High Grade Squamous Intra-epithelial Lesions (HSIL) in New Zealand

National Cervical Screening Programme

National Screening Unit
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Two reports on the epidemiology of high grade squamous epithelial lesions in New Zealand were written by Sue Paul and Dr Martin Tobias from the Public Health Intelligence Unit of the Ministry of Health, for the National Cervical Screening Programme (NCSP). The two reports were collated as one report by Dr Hazel Lewis, Clinical Leader, NCSP.

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Executive Summary

A key objective of the National Cervical Screening Programme (NCSP) is to reduce the incidence of cervical cancer by detecting precancerous high grade squamous intra-epithelial lesions (HSIL). Monitoring trends in HSIL detection is critical to understanding the epidemiology of cervical cancer in New Zealand and to evaluating the performance of the NCSP.

This report summarises the epidemiology of HSIL over approximately the first decade of the programme.

The incidence of HSIL increased by approximately 40 percent from 1993 to 2003, mirroring the corresponding decrease in invasive cervical cancer incidence. The sharpest increases in HSIL incidence occurred in the early 1990s (just after the NCSP started) and then again between 1999 and 2000 - around the time of the Ministerial Inquiry into the Under-reporting of Cervical Smear Abnormalities in the Gisborne Region (Cervical Screening Inquiry, 2001, Wellington). Most of the increase can be attributed to younger age groups.

Females in their early to late 20s have the highest risk of HSIL and the risk decreases exponentially with age. This pattern is consistent with the Australian findings, although HSIL incidence is higher among New Zealand than Australian women: a particularly surprising finding since Australia uses a broader definition in diagnosing abnormalities as high-grade.

Incidence of HSIL increased steadily with level of deprivation, with women in NZDep quintile 5 having the highest incidence, and women in NZDep quintile 1 the lowest.

Regionally, Tairawhiti and Taranaki had the highest HSIL incidence and Auckland and Wellington had the lowest incidence in recent years. Tairawhiti also had the highest relative increase in HSIL incidence between 1994–1998 and 1999–2003 (consistent with the timing of the Gisborne Inquiry). Regional differences probably reflect a mix of differences in risk (true underlying incidence rate of HSIL in the population) and differences in provider behaviour.

Over time, the trend in crude (and age-standardised) HSIL incidence has been similar for Māori and non-Māori women – the sharpest increases in incidence were observed in the first two years of the programme and then again between 1999 and 2000. Incidence has declined slightly for both Māori and non-Māori since 2000. Māori women, have consistently had higher incidence over the last decades, with no indication of the gap closing.

Age specific trends for Māori and non-Māori women vary considerably – as shown by the significant age by ethnic interaction effects in the regression results. Among non-Māori women, incidence peaks in the younger age groups (20–29) and declines steeply thereafter. Young Māori women (20–29) are at a higher risk than older Māori women, but there is no significant difference between the age groups among Māori women thereafter – although the overall trend is still downward. That is, the decline in risk of HSIL with age is much less steep for Māori than for non-Māori women (at least from age 30 onwards), so while Māori women are at higher risk of HSIL than non-Māori women at all ages (average rate ratio 1.6), the relative risk varies from 1.05 at age 25–29 to 2.43 at age 50 or more. Interestingly, there are no significant ethnic by region interactions – that is, regional variation in HSIL incidence rates – and trends in regional variation – are not significantly different for Māori compared to non-Māori women.

1 Introduction

The key objective of the National Cervical Screening Programme (NCSP) is to reduce the incidence and mortality of cervical cancer by detecting precancerous lesions. Since many precancerous lesions regress, or progress only slowly, effectiveness and efficiency of the NCSP may be enhanced by detecting these lesions as *late* as possible. Operationally this translates to detection of *high* grade squamous intraepithelial lesions (HSIL) in preference to *low* grade lesions (LSIL).

The natural history of cervical (pre)cancer implies that HSIL detection rates should approximately mirror invasive cervical cancer rates. So as NCSP coverage increases and programme quality improves, HSIL detection rates should *increase* and invasive cancer rates correspondingly *decrease*. It is therefore of interest to the NCSP to monitor trends in HSIL in New Zealand as this indicator can be used as a measure of programme performance.

In 2005 the National Screening Unit commissioned two reports from the Public Health Intelligence Unit, Ministry of Health, on the epidemiology of high grade squamous intraepithelial lesions. The first report described HSIL trends for the total population while the second report described ethnic (Māori–non-Māori) variation in these trends. These two reports have now been summarised and compiled into a single report for wider dissemination.

It is important to note that the data relate to a subset of the population at risk who participate in screening, and are based on rates of histologically verified HSIL among (unique) women screened.

2 Data Sources and Methods

Data sources

High-grade intra-epithelial lesion (HSIL) registrations and smear data were extracted from the National Cervical Screening Programme Register (NCSP-R). Data were available from 1993 to 2004. (Prior to 1993 records are incomplete.)

For the purposes of this study, a high-grade lesion is defined as a histological result of CIN 2 or CIN 3. That is, we include only histologically verified cases.

We use the term 'smears' to mean 'unique women' screened. Any woman who is screened multiple times within a year is only counted once to ensure that the incidence rate denominator captures person years rather than number of screens.

The analysis is restricted to women aged between 20 and 69 years old, as this is the age range covered by the National Cervical Screening Programme (NCSP).

Methods

Incidence

HSIL incidence is calculated using the number of histologically verified unique CIN 2, CIN 2/3 and CIN 3 biopsies as the numerator, and the number of unique women screened (unique smears) as the denominator. Hence any incidence figures reported in this report do not necessarily reflect incidence of HSIL in the population, so much as the rate of detection of HSIL by the Programme.

Firstly, we present a summary of the number of unique women screened per year to provide an indication of the trend in coverage over the period for which we have complete data (1993 to 2003 or 2004, depending on the analysis). The crude and age standardised HSIL incidence rates by single calendar year are then presented followed by the age specific rates.

Secondly, a more detailed analysis is provided by four variables believed to be important in determining HSIL rates: age, class (indexed by deprivation of small area of residence), region and Māori–non-Māori ethnicity. (Other ethnic groups could not be included as numbers were too small for stable rate estimates.)

WHO population weights are used to derive age standardised incidence.

Confidence intervals – incidence rates

Confidence intervals around incidence rates are calculated using exact Poisson confidence intervals (Ulm 1990) where the number of HSIL cases is less than 300. A normal approximation to the Poisson distribution is used where the number of cases exceeds 300. In practice, this means that exact confidence intervals will be used for subgroups within the population with low numbers of HSIL cases (eg, older women and some Māori age groups). The normal approximation is used for groups with large numbers of HSIL cases (eg, younger women – or where a confidence interval is being calculated across all age groups and regions).

Confidence intervals – rate ratios

Standard errors around rate ratios are calculated via logistic regression models. Aggregated numbers of HSIL cases are first converted into synthetic unit record data. The detection of an HSIL case is modelled as a binary response variable, with the explanatory variable of interest treated as a factor. For example, if we were interested in comparing Māori incidence to non-Māori incidence then (only) ethnicity would be included in the logistic regression model as a predictor. The odds ratios from the regression model are converted to relative risks by applying Zhang's method (Zhang 1998).

Regression analysis

Poisson regression models are used to compare HSIL incidence across age groups, regions and ethnic groups. The number of smears is used as a population offset so that the regression outputs rates, rather than the number of cases. The independent effect of each of the four variables, and all interactions between them, can be estimated. Here we present only key findings as they relate to ethnic differences. For more details about the regression modelling, see (Paul and Tobias 2005).

3 Results

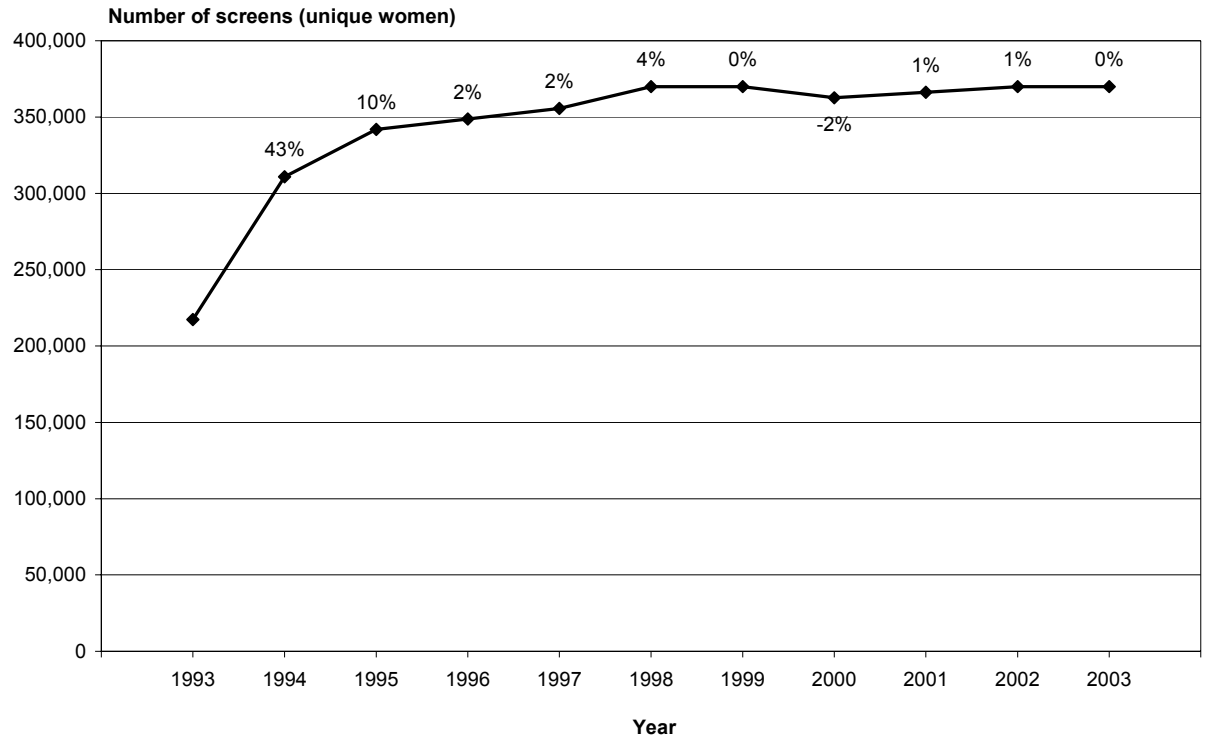
Coverage

Figure 1 below summarises the number of (unique) women screened by year over the last decade. The percentage change in the number of women screened (relative to the preceding year) is provided above each datapoint. Note that this does not correspond to three-year or five-year coverage as defined by the NCSP.

The sharpest increase in the number of women screened is seen between 1993 and 1994. The screening programme started around 1991, and relative to coverage in the 1980s, the largest increases would have been seen in the early years (1991–94), when the programme was gathering momentum. Numbers of unique women screened per year then continued to increase more slowly until 1998, before levelling off at around 370,000 smears per year.

HSIL detection rates in 1993 and 1994 most probably represent a mix of prevalence and incidence screening, with later years more closely representing 'pure' incidence screening.

