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Fractures of the mandible and maxilla: A 10-year analysis

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RESEARCH

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ABSTRACT

Background
Previous analysis of jaw fracture hospitalisations in Western Australia (WA) indicated disproportionately high rates of hospitalisations for Aboriginal people. This study was to follow-up on the earlier analysis to determine if inequalities in terms of jaw fracture hospitalisation rates between Aboriginal and non-Aboriginal people have changed.

Aims
This study, done over a 10-year period from 1999/2000 to 2008/2009, aimed to determine rates of hospitalisations for jaw fractures in WA, trends over the 10–year period, and direct costs associated with these hospital admissions.

Methods
Hospitalisation data were obtained from the Western Australian Hospital Morbidity Data System (HMDS). Episodes were selected on the basis of an ICD10-AM code being S02.4 (Fracture of the malar and maxillary bones) and S02.6 (Fracture of the mandible). Self-reported Aboriginality were used to compare Aboriginal to non-Aboriginal populations. Estimated cost of care was determined for each episode using the national standard diagnostic-related group (DRG) average price.

Results
Our findings indicate that inequalities between Aboriginal and non-Aboriginal people in terms of hospital admissions for jaw fractures exist in WA, and continued over a decade-long period. Higher fracture rates occurred amongst males, Aboriginal people, younger adult age-groups, those from low socioeconomic areas, and those from remote and very remote areas. The DRG cost per person for jaw fractures ranged between AUD $842 and $109,002, with a median cost of $4,965.

Conclusion
Hospital admission rates for the treatment of maxillary and mandibular fractures is very strongly divided along racial and socioeconomic lines in WA.

Key Words
Jaw factures, hospitalisation, epidemiology, Aboriginal population

What this study adds:

1. What is known about this subject?
Jaw fractures have a significant impact on people and also have associations with societal marginalisation.

2. What new information is offered in this study?
This research reports the substantial impact that some members of Australian society face from jaw fractures.

3. What are the implications for research, policy, or practice?
This study's findings have both wider and narrow implications for policy and practice. Narrowly, it is about where services are provided. Widely, it is about societal advancement.

Background

Maxillofacial injuries are commonly encountered in the practice of emergency medicine, and are often associated with high morbidity resulting from various degrees of physical, functional, and cosmetic consequences. Healthcare costs and the increasing burdens associated with hospitalisations and in-patient care continue to put economic pressure on state governments in Australia.[1] Previous studies reported high numbers of people in Australia being hospitalised for trauma, and especially maxillofacial fractures.[2–5] The treatment of mandibular and other facial fractures is a financial burden on health systems already under pressure.[6] Treatments are costly and increasing over time, especially because the costs of the use of rigid fixation to treat fractures are high.[7,8] Facial trauma management and care also involve several specialist groups and subspecialities for pre-operative, operative, and postoperative care.[8] Indirect costs, including time off work, travel and travel time, as well as loss of income, also contribute to overall costs, and above all, place a social and personal burden on those who suffer such injuries.

Several investigators have studied maxillary and mandibular fracture epidemiology.[9–13] Identified factors that are associated with maxillofacial fracture incidence include age, gender, geographic region, cultural aspects, socioeconomic status, temporal and climatic influence, use of alcohol and drugs, compliance with road traffic legislation, domestic violence, and osteoporosis.[9–13] Due to different socioeconomic, cultural, and political influences, however, it is not possible to extrapolate such results among different countries, or even communities within the same country. Australian studies, however, and especially those conducted in Aboriginal communities, indicate disproportionately high levels of hospitalisations of Aboriginal people[2,5] for maxillofacial injuries due to alcohol-related trauma, violence, and assaults.[2–4]

Previous analysis of jaw fracture hospitalisations in WA over a four-year period indicated disproportionately high rates of hospitalisations for Aboriginal people.[5] Several programmes and strategies have been implemented in WA to address the health issues of Aboriginal people, and this included focusing on drug and alcohol abuse problems in Aboriginal communities. In 2005, the State Government of WA initiated the Strong Spirit Strong Mind: Western Australian Aboriginal Alcohol and Other Drugs Plan (AAOD Plan) 2005–2009.[14] The AAOD Plan encouraged a whole-of-system approach across government and community organisations to ensure that Aboriginal alcohol and other drugs policy, programme, and service responses make best use of available resources and partnership arrangements. It was hoped that these and other initiatives would close the gap between Aboriginal and non-Aboriginal health inequalities.

This study was to follow up on the earlier analysis and determine if inequalities in terms of jaw fracture hospitalisation rates between Aboriginal and non-Aboriginal people have changed. This study was done over a 10-year period from 1999/2000 to 2008/2009; it aimed to determine the rates of hospitalisations for jaw fractures in WA, trends over the 10–year period, and direct costs associated with these hospital admissions.

