The incidence of Orofacial Cleft in live births in New Zealand

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ABSTRACT

AIM: To determine the incidence of orofacial cleft at birth in New Zealand over 10 years from January 2000.

METHODS: Comparison of data collected from cleft units and data held on the national minimum dataset.

RESULTS: The overall incidence of OFC in New Zealand over a 10 year period was found to be 1.79 per 1,000 live births, higher than the norm for Western society. The major reason for this increased rate was an increased rate for the Māori 2.37 per 1,000 live births, specifically related to a Cleft Palate alone rate over twice that of the European (1.54 vs 0.73 per 1,000 live births). The rate for Pacific was half way between (1.04 per 1,000 live births). The rate of Cleft Lip alone was significantly lower in both Māori and Pacific populations. Different sex ratios were also seen in relation to Cleft Lip and Cleft Lip and Palate for Māori and Pacific compared to those normally reported.

CONCLUSIONS: Māori have an increased incidence of Orofacial Cleft due to one of the highest rates of Cleft Palate alone in the world. Further aetiological studies involving genetic and environmental factors are required to elicit the reasons for this increased incidence.

The rate of orofacial cleft (OFC) in Western society is commonly quoted to be around 1 in 700 live births (1.4 per 1,000 live births). A study across 30 European registries has shown this to vary both within and between countries; with a reported mean of 1.52 per 1,000 live births 95%CI (1.49, 1.55) but a range from 0.63 in Valles, Spain to a high of 2.62 in Finland.[1] By these estimates we would expect 82–94 children are born in New Zealand each year with an orofacial cleft assuming 54,000–62,000 births per year

Studies of the incidence of OFC in New Zealand to date have been limited to a few local studies. Howie and Phillips reported an incidence of 2 per 1,000 live births between 1964 and 1967, which accounted for 6.4% of congenital malformations at National Women's Hospital, the main maternity hospital in Auckland during that period.[2] They found an increased rate of an isolated cleft palate (CP) amongst Māori; however they found no case of isolated cleft lip (CL) amongst Māori. These results were confirmed in a Northland study in the 1970s[3] and another Auckland-based study by Chapman covering the period 1960–76.[4] More recently, local data have been published from Christchurch from 1960 to 2000[5] and from 2000 to 2009,[6] based on clinic records; however the estimates from these studies reflect a mostly European population.

Data reported from official New Zealand sources have been published in the annual reports of the International Clearing-house for Birth Defects Surveillance and Research,[7] and show a rate of non-syndromic OFC of 1.55/1,000 live births over the five years from 2005 to 2009.

OFC has also been shown to be more frequent in Asian populations.[8–10] These increased rates among Asian groups appear to have continued even after they have emigrated to new countries in Western societies,[11] New Zealand has a fast-growing Asian population (Asian births 1991: 3.0%, 2006: 8.8%, 2013: 11.2%), with a younger demographic than the general population (NZ census data).[12] This implies that there is a potential for an increase in the number of OFC cases to be seen in New Zealand.

The aims of this study were to compare data over a 10-year period, obtained from two national sources and in doing so to describe the incidence in New Zealand over the 10-year period. The data sources compared were those from the five surgical cleft treatment centres in New Zealand, responsible for treatment of all cleft in New Zealand and the National Minimum Dataset (NMDS) that contains International Classification of Disease (ICD) coding of all hospital discharges in New Zealand.

Methods

Data was obtained for all cases of OFC that required surgical repair (Cleft lip alone (CL), Cleft Palate alone (CP) and Cleft lip and palate (CLP)). Syndromic cases were included, as the study was investigating the incidence at birth—at which time the presence of a syndrome is often not known (some may not be diagnosed for many years). Cases of submucosal cleft requiring repair are included, however incidental findings of bifid uvula, which required no referral to the service and hence no repair, are not.

Data were collected from two sources:

1. All five units that care for cleft lip and palate in New Zealand were asked to identify all new cases born over the 10-year period from 1 January 2000 to 31 December 2009 and whose treatment was being carried out by the unit. These records were kept by the cleft co-ordinators, who were all appointed post 2000 and data from earlier in the audit was established from appointment records. Data obtained included cleft type, sex, ethnicity, date of birth and National Health Index.
2. The National Minimum Dataset, which contained all discharges from public hospitals in New Zealand (treatment for OFC is funded by the public health system in NZ), was interrogated for all discharges with ICD9 coding 749 in any diagnosis field (up to 25), (cleft palate and cleft lip) and all its subcategories, over the 10-year period from 1 January 2000 to 31 December 2009. Data obtained included sex, ethnicity, date of birth, National Health Index and ICD coding (25 fields).