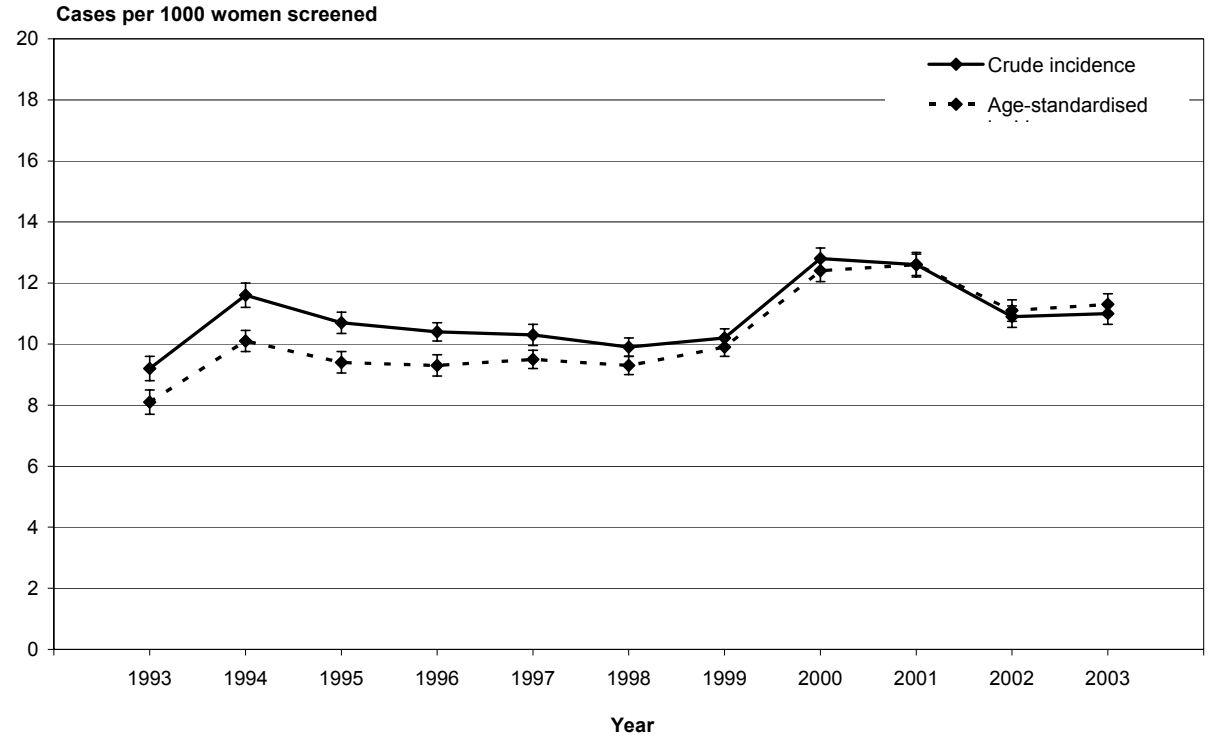
Figure 1: Cervical smears (unique women screened), 1993–2003



Trends in HSIL detection – all ages

Crude and age-standardised HSIL incidence rates are shown in Figure 2 and summarised in Table 1.

Figure 2: HSIL incidence, 1993–2003



As was the case with the number of smears, a sharp increase in incidence is seen between 1993 and 1994. This is followed by a slight decline until 1999, when incidence increases sharply again (perhaps in response to the Gisborne Inquiry). As of 2001, incidence starts declining again, before levelling off at approximately 11 per 1000 women in 2002/2003. The pattern is much the same whether rates are standardised for age or not.

Over the observation period as a whole, a significant if not smooth increase in the age standardised HSIL incidence rate is seen: the rate increases from 8.1 per 1000 in 1993 to 11.3 per 1000 in 2003, a 40% increase over the 11-year period. As expected, this roughly mirrors the corresponding decrease in invasive cancer incidence.

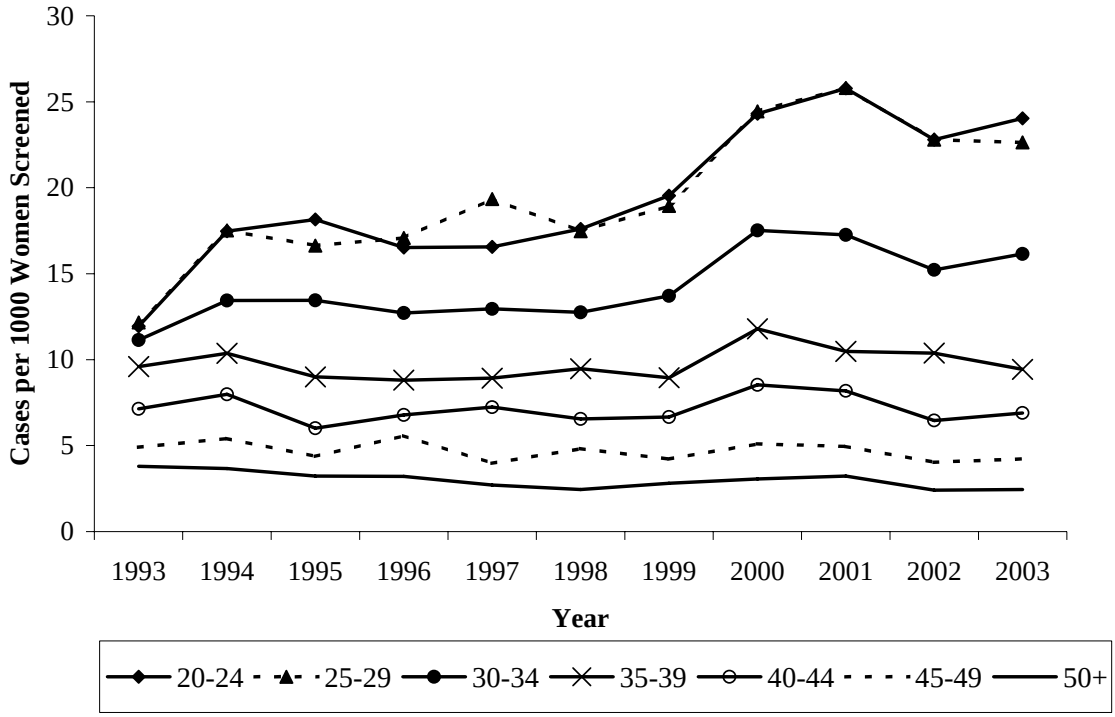
Table 1: Crude and age-standardised incidence, 1993–2003

Year	Crude rate	Age-standardised rate
1993	9.2 (8.8, 9.6)	8.1 (7.7, 8.5)
1994	11.6 (11.2, 12.0)	10.1 (9.7, 10.4)
1995	10.7 (10.3, 11.0)	9.4 (9.1, 9.8)
1996	10.4 (10.1, 10.7)	9.3 (9.0, 9.7)
1997	10.3 (10.0, 10.7)	9.5 (9.2, 9.8)
1998	9.9 (9.6, 10.2)	9.3 (9.0, 9.6)
1999	10.2 (9.9, 10.5)	9.9 (9.6, 10.2)
2000	12.8 (12.4, 13.1)	12.4 (12.1, 12.8)
2001	12.6 (12.3, 13.0)	12.6 (12.3, 13.0)
2002	10.9 (10.6, 11.3)	11.1 (10.7, 11.4)
2003	11.0 (10.6, 11.3)	11.3 (10.9, 11.6)

Age-specific trends in HSIL incidence

The graph below summarises trends in HSIL incidence over the last decade by age group. Rates for age groups older than 50 years are very similar, so these age groups have been aggregated to make the graph more readable.

Figure 3: Age-specific trends in HSIL incidence, 1993–2003



The highest incidence is observed in the 20–29 year old age group, which is consistent with Australian results (*Cervical Screening in Australia 2001–2002*, AIHW), but not with results reported for England (Sasieni PD) where a slightly different definition of high-grade lesions is employed.[1]

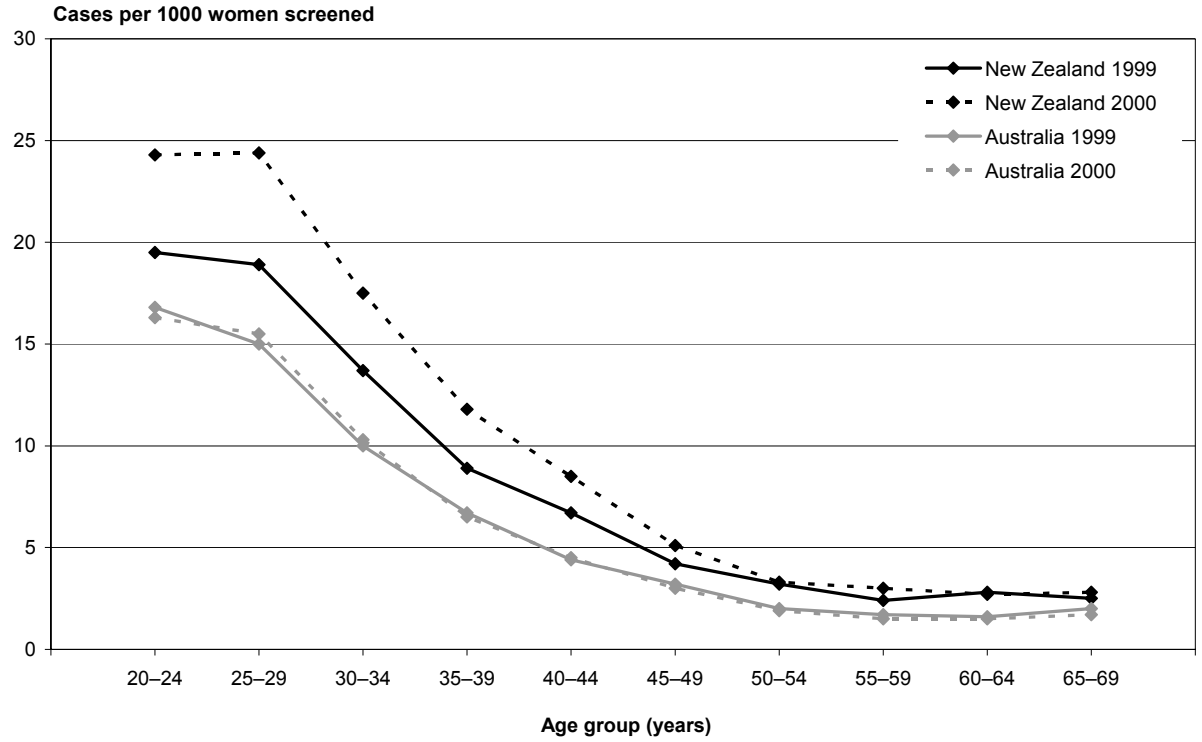
The trend in most age groups (at least for 20–44-year-olds) mimics the crude (or age-standardised) incidence trend with the largest relative increases observed between 1993 and 1994 and also between 1999 and 2000. The trend is relatively flat for middle aged and older women, with most of the rise in incidence over the study period being accounted for by younger women.

[1] The incidence of CIN 3 (the definition used in the UK report) typically peaks in the mid-30s.

Age and HSIL incidence

New Zealand and Australian incidence (in 1999 and 2000) is illustrated below as a function of age.[2]

Figure 4: Age-specific HSIL incidence in Australia and New Zealand, 1999–2000



Australian and New Zealand incidence both show the same trend with age: peaking in the early to late 20s and then exponentially decreasing with age.

However, the actual incidence rates are quite different. While the large gap between the 1999 and 2000 New Zealand incidence figures can be attributed to increased coverage after the Gisborne Inquiry, there is still a large difference between the Australian and New Zealand incidence. This is particularly surprising, as AIHW uses a larger numerator (CIN 1/2, CIN 2 and CIN 3) compared to New Zealand (CIN 2, CIN 2/3 and CIN 3).

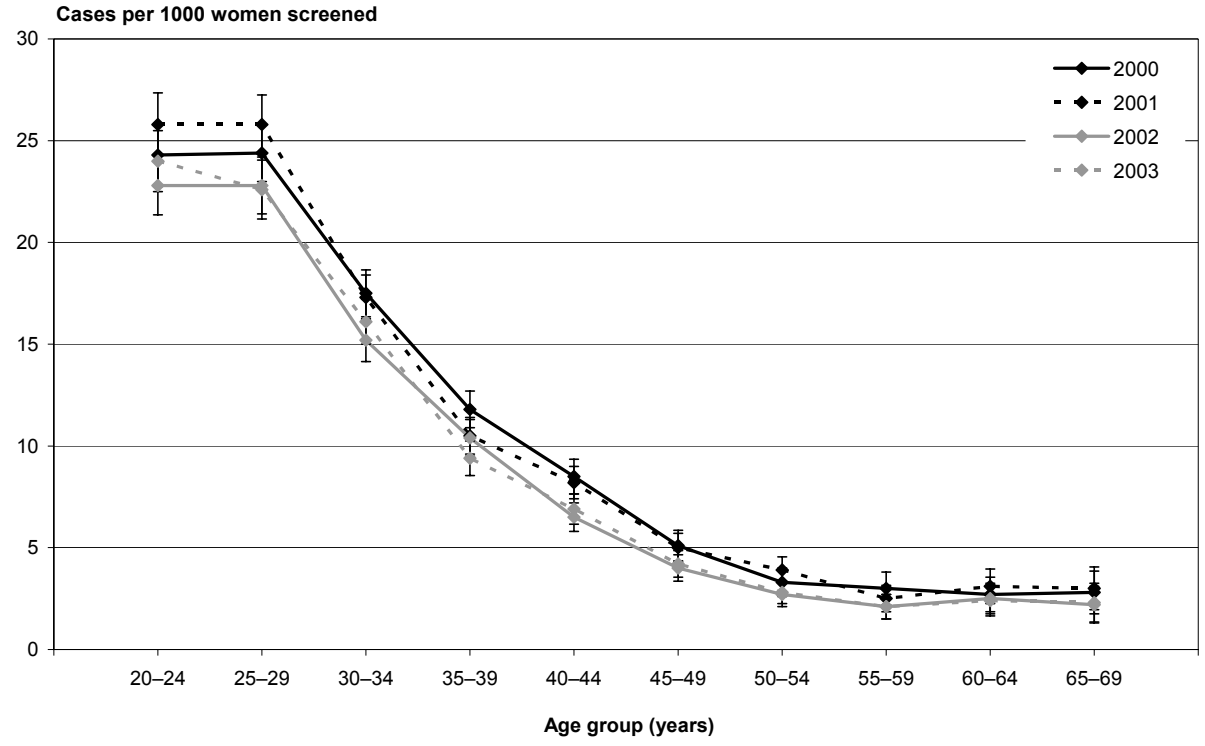
A more detailed description of the current age structure of HSIL incidence in New Zealand is summarised in Figure 5 and Table 2.

