likely to occur in 2010. Compared with community A, the rate ratio of a dog bite in community B was not significantly different (1.1, 95% CI 0.7-1.7, $P = 0.637$), whereas

Table 1
Rates of dog bite presentations to Primary Health Care Clinics in three remote Far North Queensland communities per 1,000 population by selected variables

Selected variables	Presentations	Population at risk	Rate (1,000 population)		Incidence rate ratio (IRR)		
			Rate	(95% CIs)	RR	(95% CIs)	P[c]
All presentations	229	13,861	16.5	14.4-18.7			
Communities[a]							
A	56	6520	8.6	6.3-10.8	1.0		
B	37	3332	11.1	7.5-14.7	1.1	0.7-1.7	0.637
C	136	4009	33.9	28.2-39.6	5.1	3.7-6.9	<0.001
Gender							
Female	110	6982	15.8	12.8-18.7	1.0		
Male	119	6879	17.3	14.2-20.4	1.1	0.8-1.4	0.480
Age categories [b]							
<15	51	3671	13.9	10.1-17.7	1.0		
15-24	35	2358	14.8	9.9-19.8	1.1	0.7-1.6	0.945
25-34	34	2215	15.3	10.2-20.5	1.1	0.7-1.7	0.614
35-44	66	2371	27.8	21.1-34.6	2.3	1.6-3.3	<0.001
45-54	21	1567	13.4	7.7-19.1	1.0	0.6-1.7	0.986
>55	22	1679	13.1	7.6-18.6	1.0	0.6-1.6	0.921
Arrival year							
2006	50	2262	22.1	16.0-28.2	1.0		
2007	54	2295	23.5	17.3-29.8	1.1	0.7-1.6	0.750
2008	36	2296	15.7	10.6-20.8	0.7	0.5-1.1	0.116
2009	24	2315	10.4	6.2-14.5	0.5	0.3-0.8	0.002
2010	34	2346	14.5	9.6-19.4	0.7	0.4-1.0	0.058
2011	31	2347	13.2	8.6-17.9	0.6	0.4-0.9	0.024

[a] Adjusted for age categories.
[b] Adjusted for community.
[c] Threshold for statistical significance: $P < 0.05$.

individuals in community C were 5.1 (95% CI 3.7-6.9, $P < 0.001$) times more likely to experience a dog bite.

There were significant reductions in the incidence of dog bites in community A (IRR 0.4, 95% CI 0.2-0.7, $P = 0.001$) and community C (IRR 0.7, 95% CI 0.5-1.0, $P = 0.033$) for the period 2009-2011, where alcohol restrictions were strengthened compared with the period 2006-2008 (Table 2).

Discussion

This study provides a systematically complied description of the incidence and characteristics of dog bite presentations in three remote Indigenous communities in Far North Queensland, Australia, for the period 1st January, 2006, to 31st December, 2011. The principle findings of this study highlight an overall incidence rate of dog bite injuries of 16.5 (95% CI 14.4-18.7) per 1,000 population, no variation in incidence rates between genders, a significantly higher incidence rate for the age category 35-44 when compared with the age category of <15 years, the lower limb being the most common site of injury (62.4%), and the reduction in incidence rates after the strengthening of alcohol restrictions.

Incidence rates

The incidence rate of 16.5 per 1,000 population, which equates to approximately 1,652 per 100,000 population, is far higher than other published rates in general populations. Medically treated dog bite incidence rates have been reported up to 2.7 per 1,000 population (León, 2006; Ostanello et al., 2005; Rosado et al., 2009; Thomas and Banks, 1990; Thomas and Voss, 1991), with similar rates reported from animal bite recording databases (Shuler et al., 2008). Rates from survey-based studies, which include bites that were not medically treated, are generally higher (Cornelissen and Hopster, 2010; Westgarth et al., 2018). Dog bite incidence rates in Indigenous communities are limited. A study in four remote Indigenous communities of Canada found a rate of approximately 3 per 1,000 for animal bites and scratches (Schurer et al., 2015). In Australia, Thompson reported an incidence rate of 0.7 per 1,000 population of dog bite victims seeking medical treatment in the city of Adelaide, similar to rates reported in cities of Spain and Italy (León, 2006; Rosado et al., 2009).