Where discrepancies existed between the cases identified by the cleft units and the coding in the National discharge dataset, the following steps were used to clarify each discrepant case:

1. If a case was identified on the NMDS but had not been identified by the cleft centre audit, the case notes of the child were reviewed at the hospital of birth to clarify if the child was born with a cleft. When it was clarified that the child did have a cleft, this was then additionally checked with the corresponding cleft team.
2. For cases identified by the cleft centre audit but not the NMDS, the national health index (NHI) of those cases was interrogated in the NMDS to determine what discharge coding had been ascribed.

We used the NMDS to define ethnicity, as that is the source used for the denominator (being the total number of live births) and in other New Zealand official statistics. Ethnicity was assigned using the standard prioritisation method, the method prioritises in the following order (1) Māori, (2) Pacific peoples (Tokelaean, Fijian, Nuiean, Tongan, Cook Island Māori, Samoan, Other Pacific Islander), (3) Asian (South East Asian, Indian, Chinese, Other Asian), (4) Various other ethnicities (Latin American/Hispanic, African, Middle Eastern, Other) and finally (5) European (Other European, Other European (not further defined), NZ European).[13] We used the data from the cleft units to determine the type of cleft with confirmation from the clinical notes and type of operation(s) carried out.

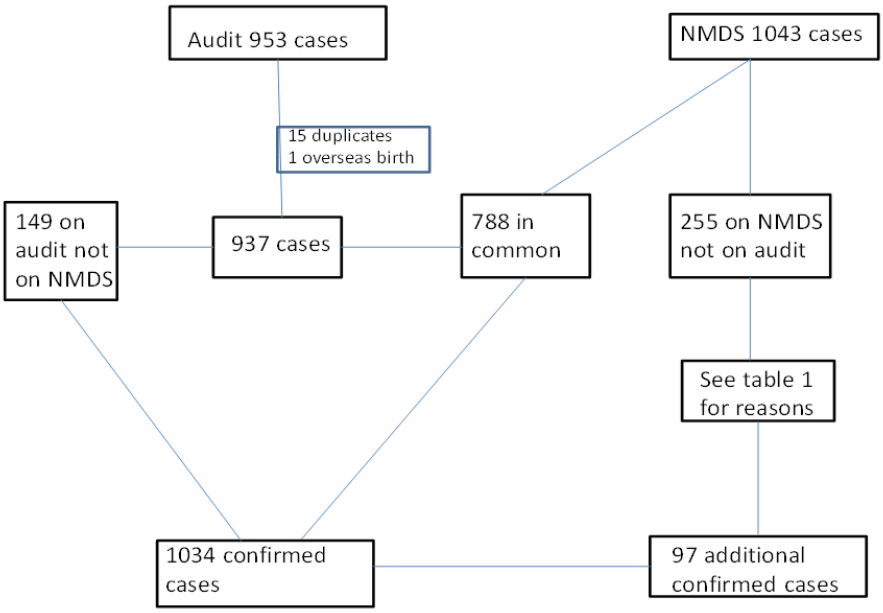
Statistical analysis

Comparison of rates of cleft by ethnicity and sex were compared by testing differences in proportions. Odds ratios were estimated to ascertain ethnic and sex stratified risks using the logistic regression procedure in SAS v9.3 (SAS Institute, Cary, N.C.).

Results

The national cleft unit audit identified 937 cases over the 10-year period (after the removal of duplicate observations, where treatment had occurred in more than one

Figure 1: Flowchart of identification of audit and NMDS identified oro-facial cleft cases.



centre), while 1,043 cases were identified with ICD coding in the NMDS. There were 255 cases identified on the NMDS but not identified by the cleft unit audit, and 149 identified in the cleft unit audit but not on the NMDS, leaving 788 identified by both sources (Figure 1).

Examination of the clinical notes of the 255 cases that had not been identified from the cleft unit audit revealed information that could be placed into 10 different categories. The main categories were (1) coded as having had cleft surgery but not identified by the cleft unit audit (25.9%); (2) bifid uvula identified at Ear Nose and Throat (ENT) surgery and no further referral (presumably as not considered to be of clinical significance) (20.4%); (3) no evidence of a cleft was found in the clinical notes (14.1%); and (4) died at or soon after birth (12.2%). The full list of categorisation is shown in table 1a.