[2] AIHW uses a wider definition of high-grade abnormalities than New Zealand.

Table 2: Age-specific HSIL incidence, 2000–2003

	2000	2001	2002	2003
20–24	24.3 (22.8, 25.9)	25.8 (24.3, 27.4)	22.8 (21.4, 24.3)	24.0 (22.6, 25.6)
25–29	24.4 (23.1, 25.9)	25.8 (24.4, 27.3)	22.8 (21.4, 24.2)	22.6 (21.2, 24.1)
30–34	17.5 (16.4, 18.7)	17.3 (16.2, 18.4)	15.2 (14.2, 16.3)	16.1 (15.1, 17.3)
35–39	11.8 (10.9, 12.7)	10.5 (9.6, 11.4)	10.4 (9.5, 11.3)	9.4 (8.6, 10.3)
40–44	8.5 (7.7, 9.4)	8.2 (7.4, 9.0)	6.5 (5.8, 7.2)	6.9 (6.2, 7.7)
45–49	5.1 (4.4, 5.9)	5.0 (4.3, 5.7)	4.0 (3.4, 4.7)	4.2 (3.6, 4.9)
50–54	3.3 (2.7, 4.1)	3.9 (3.3, 4.6)	2.7 (2.1, 3.3)	2.8 (2.3, 3.4)
55–59	3.0 (2.3, 3.9)	2.5 (1.9, 3.2)	2.1 (1.6, 2.8)	2.1 (1.5, 2.7)
60–64	2.7 (2.0, 3.7)	3.1 (2.3, 4)	2.5 (1.8, 3.3)	2.4 (1.7, 3.2)
65–69	2.8 (1.9, 4.0)	3.0 (2.1, 4.2)	2.2 (1.4, 3.2)	2.3 (1.5, 3.4)

Figure 5: Age-specific HSIL incidence, 2000–2003



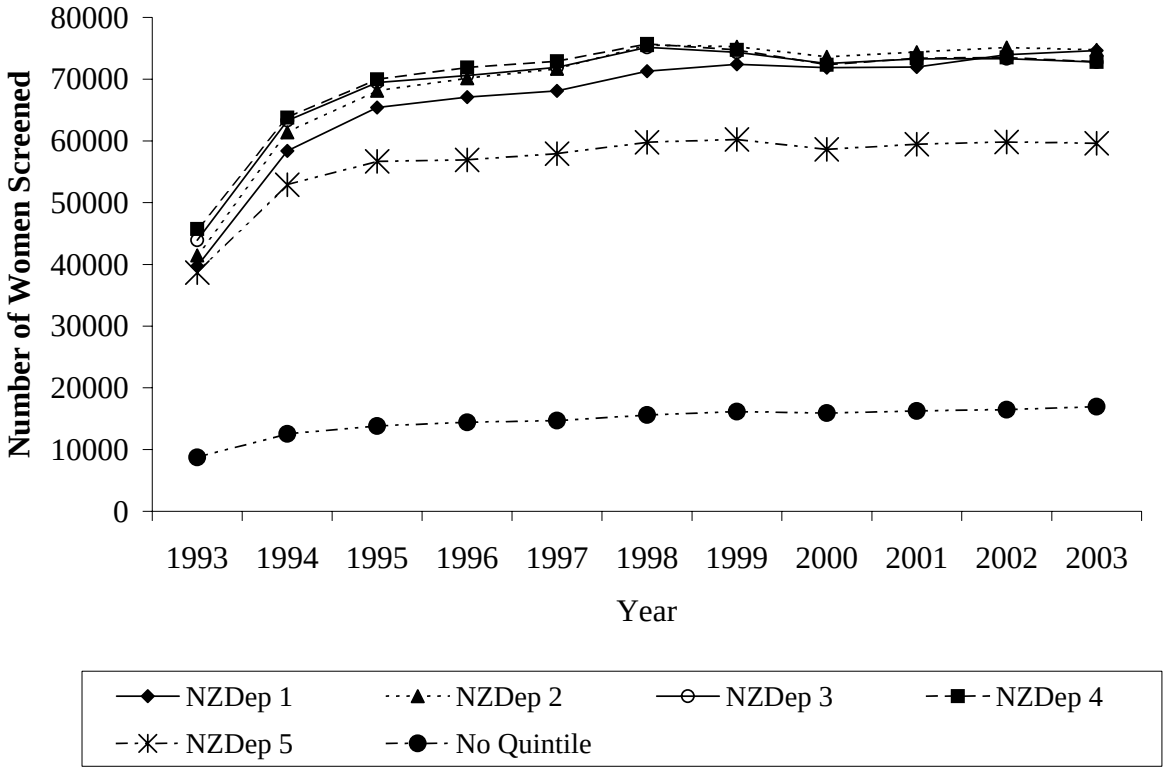
Trends by deprivation

Deprivation is measured here by the NZDep2001 index (Crampton et al 2004), with scores aggregated into quintiles (quintile 1 is the least deprived 20 percent of small areas in the country and quintile 5 is the most deprived). Note that it was not possible to allocate NZDep scores in all cases, as some women lived in isolated areas where the NZDep scores were not calculable; these women are grouped under the 'no quintile' heading.

Coverage

Number of unique smears by deprivation quintile by calendar year is shown in Figure 6.

Figure 6: Number of women screened by NZDep quintile, 1993–2003



While the above data are not standardised by the population in the various quintiles and hence do not provide an accurate measure of coverage, some interesting features emerge. First, the women in the 'no quintile' group appear to have the lowest number of smears. This makes sense, in that these women usually live in remote areas with limited access to screening.

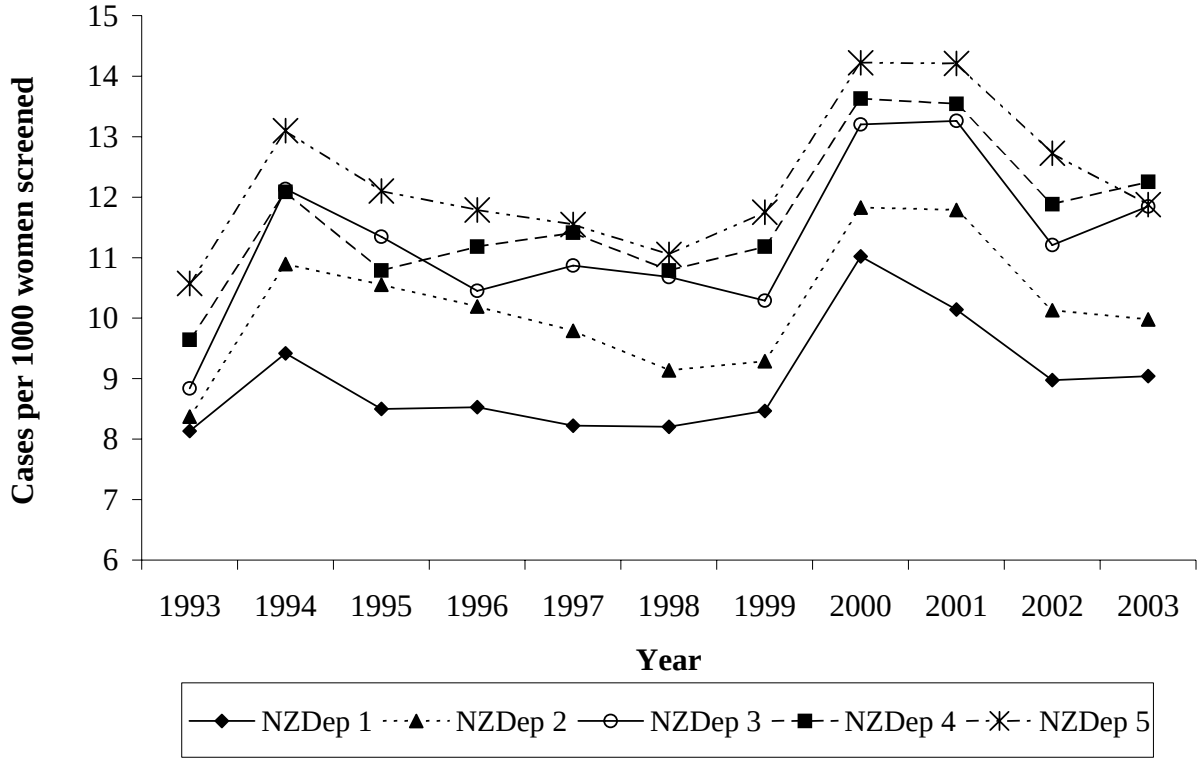
Second, as of the late 1990s quintiles 1 to 4 have a very similar number of women being screened. The number of women screened in the fifth quintile, however, is much less than the top four quintiles, suggesting a relationship between coverage and deprivation – but more of a step change affecting only the most disadvantaged areas rather than a smooth gradient across the whole socioeconomic distribution.

Overall, though, the trend with time is similar for all levels of deprivation. As noted previously, the sharpest increase is observed between 1993 and 1994, and the number of women screened levels off thereafter.

HSIL incidence

The incidence of HSIL by level of deprivation over the last decade is illustrated in Figure 7. The women in the No Quintile category have been omitted to make the graph less unwieldy. The number of women in this category was relatively low, and no interesting features were noted in incidence trend for this particular group.

Figure 7: HSIL incidence by NZDep 2001 quintile, 1993–2003



The incidence curves for the various NZDep quintiles are almost parallel to one another, particularly in the late 1990s. This parallel trend indicates an almost linear slope with level of deprivation: the highest HSIL incidence is observed in the most deprived quintile, and the lowest incidence in the least deprived.

To better illustrate the relationship of incidence and deprivation, HSIL incidence by NZDep quintile is summarised for recent years (2000-2003) in Figure 8 and Table 3. Figure 8 clearly shows the positive linear relationship between level of deprivation and HSIL incidence. In other words, women in the most deprived quintile are at a higher risk of being diagnosed with HSIL than their less deprived counterparts (on average over the last four years, approximately 33% higher risk).