Method

Ethics

Ethics approval for this study was obtained from the Human Research Ethics Committee at the University of Western Australia reference number RA/4/1/5502.

Study population

The total population in WA was 1,849,055 in 1999, 1,901,168 in 2001, and 2,059,614 in 2006. In 2006, 3.8 per cent of the WA population was of Aboriginal or Torres Strait Islander descent. About one-third (34 per cent) of Aboriginal people and 80 per cent of the non-Aboriginal people resided in metropolitan Perth.[15]

Hospitalisation data

Hospitalisation data was obtained from the Western Australian Hospital Morbidity Data System (HMDS). The principal diagnosis, as classified by the International Classification of Disease (ICD-10AM),[16] was obtained for every episode of discharge from all private and public hospitals in WA for the financial years 1999–2000 to 2008–2009. In this study, episodes were selected on the basis of an ICD10-AM code being S02.4 (Fracture of the malar and maxillary bones) and S02.6 (Fracture of the mandible).

Aboriginal status, population rates, and cost

Self-reported Aboriginality was used to compare Aboriginal to non-Aboriginal populations. Population data for rate calculations were obtained from the estimates as calculated by the Western Australian Department of Health. These estimates were extrapolated from census data collected by the Australian Bureau of Statistics. Estimated cost of care was determined for each episode using the national standard diagnostic-related group (DRG) average price. Each AR-DRG represents a class of patients with similar clinical conditions requiring similar hospital services.[17]

Place of residency

Primary place of residency at the time of hospitalisation and the geographical classification was done according to Accessibility and Remoteness Index of Australia (ARIA). ARIA calculates remoteness as accessibility to service centres based on road distances, and are grouped into five categories: Highly Accessible; Accessible; Moderately Accessible; Remote; and Very Remote.[18]

Socioeconomic Index of Disadvantage

The population census provides data on the income, housing, education, employment, family structure, disability, transport, age, gender, and ethnicity of people all over Australia. The Australian Bureau of Statistics has combined these in a set of indicators called the Socioeconomic Indexes for Areas (SEIFA) which give a summary measure of socioeconomic status for people living in specific geographic regions in Australia. Each geographic area is given a score, then ranked against all other areas in Australia, and the rankings are grouped into five equal size bands (quintiles). Quintile 1 contains the 20 per cent most disadvantaged areas in Australia, and Quintile 5 contains the 20 per cent least disadvantaged areas in Australia.[19]

Statistical analysis

All rates were calculated using the Rates Calculator, a software package developed by the Government of Australia Department of Health. All rates were calculated per 1,000 person years. Significant differences between rates were based on non-overlapping 95% CI (p<0.05). Means between groups were compared using one-way ANOVA. Both Poisson regression and chi-square tests were used to determine if trends were significant for age-standardised rates over time. All statistical analysis was undertaken using IBM SPSS Statistics 19 (IBM: New York, USA).

Results

Over a 10-year period, a total number of 7,183 persons were admitted to a hospital in Western Australia for treatment of a fractured mandible, maxilla, or both. More fractures were of the mandible (64 per cent), compared to the maxilla (36 per cent).

Men were far more likely to be admitted (82 per cent) than women. Admissions were associated with age, with more than half (56 per cent) of all those hospitalised between the ages of 15 and 29 years (Table 1). More than one-quarter (27 per cent) were aged 30–44 years (Table 1).

Cost and bed days

There was a significant difference (p<0.0001) in the mean number of bed days between Aboriginal (2.39 days, sd 2.08), and non-Aboriginal patients (2.09, sd 2.94). Over the 10-year period, Aboriginal patients spent a total of 4,186, and non-Aboriginal patients 11,346 days in hospital, resulting in a total of 15,522 bed days attributed to jaw fractures.

There was a significant difference (p<0.0001) in mean DRG cost per person between Aboriginal and non-Aboriginal patients, with a mean cost of AUD $4,868 (sd 5268) (median $4,445) for Aboriginal, and AUD $6,031 (sd 8446) (median $5,683) for non-Aboriginal patients. The total cost over 10 years totalled AUD $41,283,903. The DRG cost per person for jaw fractures ranged between AUD $842 and AUD $109,002, with a median cost of AUD $4,965.

Rates

Rates over time increased slightly, with rates in the last two years significantly higher (p<0.05) than in the first year. The lowest rate was in 2003/2004, significantly lower (p<0.05) than all other years, except 1999/2000. Trend analysis of rates over the 10-year period indicated a rate ratio of 1.023, with a confidence interval (CI) of 1.015 to 1.031.The average annual change (2.29 per cent) showed a significant (p<0.0001) increase in rate.