Of those cases not identified on the clinical audit but coded as having cleft surgery (n=66), cross-checking was then carried out with the cleft unit that should have been responsible for each patient. This resulted in confirmation of a cleft in all but three cases (who are not known to any unit and the authors believe are likely to have been miscoded). The classification of these 66 cases is shown in Table 1b. The

Table 1a: Categorisation of cleft cases notified by the National Minimum Dataset not on the original cleft unit audit.

‡Coded as surgical repair of cleft - but not on audit	66 (25.9%)
Cleft/Bifid uvula - probably NOS and not referred	52 (20.4%)
No mention of cleft in clinical notes	36 (14.1%)
†Died or seriously ill child - not likely to have surgery	31 (12.2%)
Overseas birth	25 (9.8%)
Cleft queried but NOS on examination at cleft clinic	20 (7.8%)
Sub mucosal cleft NOS and no referral made	8 (3.1%)
Cleft diagnosed then diagnosis changed	7 (2.8%)
Coded under different NHI	7 (2.8%)
†Procedure carried out outside audit period but have cleft	3 (1.2%)

† Included in final dataset

‡ Include in final dataset except 3 cases excluded as per table 1b

Table 1b: Categorisation of cleft cases coded as surgical repair on the National Minimum Dataset (n=66).

Missed by audit	38
Contracted patient, not on any units books	16
Repaired but not in a non-cleft unit hospital	2
Now overseas	2
Lost to follow up	3
Deceased never seen	2
†Not a cleft	3

†Excluded from final dataset

main category was confirmation of the case (n=38) and was mostly related to those who diagnosed at a later age with a submucosal cleft palate (SMCP); these had been kept on a separate database in one unit and had not been included in the supplied audit data. A number (n=16) of patients had been seen by a surgeon from one of the cleft units under private contract at out-patient clinics in regional centres, with the surgery carried out at the cleft unit, with follow up back at the regional centre. Upon retirement of the surgeon these cases should have reverted back to a regional unit, but none of the units considered these patients to be under their care and hence had not included them in their audit data.

Of the 149 cases identified by the cleft unit audit but not on the initial NMDS data, all were included as they were known to have had surgery relating to a cleft. Re-interrogation of the discharge dataset found 124 of these cases had surgical coding for cleft lip or palate. A re-interrogation of the dataset was carried out using ICD10 coding. Further investigations at the Ministry of Health revealed a discrepancy in the Ministry of Health mapping of ICD9 and ICD10 coding. Seven had coding relating to the cleft but not coded as having a cleft as follows: Q87.0 (n=4, Congenital malformation syndromes predominantly affecting facial appearance), L90.5 (n=1,Scar conditions and fibrosis of skin), Q38.0 (n=1, Congenital malformations of lips, not elsewhere classified), Z42.0 (n=1, Follow-up care involving plastic surgery of head and neck).

A further case had coding Q210 Ventricular septal defect amongst other cardiac codes, but no coding for the cleft as no surgery had taken place for the cleft. Another six cases

Table 2: Total number of cleft cases/births by year and ethnicity.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	**Total**	**Rate/ 1,000 live births**
Māori	26	34	28	31	26	27	23	36	26	32	289	2.37
	10,980	10,968	10,565	11,310	11,723	12,193	12821	13,707	13,902	13,653	121,822	
Pacific	8	7	9	15	6	8	14	9	10	14	100	1.65
	5,611	5,672	5,622	5,809	5,779	5,765	6,078	6,632	6,853	6,891	60,712	
European/ Other	70	57	56	66	72	65	63	60	64	72	645	1.63
	39,408	38,204	37,700	38,264	38,607	38,886	39,734	41,847	41,641	40,981	395,272	
Total	104	98	93	112	104	100	100	105	100	118	1034	1.79
	55,999	54,844	53,887	55,383	56,109	56,844	58,633	62,186	62,396	61,525	577,806	
Rate	1.86	1.79	1.73	2.02	1.85	1.76	1.71	1.69	1.60	1.92	1.79	

Table 3: Number and rate (per 1000 live births) of orofacial cleft by type, sex and ethnicity.