Figure 8: HSIL incidence by level of deprivation, 2000–2003

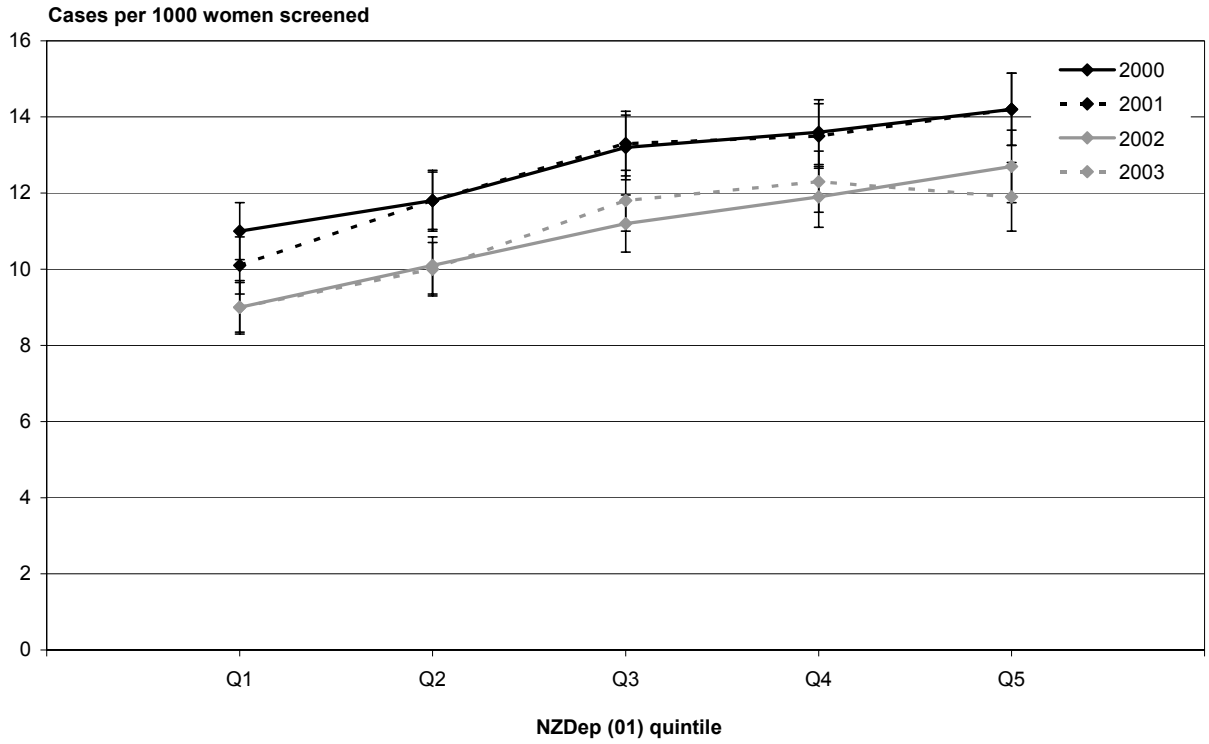


Table 3: HSIL incidence by NZDep (01) quintile

	2000	2001	2002	2003
Quintile 1	11.0 (10.3, 11.8)	10.1 (9.4, 10.9)	9.0 (8.3, 9.7)	9.0 (8.4, 9.7)
Quintile 2	11.8 (11.1, 12.6)	11.8 (11, 12.6)	10.1 (9.4, 10.9)	10.0 (9.3, 10.7)
Quintile 3	13.2 (12.4, 14.1)	13.3 (12.4, 14.1)	11.2 (10.5, 12)	11.8 (11.1, 12.7)
Quintile 4	13.6 (12.8, 14.5)	13.5 (12.7, 14.4)	11.9 (11.1, 12.7)	12.3 (11.5, 13.1)
Quintile 5	14.2 (13.3, 15.2)	14.2 (13.3, 15.2)	12.7 (11.8, 13.7)	11.9 (11, 12.8)
No quintile	13.5 (11.8, 15.5)	10.9 (10.6, 11.3)	10.9 (9.3, 12.6)	11.5 (10, 13.2)
Total (New Zealand)	12.8 (12.4, 13.1)	12.6 (12.3, 13)	14.3 (12.6, 16.3)	11.0 (10.6, 11.3)

Regional trends

Within the NCSR database, data are mapped to 13 'regions' within New Zealand Table 4). These regions do not correspond exactly with laboratory or colposcopy providers, so regional variation in underlying HSIL incidence cannot be teased apart from regional variation in provider behaviour. Nevertheless, regional analysis can still provide useful insights.

Table 4: Regional codes

Code	Region
AK	Auckland
BP	Bay of Plenty / Taupo
CT	Canterbury
HB	Hawkes Bay
MW	Manawatu / Wanganui
NL	Northland
NM	Nelson / Marlborough
OS	Otago / Southland
TI	Tairawhiti
TK	Taranaki
WC	West Coast
WK	Waikato
WN	Wellington

To provide reasonably tight confidence bounds, calendar years were aggregated into two five-year periods: 1994–1998 and 1999–2003.

HSIL incidence (age standardised) by region is summarised in Figure 9 and Table 5.

The regions that saw the largest relative increases in HSIL incidence were Tairawhiti and Nelson-Marlborough (over 40 percent). The increase in the former region is expected given the Gisborne Inquiry in 1998. In fact, incidence in Tairawhiti increased by 100 percent between 1999 and 2000.

In the most recent time period, Taranaki and Tairawhiti had the highest HSIL incidence in the country, and Wellington and Auckland the lowest (Table 5 and Figure 10). The difference between the highest and the lowest regions is almost exactly two-fold (100 percent). Inspection of Figure 10 shows that Hawkes Bay, Otago/Southland, Northland and Nelson/Marlborough are also significantly above the national average.

Figure 9: Age-standardised HSIL incidence by region, 1993–2003

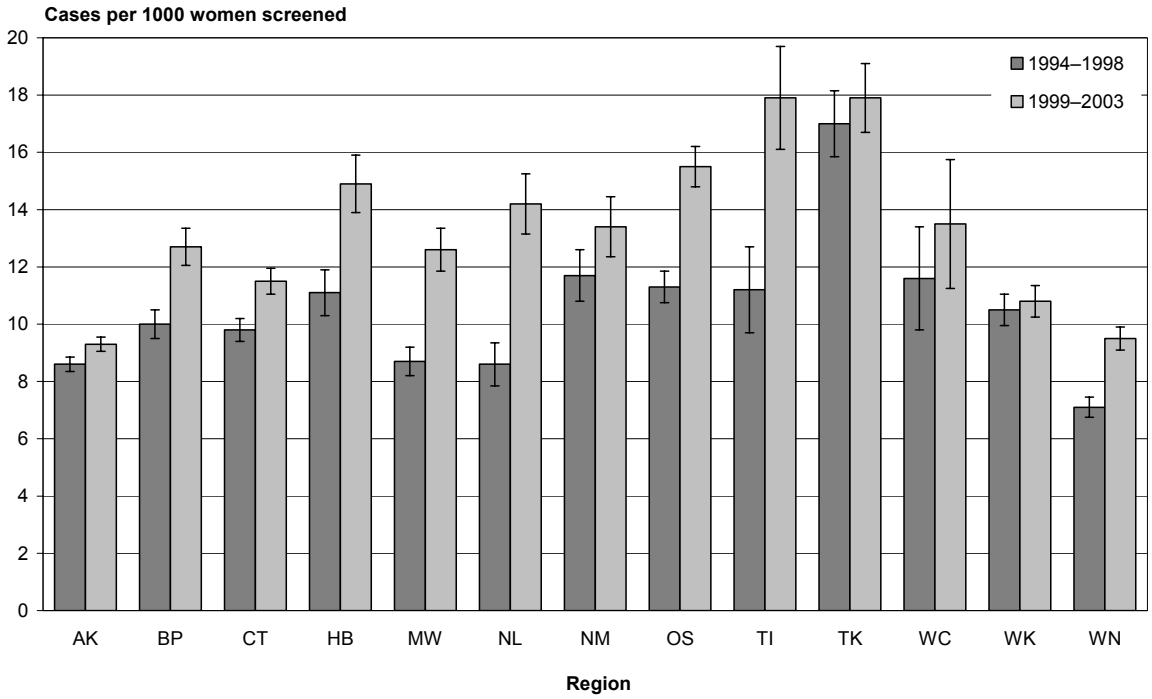
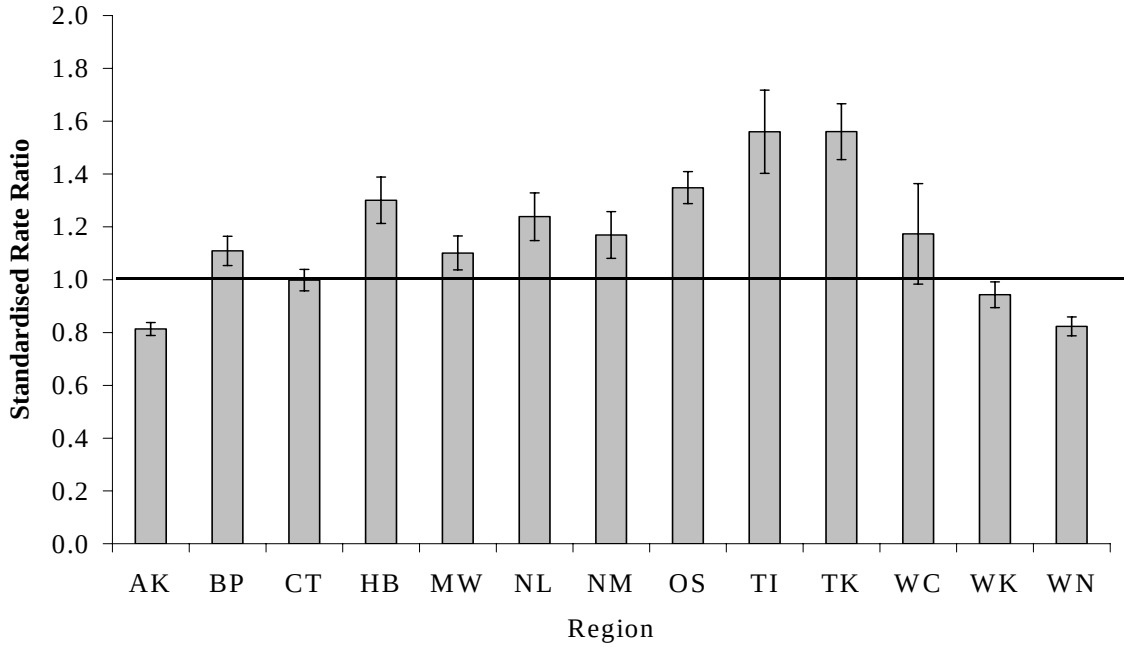


Table 5: Age-standardised HSIL incidence by region, 1993–2003

Region	1994–1998	1999–2003	Relative change
AK	8.6 (8.4, 8.9)	9.3 (9.1, 9.6)	8.34%
BP	10 (9.5, 10.5)	12.7 (12.1, 13.4)	27.54%
CT	9.8 (9.4, 10.2)	11.5 (11, 11.9)	17.44%
HB	11.1 (10.3, 11.9)	14.9 (14, 16)	34.82%
MW	8.7 (8.2, 9.2)	12.6 (11.9, 13.4)	45.56%
NL	8.6 (7.9, 9.4)	14.2 (13.2, 15.3)	64.93%
NM	11.7 (10.9, 12.7)	13.4 (12.4, 14.5)	14.41%
OS	11.3 (10.8, 11.9)	15.5 (14.8, 16.2)	37.10%
TI	11.2 (9.8, 12.8)	17.9 (16.2, 19.8)	60.14%
TK	17 (15.9, 18.2)	17.9 (16.8, 19.2)	5.22%
WC	11.6 (9.9, 13.5)	13.5 (11.4, 15.9)	16.57%
WK	10.5 (9.9, 11)	10.8 (10.3, 11.4)	3.49%
WN	7.1 (6.7, 7.4)	9.5 (9.1, 9.9)	33.87%

Figure 10: HSIL SIRs, 1999–2003



Note: Regional rates are standardised for age, not ethnicity or deprivation.

Regional variations probably represent a mix of provider variation and true variation in the underlying incidence of HSIL in the regional populations. Standardising Figure 10 for the ethnic and NZDep distributions of the screened population, as well as the age distribution, may help to tease out the relative contribution of these two causes. Alternatively, the issue could be investigated using multiple regression modelling. These approaches are applied in the next section of this report.

Ethnic analysis: Māori and non-Māori trends

Coverage

Figure 11 below summarises the number of (unique) women screened by year over the last decade. Two axes are used to account for the difference in Māori and non-Māori population size.

Figure 12 shows the annual relative change in the number of Māori and non-Māori women screened. For example, in 1995, the number of non-Māori women screened increased by 10 percent relative to 1994.

The trends observed for non-Māori and Māori women are similar. A sharp increase is observed between 1993 and 1994 (as illustrated by the peak in Figure 12). This is likely to be attributable to the programme gathering momentum in the initial years. Between 1999 and 2000 women in both ethnic populations experienced a relative decrease in the number of women screened. As of 2000 the number of women screened has been relatively stable (around 340,000 for non-Māori women and 34,000 for Māori women).