The high incidence rate in this study may be due to a number of factors. The Primary Health Care Clinics in the study area are the sole source of medical treatment within these communities and would therefore capture a higher proportion of dog bite injuries than health facilities in more urbanized areas where other treatment facilities are available. Several studies have also suggested higher incidence rates in rural and remote areas of low population compared to more urbanized regions (León, 2006; Ostanello et al., 2005; Rosado et al., 2009; Wake et al., 2009). Other factors that have been attributed to an increased rate of dog bites, and apply to the study area, include dogs that bite are more likely to live in areas

Table 2
Rates of dog bite presentations to Primary Health Care Clinics in three remote Far North Questions communities per 1,000 population before and after the strengthening of alcohol restrictions

Community	Before rate (1,000 population)		After rate (1,000 population)		Incidence rate ratio (IRR)		
	Rate	(95% CIs)	Rate	(95% CIs)	RR	(95% CIs)	P[ss]
A	12.4	8.6-16.3	4.8	2.5-7.2	0.4	0.2-0.7	0.001
B	12.9	7.5-18.3	9.2	4.6-13.9	0.7	0.4-1.4	0.317
C	40.4	31.4-49.4	27.9	20.7-35.1	0.7	0.5-1.0	0.033
All communities	20.4	17-23.8	12.7	10.1-15.3	0.6	0.5-0.8	<0.001

[a] Threshold for statistical significance: $P < 0.05$.

of lower median income (Shuler et al., 2008) and higher temperatures (Frangakis and Petridou, 2003; Zhang et al., 2017).

Community C experienced an incidence rate 3.9 (95% CI 2.9-5.4, $P < 0.001$) times that of community A. This suggests there are contributing factors that influence the incidence of dog bites that are unique to individual communities such as inappropriate behavior of dogs or humans, dog breed, size of dog populations, cultural perspectives on animal health and husbandry, neuter status, and the characteristics of roaming dog populations (Casey et al., 2014; Hsu and Sun, 2010; Raghavan, 2008; Wake et al., 2009).

Demographics of victims

Children under 15 y are generally reported to be at significantly higher risk of dog bites when compared with other age groups (Feldman et al., 2004; Ostanello et al., 2005; Ozanne-Smith et al., 2001; Rosado et al., 2009; Thompson, 1997). This has been attributed to the limited ability of a child to interpret potentially hazardous situations and dog body language, which may provoke a dog to bite (Lakestani and Donaldson, 2015; Mathews and Lattal, 1994); and that more dog bites in children result in medical attention due to severity of wounds, a higher proportion of head and facial injuries compared with adults, and parental responsibility to seek treatment (Guy et al., 2001). In this study, the age group most at risk is 35- to 44-year-olds who were twice as likely to present to a clinic (IRR 2.0, 95% CI 1.4-2.9, $P < 0.001$) compared to those aged <15 years. A higher risk of dog bites in adults, or a recording of no significant difference between children and adults, has only been noted in a few studies (Cornelissen and Hopster, 2010; Guy et al., 2001), further suggesting that factors unique to this study area may contribute to the frequency of dog bites in adults.

Dog bite studies generally indicate that males are more likely to be the victim of a bite than females (Feldman et al., 2004; Kahn et al., 2003; MacBean et al., 2007; Ostanello et al., 2005; Rosado et al., 2009). This may be attributed to a higher engagement of risk-taking behaviors in males than females (Mathews and Lattal, 1994). In this study, no significant difference in incidence rates was observed between genders, which is similar to results reported by Sarcey et al. (2017).

Location of injury

Over half of the recorded dog bite injuries (n = 145, 62.4%) in this study affected the lower limbs of patients. While this is comparable with a similar study monitoring dog bite presentations in an emergency department by Ostanello et al., (2005) generally victims are more frequently injured on the upper extremities (Cornelissen and Hopster, 2010; MacBean et al., 2007; Oxley et al., 2018; Pfortmueller et al., 2013; Rosado et al., 2009). Upper extremity dog bites are generally associated with victims who have approached the dog, whereas lower extremity bites are more likely when the dog approaches the victim (Oxley et al., 2018; Rosado et al., 2009). In addition, bites to both the upper and lower extremities have been reported when victims attempt to separate fighting dogs (Oxley et al., 2018). Given the findings of this study are in opposition to the normal trend, it highlights the need for a further understanding of the interactions between dogs and humans in these communities.