	Cleft Palate				**Cleft Lip**				**Cleft Lip and Palate**			
	Male	Female	Total	Rate	Male	Female	Total	Rate	Male	Female	Total	Rate
Māori	80 (1.27)	108 (1.82)	188	1.54	20 (0.32)	18 (0.30)	38	0.31	31 (0.49)	32 (0.54)	63	0.52
Pacific	26 (0.83)	37 (1.25)	63	1.04	8 (0.26)	3 (0.10)	11	0.18	13 (0.42)	13 (0.44)	26	0.43
Euro/ Other	122 (0.60)	167 (0.86)	289	0.73	106 (0.52)	51 (0.26)	157	0.40	142 (0.70)	57 (0.30)	199	0.50
Total	228	312	540	0.93	134	72	206	0.36	186	102	288	0.50
Rate	0.77	1.11	0.93		0.45	0.26	0.36		0.63	0.36	0.50	

had no cleft coding and on further investigation were determined to have SMCP which was yet to be operated on. We received no data back for nine cases and two NHIs sent were in an invalid format.

Thus the cross validation of data sources has resulted in a total of 1,034 cases (937 confirmed cases from the cleft audit, and 97 additional cases identified from the NMDS (31 cases whom had died without referral to a cleft unit, 63 cases coded as surgical repair but not on audit, and three cases whom were born in the audit period, but not having had primary surgery and therefore not being included in the audit data) of cleft lip and palate over the 10 year period. This resulted in a rate of 1.79/1,000 live births (Table 2). The table also shows that there are distinct differences in the overall rate of OFC by ethnicity with the Māori rate being statistically significantly higher at 2.37/1,000 live births vs 1.65/1,000 live births for Pacific and 1.63/1,000 live births for Non Māori/Non Pacific populations.

This difference in rates of OFC is highlighted by the difference in rates of CP alone (Table 3), the rate in Māori being twice that of the Non Māori/Non Pacific rate (1.54 vs 0.73/1,000 live births) with the Pacific rate intermediate (1.04/1,000 live births). The rates of CL with or without CP were 0.83, 0.61, and 0.90/1,000 live births for Māori, Pacific and Non Māori/ Non Pacific respectively. Of note is that the Pacific rate of CL alone was 0.18 compared to 0.31 and 0.40 for Māori and Non Māori/ Non Pacific respectively. Rates of CLP were 0.43 for Māori while Pacific and Non Māori/Non Pacific rates were 0.52 and 0.50 respectively. The relatively small numbers of cases in these ethnic-specific groups meant a lack of power to detect statistically significant differences.

A further issue is that there are differences in risk associated with sex within ethnic groups (table 4). For CP alone there is a similarly and statistically increased risk in both male (OR=2.12) and female (OR=2.11) for Māori compared to Non Māori/Non Pacific. The risks for Pacific male (OR=1.39) and female (1.45) are intermediate with the male:female ratio preserved.

Table 4: Odds ratios associated with Male vs Female and Ethnic group by cleft type.

	Cleft Palate Male	**Female**	**Cleft Lip Male**	**Female**	**Cleft Lip and Palate Male**	**Female**
Māori	2.12 (1.60, 2.81)	2.11 (1.66, 2.69)	0.61 (0.38, 0.98)	1.15 (0.67, 1.97)	0.70 (0.48, 1.04)	1.83 (1.19, 2.82)
Pacific	1.39 (0.91, 2.12)	1.45 (1.01, 2.06)	0.49 (0.24, 1.01)	0.38 (0.12, 1.23)	0.60 (0.34, 1.05)	1.49 (0.81, 2.72)
Euro/Other	Ref	Ref	Ref	Ref	Ref	Ref
Male vs Female	0.69 (0.59, 0.82)	Ref	1.77 (1.33, 2.36)	Ref	1.73 (1.36, 2.21)	Ref
Ethnicity*Sex interaction	P=0.99		P=0.19		P=0.0017	

For CL alone, the risk for males is significantly lower in Māori males compared to the Non Māori/Non Pacific group but no difference is seen in females. For Pacific, the differences in sex are similar but do not reach statistical significance, however, the numbers in these groups are relatively small.

Of particular note are the differences associated with CLP. Both Māori and Pacific males show decreased risks of borderline significance compared to Non-Māori/Non Pacific. Female Māori show a significantly increased risk compared to Non Māori/Non Pacific. The risk for Pacific females is elevated but not of statistical significance. An interaction term of ethnicity by sex was statistically significant (p=0.0017). Calculating the ethnic specific risks of male vs female for CLP gives odds ratios of (Māori 0.91 95% CI=0.56, 1.50, Pacific 0.95 95%CI=0.44, 2.05, and Non Māori/Non Pacific of 2.38 95% CI=1.75, 3.23).