Figure 11: Cervical smears (unique women screened), 1993–2004

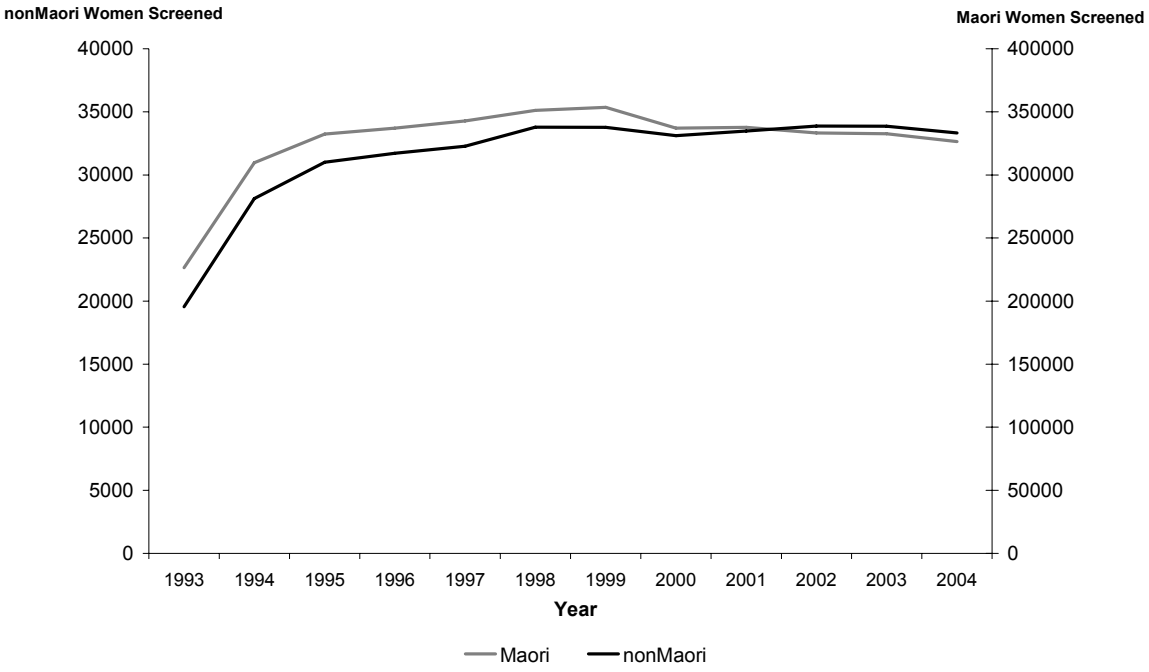


Figure 12: Relative change in women screened, 1992–2004

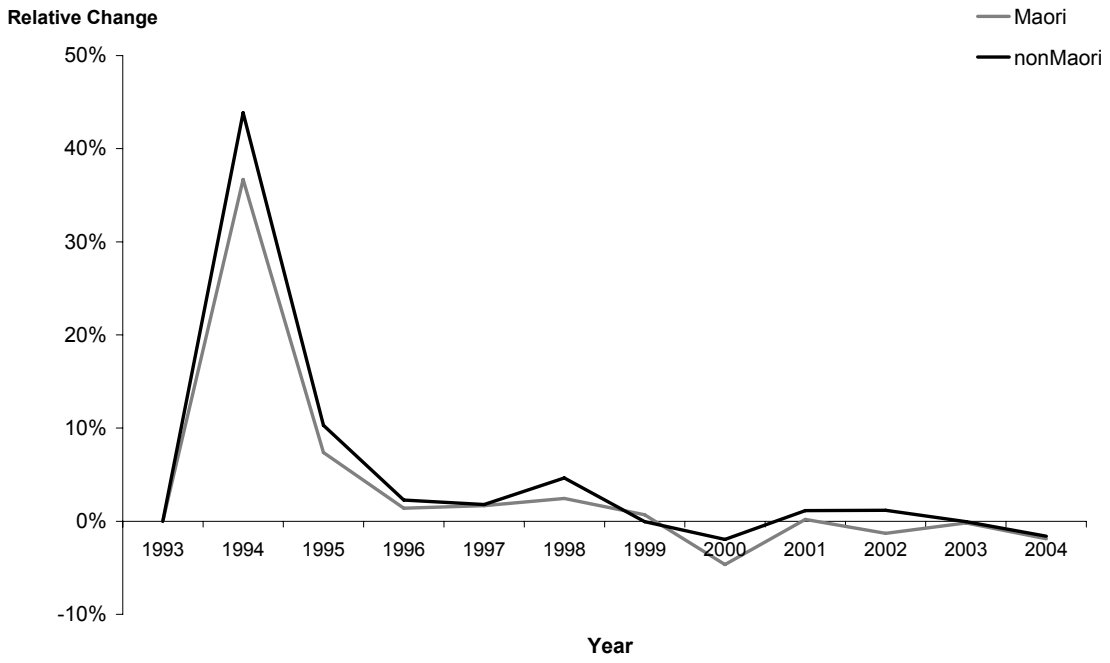


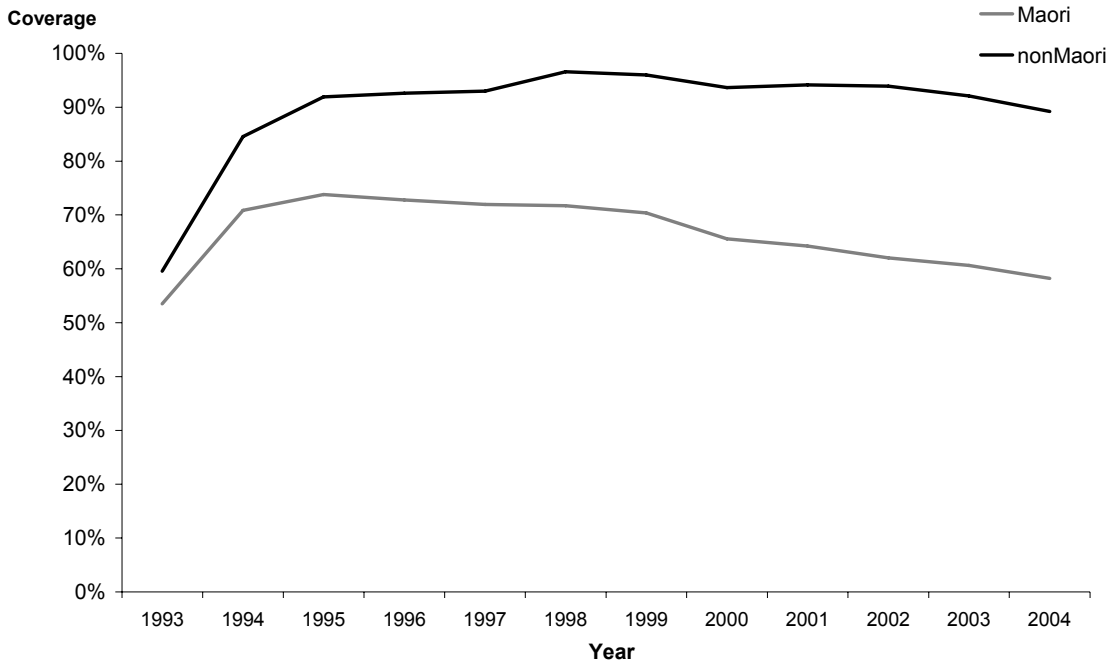
Figure 13 roughly approximates screening coverage of the female population. The proportion of women covered in year t is estimated as follows:

$$\text{Coverage}_t = \frac{3 \times \text{Smears}_t}{\text{Population}_t}$$

The numerator is multiplied by 3 to account for the three-yearly interval recommended between smears. Note, however, that this means that the coverage estimate is an upper bound (and can sometimes exceed 100%). Some women will get screened more frequently than the recommended three year interval – this is particularly true for women who receive abnormal smears in any given year and are required to return for smears more frequently.

The populations used to obtain coverage rates are Statistics New Zealand estimates for the mean year ended 31 December.

Figure 13: Screening coverage, 1993–2004



While the trends in the absolute number of women screened have been similar for Māori and non-Māori women, there appear to be gaps in coverage. Coverage for Māori women has always been lower than non-Māori coverage. The gap in coverage, however, appears to be widening over time.

In interpreting the findings above, it is important to note the caveats around the estimate of coverage rate. First, due to the multiplicative factor of 3 used in coverage estimation, this may slightly overestimate coverage rates. Second, there are caveats around the definition of Māori ethnicity.[3]

[3] Statistics New Zealand Population Estimates, www.stats.govt.nz/tables/maori-popn-est-tables.html.

HSIL trends – all ages pooled

Crude and age standardised incidence is presented in this section. All incidence rates are expressed as cases detected per 1000 women screened.

Figures 14 and 15 summarise crude and age standardised HSIL incidence for Māori and non-Māori women respectively. Table 6 summarises these rates with the 95 percent confidence intervals provided in parentheses.

Figure 16 and Table 7 present the ethnic comparison via rate ratios.