Age-adjusted population rate calculations indicated that rates were the highest for 15–44 year olds, and lowest for children between birth and 14 years. Slightly higher rates were experienced by those older than age 75, compared to age groups just below (45–74 years) (Table 1). Rates for men (0.58) were more than four times higher than those for women (0.13) (Table 1). Rates for Aboriginal people were almost 10 times higher than for non-Aboriginal people (Table 1).

Age-adjusted rates differed between Aboriginal and non-Aboriginal people, and between males and females (Figure 1). The rates for male Aboriginal patients (7.07) between 15–29 years were almost double that of Aboriginal females (3.76), almost seven times higher than for non-Aboriginal males (1.35), and 70 times higher for non-Aboriginal females, all between 15–29 years (Figure 1). There were no Aboriginal patients older than 75 years, and in non-Aboriginal patients, there was an increase in rates after the age of 75, with the rate of females (0.22), higher than that of males (0.16). This was the only age group where females had higher rates than males.

Socioeconomic disadvantage

Amongst Aboriginal patients, admission rates were highest for those from the most disadvantaged areas, with a rate almost three times higher than for those from the least disadvantaged areas. The most disadvantaged rates were also higher than any other rate, including those amongst non-Aboriginal patients (Table 2).

Amongst the non-Aboriginal patients, rates were also highest amongst those from the most disadvantaged areas, and this was almost 30 times higher than for those from the least disadvantaged areas (Table 3). Almost all Aboriginal patients were uninsured (99.6 per cent) compared to non-Aboriginal patients (75 per cent not insured). Of all admissions, 81 per cent were uninsured patients.

Accessibility and remoteness

Amongst Aboriginal patients, rates were the highest amongst those from remote and very remote areas, and amongst non-Aboriginal patients, the highest rates were amongst those from remote areas. Aboriginal rates in all five areas (ARIA categories) were significantly higher than those of non-Aboriginal patients in the same areas.

Discussion

Our findings indicate that inequalities between Aboriginal and non-Aboriginal people in terms of hospital admissions for jaw fractures exist in WA, and continued over a decade-long period. Higher fracture rates occurred amongst males, Aboriginal people, younger adult age groups, those from low socioeconomic areas, and those from remote and very remote areas.

More than 80 per cent of all those admitted to hospital were men—this is consistent with other studies. The very disproportionate rates between males and females is believed to be related to the risk factors for maxillofacial fractures, which include a high prevalence of interpersonal violence.[4] The numbers of mandibular fractures were higher than maxillary fractures, confirming national and international findings.[5,9,11,20–24] An earlier study from Azevedo found the mandible to be the tenth most commonly injured bone in the body, and the second most commonly injured bone in the face.[20]

The rates of admission were highest in young adult age groups, between ages 15 and 29. More than half (56 per cent) of admissions were in this age group. The reasons might be the risk-taking behaviours associated with maxillofacial trauma that younger age groups engage in, as identified by other studies.[9,10,25]

In this study it was also determined that the rates for the oldest age group, those above age 75 years, was significantly higher than for those aged 30–64 years. Previous studies identified maxillofacial trauma as common amongst older people, and falls were identified as the major etiological factor in older age groups.[21,26] With the older proportion of the population in Australia rapidly increasing, higher numbers of older people are expected to present with maxillofacial trauma.[21]

When comparing rates of Aboriginal with non-Aboriginal patients, the admissions of Aboriginal people were disproportionately higher than for non-Aboriginal patients, and this situation remained consistent over the decade-long study period. Aboriginal males were admitted at a rate that was nearly 10 times that of non-Aboriginal males, Aboriginal female rates were almost three times that of non-Aboriginal males, and 37 times higher than for non-Aboriginal females at the peak ages of 15–29 years. Other Australian studies found similar disparities.[2,24,27,28] The aetiology of facial fractures in Australia, and especially in the Aboriginal population, is strongly associated with alcohol-related violence and assaults.[2,3,27,28] Indigenous females and males were 35 and 22 times as likely to be hospitalised due to family violence-related assaults as other Australian females and males, respectively.[29]

Rates were significantly higher for individuals (both Aboriginal and non-Aboriginal) from the most socioeconomically disadvantaged areas. The rate for Aboriginal people from the poorest areas was double that of the non-Aboriginal rate from the poorest areas. Rates were also highest for those from remote and very remote areas. Poverty has shown to be associated with violence in Australia[29]: about one-in-four Aboriginal people aged 15 years or over reported being a victim of physical or threatened violence, and the rate was higher among those who lived in low-income households, and were unemployed. The age-standardised rate for being a victim of physical or threatened violence among the Aboriginal population was more than twice the rate of the non-Aboriginal-population.[29] Although the rates were similar among those living in major cities and in remote areas, people in remote areas were much more likely to report that family violence was a neighbourhood problem (41 per cent compared with 14 per cent in non-remote areas).[29]

Reasons for the slightly higher direct costs for Aboriginal people is unknown, but the direct costs (DRG) distribution across all episodes was not a normal distribution, and as such, mean costs could be misleading. Median costs

between Aboriginal and non-Aboriginal groups did not differ as much. With the majority of the Aboriginal population residing in rural and remote WA, it can be assumed that longer travel times and distances to obtain specialist care would be necessary. It might be the reason for the slightly longer hospital stay of Aboriginal, compared to non-Aboriginal patients.