Discussion

This is the first nationwide study of the incidence of OFC in New Zealand. It provides data over a 10-year period, showing a national incidence of 1.79/1,000 live births (1 in 559) that is relatively high in terms of the quoted international incidence. The overall rate is statistically significantly higher in Māori compared to Non Māori: 2.37/1,000 (1 in 422) vs 1.63/1,000 (1 in 612), however even the non-Māori rate is high in terms of international comparisons.

This study also provides the first information on the rates of cleft lip and palate amongst the Pacific population. Whilst the population is somewhat smaller and the yearly estimates of incidence vary, the overall incidence of OFC over the 10-year period is almost identical to that of the Non Māori/Non Pacific group.

The increased rate amongst Māori is almost exclusively due to the increased rate of cleft palate alone in this population. The increased rate has been suggested in earlier audits carried out over 30 years ago.[2–4] This nationwide study clarifies these findings. The rate of cleft palate alone is in fact twice that of Non Māori/Non Pacific, with Pacific falling midway between the two. This difference in rate suggests a genetic component is involved either directly or perhaps through interactions with environmental factors. There have been a number of genes related to cleft lip and palate however, to date, these genes account only for a small proportion of cases, mostly related to syndromic related clefts. Whilst the rate of CP alone is higher in Māori and Pacific populations, the internationally recognised predominance of female CP is preserved across ethnicities.

Contrary to earlier reports, there are cases of cleft lip alone in Māori, though the rate is lower in Māori males compared to that of the Non Māori/Non Pacific population, but not different for Māori females. The rate for the Pacific population is half of that for the Non Māori/Non Pacific group; the risk is decreased for both males and females, however small numbers mean a lack of power to show statistically significant effects. The predominant male effect is evident in the Non Māori groups, while not statistically significantly different, the rates are similar for Māori male and female and appears to be due to a decreased rate in Māori male. It has been proposed that the audit be repeated in five-year cycles and, with increased data over time, the sex and ethnic patterns in CL will become clearer.

The most notable sex effect is that for CLP where the expected male predominance exists for the Non Māori/Non Pacific population but there is no sex differential in rates for Māori or Pacific. We do not know of any other population in the world where this male predominance does not exist for CLP. The data suggest that this is a combination of a slightly lower rate of CLP in Māori and Pacific males than expected and a slightly higher than expected rate amongst females.

Data for live births are only published for Māori, Pacific and other ethnic populations, thus we were not directly able to assess the impact of the growing Asian population. The overall rate of OFC has not increased over time, thus suggesting that over the period 2000–2009 there has been little impact from the increasing Asian birth rate.

Data provided to the international clearinghouse for birth defects that uses information from the NMDS excludes cases that are also coded as being part of a syndrome. The published rates equate to 547 cases of cleft palate alone compared to

540 from this study. The difference is greater in the cases of cleft lip with or without cleft palate where the reported numbers to the international clearing house are 359 compared to 494 in this study. The reasons for these discrepancies are not entirely clear; though the clearing house data exclude those with a syndrome, it would normally be expected that many of these would likely have only palate involvement. Our data do not currently allow reliable identification of those who have a cleft as part of a syndrome, and this should be a goal for the future. Non syndromic OFC rates do, however, pose some difficulties, as some cases may not be identified and confirmed as syndromic until later in childhood.

The study also raises an issue about how clinical coding is carried out. In the New Zealand setting, ICD coding is carried out at hospital level by non-clinically trained coders. In this instance, the data would suggest significant over-coding of OFC, due to lack of depth of knowledge and/or misinterpretation of clinical notes. We do not believe there is likely to be an issue of undercoding. Cases were identified by the audit and missed on the initial NMDS download, mainly due to a discrepancy in ICD9 and ICD10 codings at Ministry of Health level. All primary repair in NZ is carried out in the public health system and if any cases were operated on in the private system, they would still require referral back to the cleft units for provision of other services such as orthodontic and speech language therapy, so would be expected to be known by one of the units.

Furthermore,there are more general implications of the coding of clinical data. This study has shown substantial differences in the numbers of cases coded for what should be a relatively clearcut diagnosis. Thus, the implications for reported rates of other common diseases with less categorical diagnoses could be significant.

In conclusion, this study has clarified the incidence of orofacial clefts in New Zealand and confirmed a high rate of CP alone in the Māori population and unexpected male:female ratios of CLP for Māori and Pacific populations. This dataset is providing a base for ongoing studies on the epidemiology, genetics, quality of life, burden of care and treatment outcome studies.

Competing interests:
Nil.

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