Figure 14: Crude HSIL incidence, 1993–2004

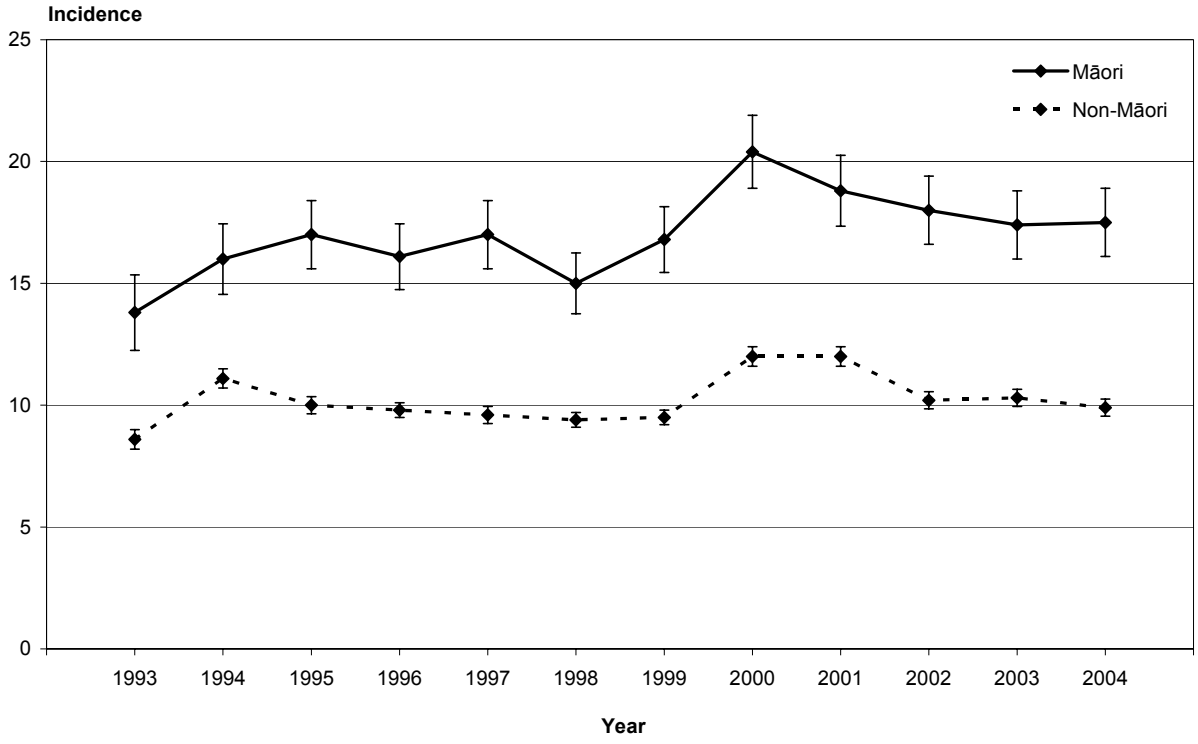


Figure 15: Age-standardised HSIL incidence, 1993–2004

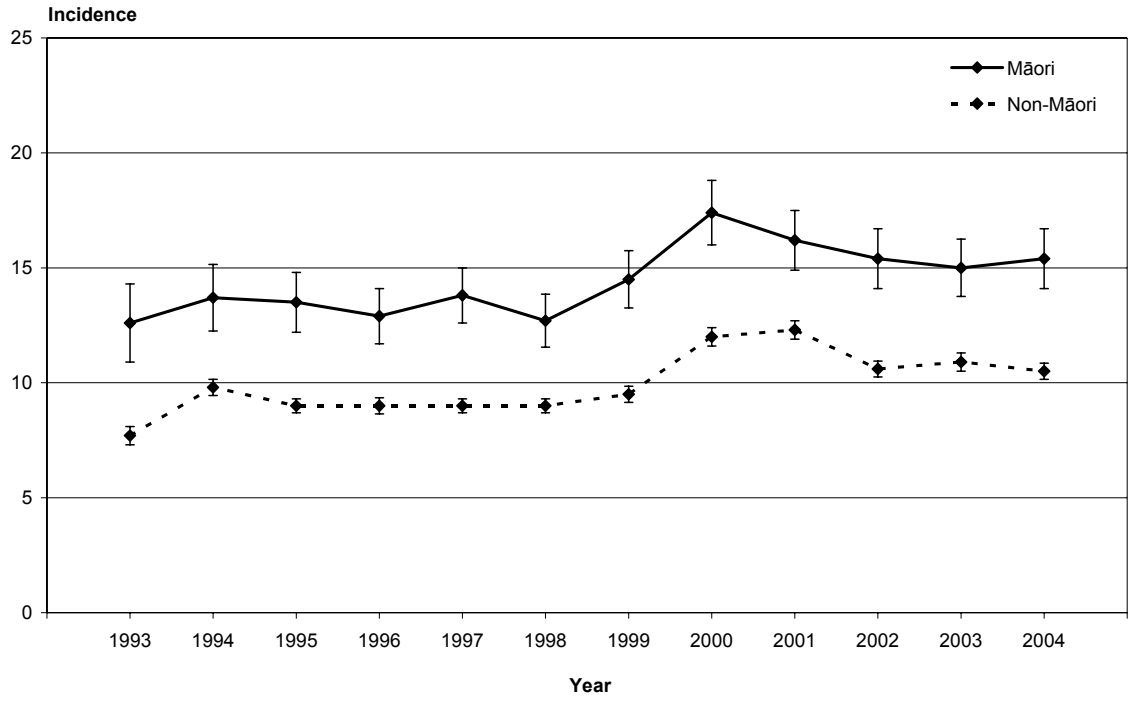


Table 6: Crude and age-standardised HSIL incidence, 1993–2004

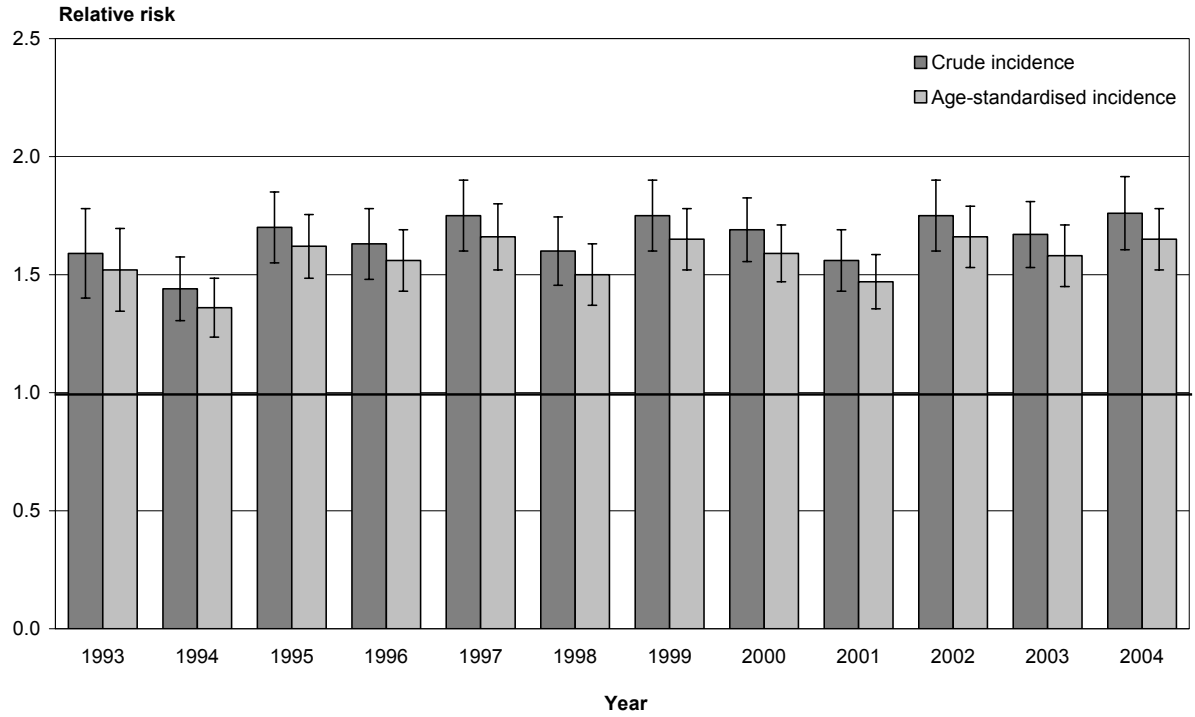
	Crude		Age-standardised	
	Māori	**Non-Māori**	**Māori**	**Non-Māori**
1993	13.8 (12.2, 15.3)	8.6 (8.2, 9.0)	12.6 (10.9, 14.3)	7.7 (7.3, 8.1)
1994	16.0 (14.5, 17.4)	11.1 (10.7, 11.5)	13.7 (12.2, 15.1)	9.8 (9.4, 10.1)
1995	17.0 (15.6, 18.4)	10.0 (9.6, 10.3)	13.5 (12.2, 14.8)	9.0 (8.7, 9.3)
1996	16.1 (14.7, 17.4)	9.8 (9.5, 10.1)	12.9 (11.7, 14.1)	9.0 (8.6, 9.3)
1997	17 (15.6, 18.4)	9.6 (9.3, 10.0)	13.8 (12.6, 15)	9.0 (8.7, 9.3)
1998	15.0 (13.8, 16.3)	9.4 (9.1, 9.7)	12.7 (11.6, 13.9)	9.0 (8.7, 9.3)
1999	16.8 (15.4, 18.1)	9.5 (9.2, 9.8)	14.5 (13.3, 15.8)	9.5 (9.1, 9.8)
2000	20.4 (18.9, 21.9)	12.0 (11.6, 12.4)	17.4 (16, 18.8)	12.0 (11.6, 12.4)
2001	18.8 (17.4, 20.3)	12.0 (11.6, 12.4)	16.2 (14.9, 17.5)	12.3 (11.9, 12.7)
2002	18.0 (16.6, 19.4)	10.2 (9.9, 10.6)	15.4 (14.1, 16.7)	10.6 (10.3, 11)
2003	17.4 (16.0, 18.8)	10.3 (10.0, 10.7)	15.0 (13.7, 16.2)	10.9 (10.5, 11.3)
2004	17.5 (16.1, 18.9)	9.9 (9.5, 10.2)	15.4 (14.1, 16.7)	10.5 (10.2, 10.9)

Māori incidence has been consistently higher than non-Māori incidence over the last decade. Māori rates appear to fluctuate more than non-Māori rates. The larger variation can be attributed to the relatively smaller numbers of cases detected among Māori women.

The trends for Māori and non-Māori women appear to be more or less parallel – a sharp increase in incidence is observed over the 1993–1994 period (mirroring the increase in smears). Thereafter, HSIL incidence appears relatively stable until 1998, when a further increase is observed – presumably in response to the Gisborne Inquiry. Both Māori and non-Māori have experienced a decrease in HSIL incidence since 2000 – although the decrease among Māori women appears to have occurred more gradually.

Also note that Māori age standardised incidence is consistently lower than its crude counterpart. There is very little difference between crude and age standardised rates for non-Māori women. This is due to the much younger age-structure of the Māori population. Non-Māori women, on the contrary, have a similar age structure to the WHO population – hence the negligible difference between crude and age standardised rates.

Figure 16: Ethnic incidence rate ratios, 1993–2004



Note: Non-Māori is the reference group (ratio denominator).

Table 7: Ethnic incidence rate ratios, 1993–2004

Year	Crude	Age-standardised
1993	1.59 (1.42, 1.80)	1.52 (1.35, 1.7)
1994	1.44 (1.31, 1.58)	1.36 (1.24, 1.49)
1995	1.7 (1.55, 1.85)	1.62 (1.49, 1.76)
1996	1.63 (1.49, 1.79)	1.56 (1.44, 1.7)
1997	1.75 (1.61, 1.91)	1.66 (1.53, 1.81)
1998	1.60 (1.46, 1.75)	1.50 (1.38, 1.64)
1999	1.75 (1.61, 1.91)	1.65 (1.52, 1.78)
2000	1.69 (1.56, 1.83)	1.59 (1.48, 1.72)
2001	1.56 (1.44, 1.7)	1.47 (1.36, 1.59)
2002	1.75 (1.61, 1.91)	1.66 (1.53, 1.79)
2003	1.67 (1.54, 1.82)	1.58 (1.46, 1.72)
2004	1.76 (1.61, 1.92)	1.65 (1.53, 1.79)

Crude and age-standardised ethnic rate ratios are summarised in Figure 16 and Table 7. Non-Māori women are the reference group – from Figure 16 we can see that in 1993, Māori women were roughly 1.6 times more likely to get an HSIL detection than their non-Māori counterparts.

Over the last decade the rate ratios have been consistently higher than 1 – reflecting the greater risk faced by Māori women. The crude and age standardised rate ratios have been relatively stable around 1.5–1.7 – this translates to Māori women being between 50 and 70 percent more likely to be detected with HSIL as the result of a smear.

Age-specific HSIL trends

Age-specific HSIL incidence is presented for Māori and non-Māori women in Figures 17 and 18. Results for ages 50+ are amalgamated as there is not much difference in the observed incidence for this age group.

Figure 17: Age-specific HSIL trends in Māori women

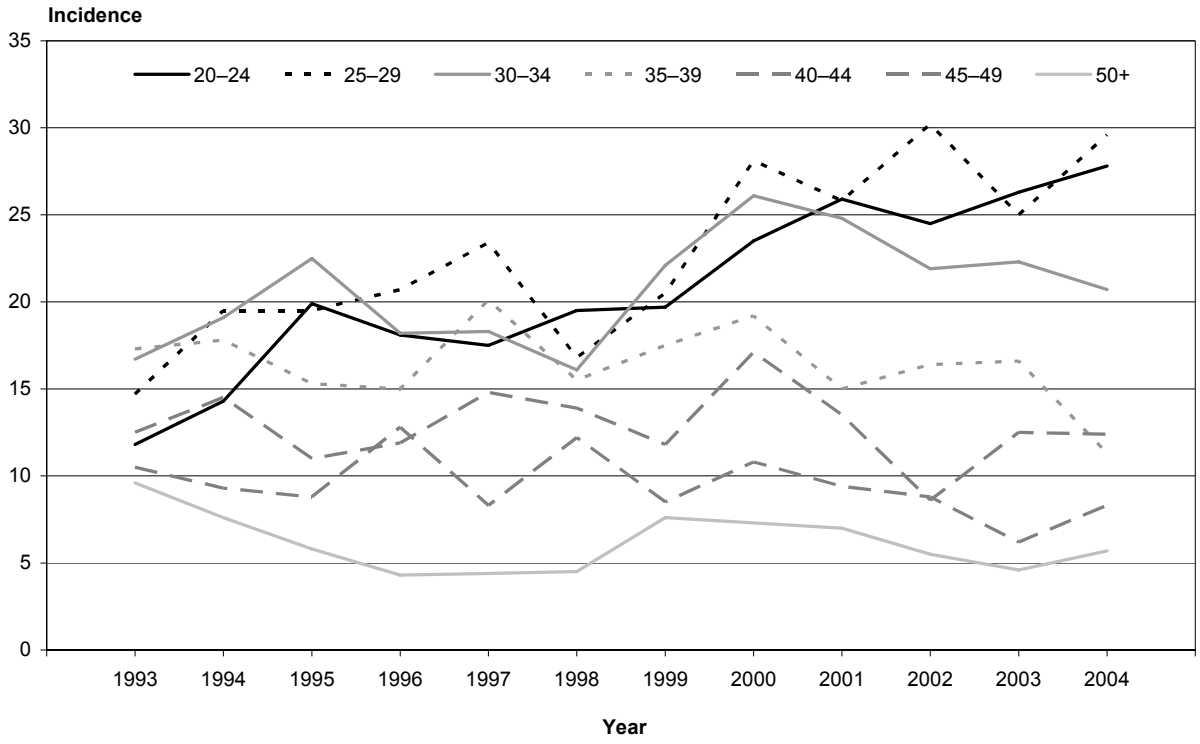
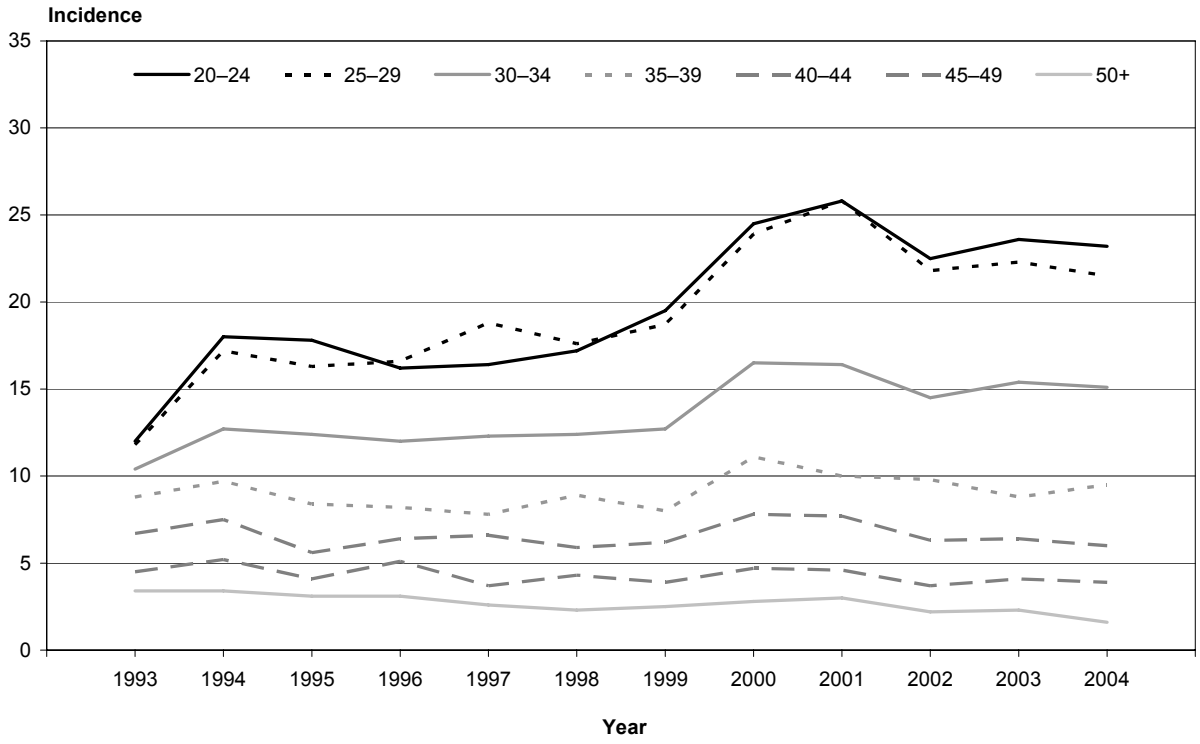