Trend analysis indicates a positive (2.2 per cent) and significant increase in hospitalisation rates for jaw fractures in WA, over a 10-year period. This is an indication that hospitalisations for the treatment of maxillary and mandibular fractures remain a burden on the health system, and the very high rates of Aboriginal people admitted compared to non-Aboriginal remains a concern.

Conclusion

Hospital admission rates for the treatment of maxillary and mandibular fractures are very strongly divided along racial and socioeconomic lines in WA. The reasons for this include the determinants and risk factors for maxillofacial fractures, which are strongly associated with poverty, and compounded by geographical location and culture. The complexity of factors determining disadvantage and related health concerns, and the alleviation of risk-damaging lifestyles and behaviours require a broad integrated approach. This approach would need to be based on the social determinants of health, where health should be viewed from both a social and economic justice perspective.

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CONFLICTS OF INTEREST

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Table 1: Jaw fracture rates by age, gender, and Aboriginal status over 10 years in WA

		N	Rate per 1,000	95% CI*
Year	1999/2000	614	0.32	0.29–0.35[a]
	2000/2001	673	0.35	0.32–0.38
	2001/2002	635	0.33	0.30–0.36
	2002/2003	682	0.35	0.32–0.38
	2003/2004	608	0.31	0.29–0.33[a]
	2004/2005	740	0.37	0.35–0.40
	2005/2006	765	0.38	0.35–0.41
	2006/2007	756	0.37	0.34–0.40
	2007/2008	853	0.40	0.38–0.43[a]
	2008/2009	857	0.39	0.37–0.42[a]
	All years	7,183	0.36	0.35–0.37
Age group	0–14	186 (3%)	0.04	0.39–0.52[a]
	15–29	4,048 (56%)	0.95	0.93–0.98[a]
	30–44	1,968 (27%)	0.44	0.42–0.46[a]
	45–59	616 (9%)	0.16	0.14–0.17
	60–74	161 (2%)	0.07	0.06–0.08[a]
	75+	204 (3%)	0.19	0.17–0.22
Gender	Male	5,876 (82%)	0.58	0.56–0.59[a]
	Female	1,309 (18%)	0.13	0.12–0.14
Aboriginal status	Aboriginal	1,752 (24%)	2.50	2.38–2.62[a]
	Non-Aboriginal	5,431 (76%)	0.28	0.27–0.29[a]

**CI=Confidence Interval*
[a] Significant differences between groups

Table 2: Distribution of jaw fractures cases over 10 years by area Socio-Economic Index of Disadvantage (SEIFA) quintiles

	N	Rate per 1,000 (95% CI*)	N	Rate per 1,000 (95% CI)
SEIFA1	1,246	11.4 (11.2–11.6)	1,180	5.84 (5.73–5.96)[a]
SEIFA2	199	2.00 (1.90–2.10)	1,099	0.85 (0.83–0.87)[a]
SEIFA3	120	0.58 (0.54–0.62)	1,057	0.15 (0.15–0.16)[a]
SEIFA4	94	0.73 (0.68–0.78)	981	0.20 (0.20–0.21)[a]
SEIFA5	82	3.10 (2.87–3.32)	978	0.20 (0.20–0.21)[a]

**CI=Confidence Interval*
[a] p<0.05, significant differences in rates in each SEIFA category between Aboriginal and Non-Aboriginal. SEIFA1=Most disadvantaged, SEIFA5=Least disadvantaged

Table 3: Distribution of jaw fractures cases over 10 years by ARIA classification

	N	Rate per 1,000 (95% CI*)	N	Rate per 1,000 (95% CI)
HA	283	1.20 (1.15–1.25)	3,126	0.21 (0.20–0.22)[a]
A	119	2.71 (2.55–2.88)	944	0.83 (0.81–0.85)[a]
MA	159	4.13 (3.92–4.36)	580	0.76 (0.74–0.78)[a]
R	115	9.90 (9.33–10.5)	270	1.06 (1.02–1.11)[a]
VR	1,060	4.49 (4.40–4.58)	394	0.51 (0.50–0.53)[a]

**CI=Confidence Interval*
[a] p<0.05, significant differences in rates in each ARIA category between Aboriginal and Non-Aboriginal.

Figure 1: Hospitalisation rates (per 1,000 population) for jaw fractures in WA over a decade, by age group, gender, and Aboriginal status