Dog bites and alcohol

A significant reduction in the incidence of dog bite–related injuries occurred in communities A and C, where full prohibition was in effect after the strengthening of alcohol restrictions. In community B, where the strengthening of restrictions established zero carriage limits but allowed a tavern to continue operations, a nonsignificant reduction in the incidence of dog bites occurred. The reduction of incidence rates after the strengthening of alcohol restrictions suggests that a relationship may exist between the availability of alcohol and dog bites. While examining dog bite–associated fatalities, Patronek et al. (2013) identified alcohol consumption as a victim-related factor that compromises a person's ability to interact appropriately with a dog. It is plausible that strengthened alcohol restrictions reduced the number of events where an individual's ability to interact with a dog was diminished by alcohol and resulted in a dog bite. Furthermore, tighter restrictions may be more effective at reducing these events.

Strengths, limitations, and recommendations

The clinical file audit provided a narrow, six-year window of dog bite victims who sought medical attention for their injuries. While the study had a small sample size due to the small and isolated nature of the study communities, it was exhaustive and systematic in recording every dog bite that required medical treatment. In addition, this study is the first to assess the effect of alcohol restrictions on the incidence of dog bites.

Medically based monitoring studies of dog bites have several important limitations including a tendency to over represent younger victims and the severity of bites (Lakestani and Donaldson, 2015); under represent the frequency of dog bites as only 10-60% of victims seek medical assistance (Cornelissen and Hopster, 2010; Morgan and Palmer, 2007; Oxley et al., 2018); and generally do not record complex factors (such as victim or dog behaviors preceding a bite) associated with a dog bite event (Westgarth and Watkins, 2015). These limitations indicate that the rates obtained in this study are likely an under representation of the incidence of dog bites in these communities.

The data in this study were obtained by applying the ICD-10-CM coding scheme to medical charts at Primary Health Care Clinics as a means of documenting all injury presentations, and as such, was not designed for the specific collection of dog bite injury data. As the clinics are the sole medical providers in the communities, they present a unique opportunity to monitor the incidence and characteristics of dog bites. Implementation of a simple monitoring system at the clinic would provide valuable additional information around the characteristics of each dog bite. This system could include variables such as if the dog involved was domestic or roaming, information on the dog-human interaction preceding a bite, and the role of alcohol in dog bite events. Integration between the local governments and contracted veterinary services and researchers would yield robust dog population and community dog bite surveys. This information would help to address the knowledge gaps outlined in this study, in particular, the differences to the established literature concerning the site of injury and the role of gender; assist in directing policy direction; and the evaluation of dog bite mitigation strategies.

Conclusion

This study investigated the incidence and characteristics of dog bites in three remote Indigenous communities in Far North Queensland, Australia, between 2006 and 2011. It revealed an overall high incidence rate of dog bites, differences to established literature on demographic and site of injury characteristics, significant differences in incidence rates between communities and a significant reduction in dog bites after the strengthening of alcohol restrictions. Development of a specific dog bite monitoring system through the Primary Health Care Clinics could enhance knowledge of human-dog interactions, assist in the development of mitigation

strategies aimed at reducing dog bites, and assess if these strategies are effective.

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Conflict of interest

The authors declare no conflict of interest.

Ethical considerations

Ethical approval was granted by the Human Research Ethics Committee (HREC) James Cook University (H5618, H5241, and H4967), Cairns and Hinterland Health Services District Human Research Ethics Committee (HREC/14/QCH/3–883) and Townsville and District Human Research Ethics Committee (HREC/13/QTHS/187). Waiver of individual consent for the clinical file audit was granted by each HREC. All parts of the study were considered and supported by the Indigenous Leaders Forum of the Local Government Association of Queensland which included the elected Mayors and CEOs from the study communities.

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