Figure 18: Age-specific HSIL trends in non-Māori women



The overall trend in non-Māori age-specific incidence mirrors the findings of the previous section. An increase in incidence is observed between 1993 and 1994 followed by a flat period. A second peak in incidence occurs between 1998 and 1999.

For non-Māori women, ages 20–24 and 25–29 are almost identical with regard to both magnitude and time trend. The age-specific time trends are more or less parallel. Overall, although there is a decline in the magnitude of incidence with age, the trend over the last decade has been similar across all age groups.

The Māori data is more volatile (Table 8) – most age groups experience increases in incidence in one year, followed by decreases in the next. Despite the fluctuations, all ages (except the 50+ group) experience the sharpest increases in the early years of the programme and between 1998 and 1999. No increases in incidence are observed for the 50+ age group until 1998 – in fact there is a gradual decline in HSIL incidence up until that point. Unlike the non-Māori data (Table 9), the time trends for the various age groups are not parallel. In other words, the periodic trend for Māori women varies by age group.

Table 8: Age-specific HSIL incidence (Māori women)

Year	20–24	25–29	30–34	35–39	40–44	45–49	50+
1993	11.8 (9.1, 14.9)	14.7 (11.5, 18.5)	16.7 (13, 21.1)	17.3 (12.7, 22.9)	12.5 (7.8, 18.9)	10.5 (5.4, 18.3)	9.6 (5.9, 14.8)
1994	14.3 (11.8, 17.2)	19.5 (16.3, 23.2)	19.1 (15.8, 23)	17.8 (13.8, 22.6)	14.5 (10, 20.3)	9.3 (5.2, 15.4)	7.6 (4.6, 11.7)
1995	19.9 (16.9, 23.2)	19.5 (16.4, 23)	22.5 (18.8, 26.6)	15.3 (11.8, 19.5)	11.0 (7.4, 15.8)	8.8 (5, 14.3)	5.8 (3.4, 9.2)
1996	18.1 (15.2, 21.4)	20.7 (17.5, 24.3)	18.2 (15.0, 21.9)	15.0 (11.7, 19)	11.9 (8.2, 16.6)	12.8 (8.3, 19)	4.3 (2.3, 7.2)
1997	17.5 (14.6, 20.8)	23.4 (20, 27.3)	18.3 (15.1, 22.1)	20.1 (16.3, 24.5)	14.8 (10.9, 19.7)	8.3 (4.9, 13.1)	4.4 (2.5, 7.1)
1998	19.5 (16.4, 23)	16.8 (13.9, 20.1)	16.1 (13.1, 19.7)	15.5 (12.3, 19.3)	13.9 (10.3, 18.5)	12.2 (8.2, 17.5)	4.5 (2.7, 7.1)
1999	19.7 (16.5, 23.4)	20.5 (17.2, 24.2)	22.1 (18.5, 26.3)	17.5 (14.1, 21.5)	11.8 (8.6, 15.8)	8.5 (5.3, 13.0)	7.6 (5.3, 10.7)
2000	23.5 (19.9, 27.6)	28.1 (24.1, 32.5)	26.1 (22, 30.7)	19.2 (15.6, 23.5)	17.1 (13.2, 21.9)	10.8 (7.1, 15.7)	7.3 (5.0, 10.3)
2001	25.9 (22.1, 30.3)	25.8 (21.9, 30.2)	24.8 (20.8, 29.3)	15.0 (11.7, 18.8)	13.5 (10.1, 17.7)	9.4 (6.1, 13.9)	7.0 (4.8, 9.9)
2002	24.5 (20.7, 28.8)	30.2 (25.9, 35.1)	21.9 (18.1, 26.2)	16.4 (12.9, 20.5)	8.6 (6.0, 11.9)	8.8 (5.6, 13.1)	5.5 (3.6, 8.1)
2003	26.3 (22.3, 30.8)	25.0 (21.0, 29.6)	22.3 (18.5, 26.7)	16.6 (13.1, 20.8)	12.5 (9.4, 16.4)	6.2 (3.6, 9.7)	4.6 (2.9, 7)
2004	27.8 (23.6, 32.6)	29.6 (25.1, 34.7)	20.7 (17.0, 25)	11.3 (8.4, 14.8)	12.4 (9.2, 16.2)	8.3 (5.4, 12.3)	5.7 (3.8, 8.3)

Table 9: Age-specific HSIL incidence (non-Māori women)

Year	20–24	25–29	30–34	35–39	40–44	45–49	50+
1993	12 (10.8, 13.2)	11.8 (10.6, 13)	10.4 (9.3, 11.5)	8.8 (7.7, 10)	6.7 (5.7, 7.9)	4.5 (3.6, 5.7)	3.4 (2.8, 4.1)

1994	18 (16.7, 19.2)	17.2 (16, 18.4)	12.7 (11.7, 13.8)	9.7 (8.7, 10.6)	7.5 (6.6, 8.5)	5.2 (4.3, 6.1)	3.4 (2.9, 4)
1995	17.8 (16.6, 19)	16.3 (15.1, 17.4)	12.4 (11.4, 13.4)	8.4 (7.5, 9.2)	5.6 (4.9, 6.5)	4.1 (3.4, 4.9)	3.1 (2.6, 3.6)
1996	16.2 (15, 17.4)	16.6 (15.5, 17.7)	12 (11.1, 13)	8.2 (7.4, 9)	6.4 (5.6, 7.3)	5.1 (4.4, 6)	3.1 (2.7, 3.6)
1997	16.4 (15.1, 17.6)	18.8 (17.6, 20)	12.3 (11.3, 13.3)	7.8 (7, 8.6)	6.6 (5.8, 7.5)	3.7 (3.1, 4.4)	2.6 (2.2, 3)
1998	17.2 (15.9, 18.6)	17.6 (16.4, 18.7)	12.4 (11.4, 13.3)	8.9 (8, 9.7)	5.9 (5.2, 6.7)	4.3 (3.7, 5.1)	2.3 (2, 2.7)
1999	19.5 (18.1, 21)	18.7 (17.5, 20)	12.7 (11.7, 13.7)	8 (7.3, 8.8)	6.2 (5.5, 7)	3.9 (3.3, 4.6)	2.5 (2.2, 2.9)
2000	24.5 (22.8, 26.1)	23.9 (22.5, 25.4)	16.5 (15.4, 17.6)	11.1 (10.1, 12)	7.8 (7, 8.6)	4.7 (4, 5.4)	2.8 (2.4, 3.2)
2001	25.8 (24.1, 27.4)	25.8 (24.3, 27.4)	16.4 (15.2, 17.5)	10 (9.1, 10.9)	7.7 (6.9, 8.6)	4.6 (3.9, 5.4)	3 (2.7, 3.4)
2002	22.5 (21, 24.1)	21.8 (20.3, 23.2)	14.5 (13.4, 15.6)	9.8 (8.9, 10.7)	6.3 (5.6, 7)	3.7 (3.1, 4.4)	2.2 (1.9, 2.6)
2003	23.6 (22, 25.2)	22.3 (20.8, 23.8)	15.4 (14.3, 16.5)	8.8 (7.9, 9.6)	6.4 (5.7, 7.1)	4.1 (3.4, 4.7)	2.3 (2, 2.7)
2004	23.2 (21.7, 24.8)	21.5 (20, 23)	15.1 (14, 16.3)	9.5 (8.6, 10.4)	6 (5.4, 6.8)	3.9 (3.3, 4.5)	1.6 (1.4, 1.9)

The age-specific pattern for HSIL incidence in Māori and non-Māori women is presented for 2003 (Figure 19) and 2004 (Figure 20). Note that the 50+ age group has not been amalgamated in the figures below – this is to fully illustrate how HSIL incidence varies by age group (as opposed to across periods).

Figure 19: Age-specific patterns, 2003

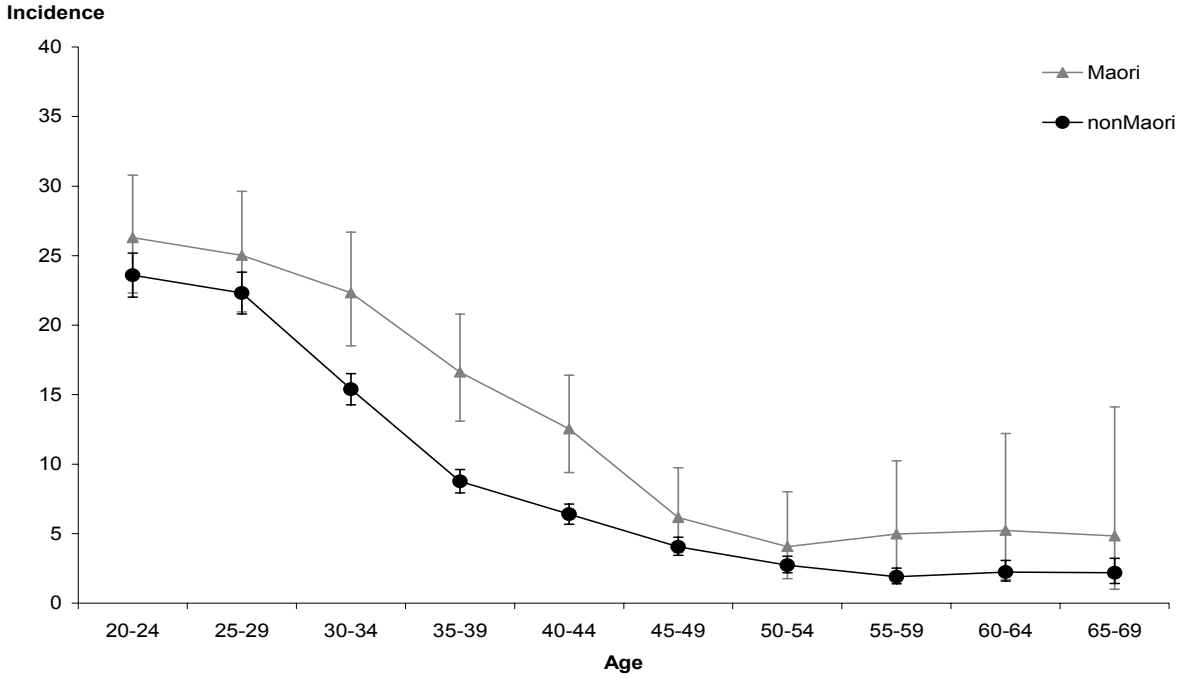
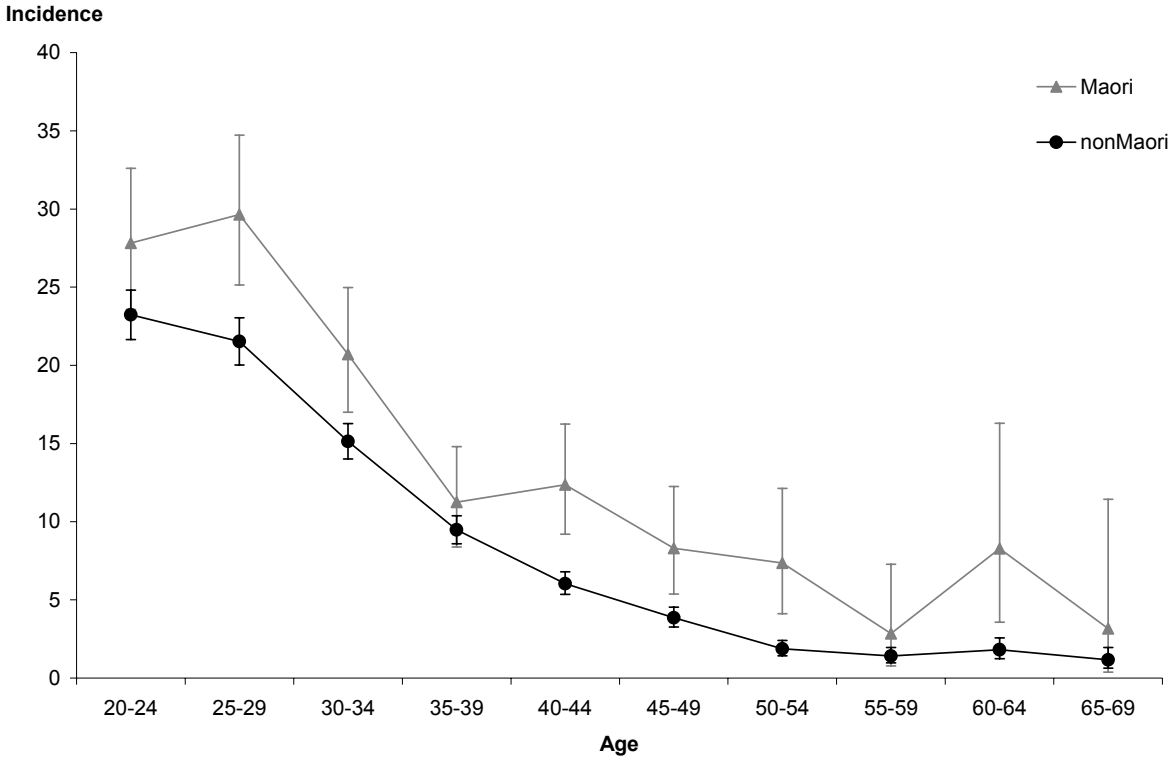


Figure 20: Age-specific patterns, 2004



The age-specific patterns observed in 2003 and 2004 are similar. There is an unusual peak observed for 60–64-year-old Māori women in 2004. However, this is accompanied by a wide error bar as well. Note that there is no significant age trend in incidence among middle-aged Māori women – ie, a 40–44-year-old Māori woman does not have a significantly higher risk of getting an HSIL detection than a 50–54-year-old. This is quite different from non-Māori women, where every age group is significantly different to one another (except the two youngest groups).

Overall, however, HSIL incidence declines with age as expected. The gap between Māori and non-Māori incidence varies between 2003 and 2004. For example, in 2003, the gap between Māori and non-Māori women aged 20–29 is relatively small. In 2004, however, the gap between the younger Māori and non-Māori women has grown wider.

Regional HSIL trends

Due to the small numbers of cases observed for some age by ethnic groups in some regions, the periods have been grouped into two five-year periods: 1994–1998 and 1999–2003. The first (1993) and last years (2004) have been omitted to coincide with the regional analysis for all women, presented earlier in this report.

Figures 21 and 22 summarise Māori and non-Māori crude regional incidence (respectively) while Figures 23 and 24 summarise age standardised regional rates for Māori and non-Māori respectively.

Tables 9 and 10 summarise the regional incidence for both ethnic groups and provide the relative change over the two periods.

Figure 21: Crude incidence by region (Māori women)

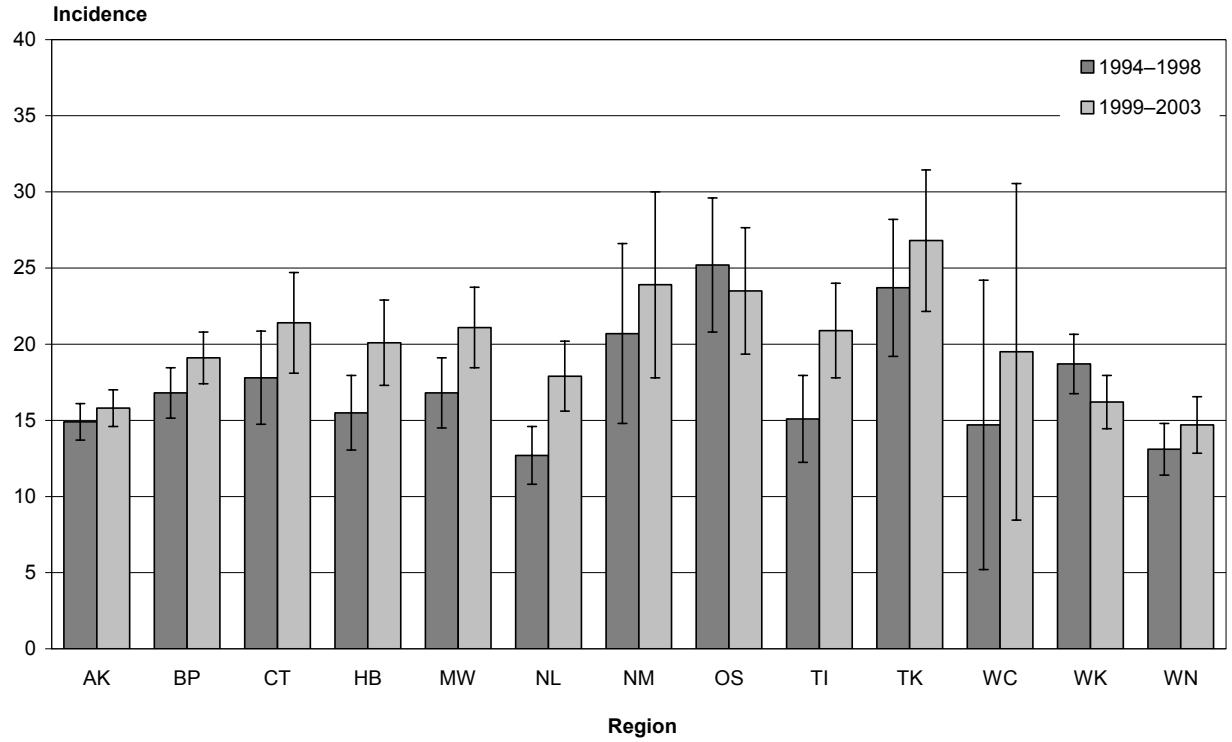


Figure 22: Crude incidence by region (non-Māori women)

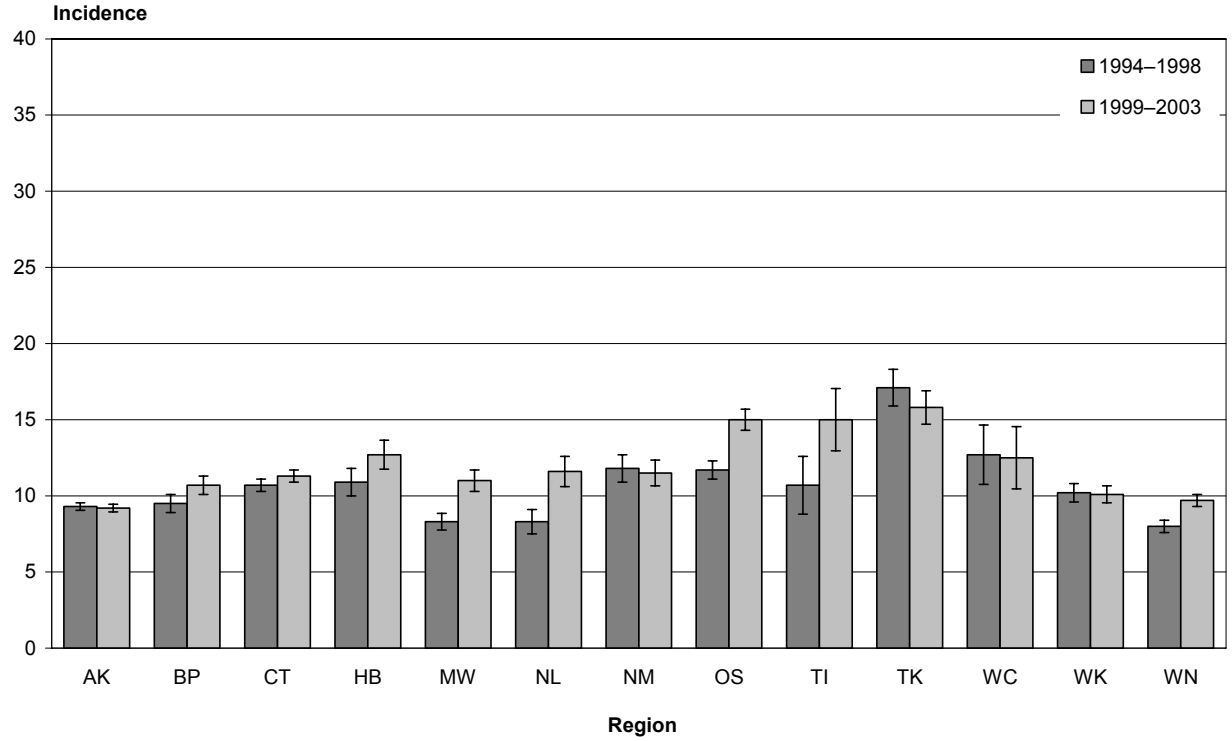


Figure 23: Age-standardised incidence by region (Māori women)

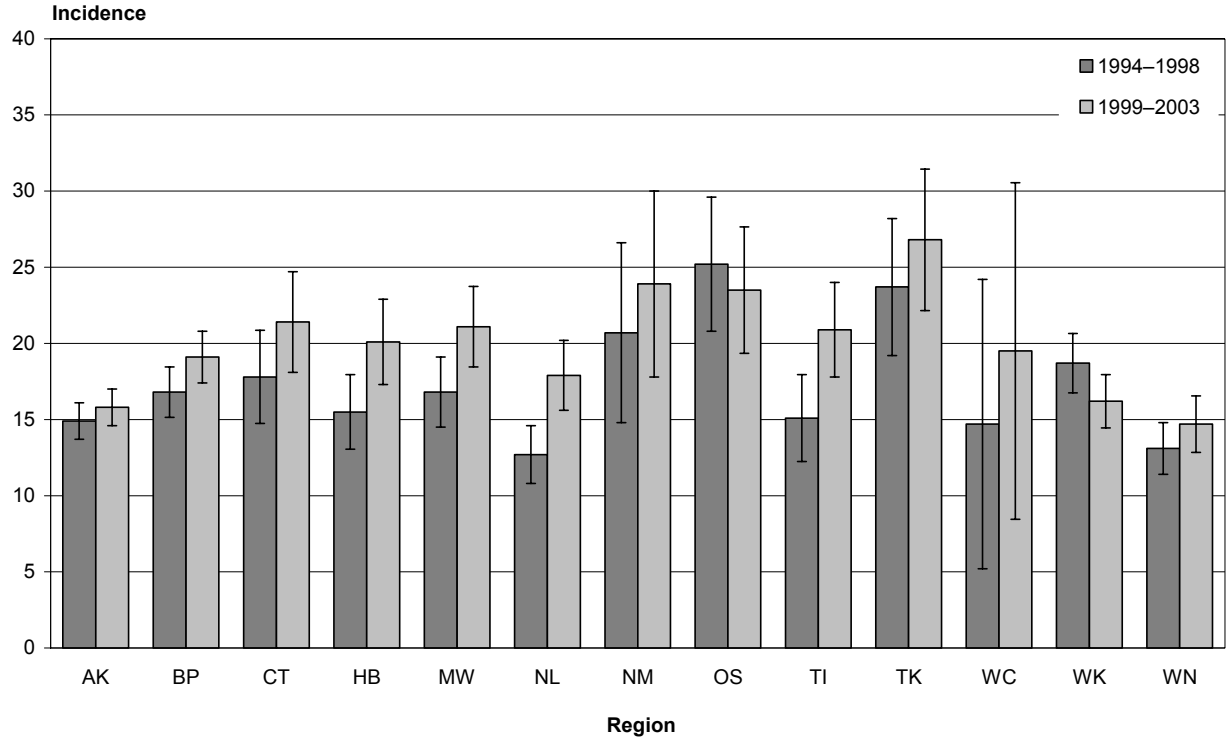
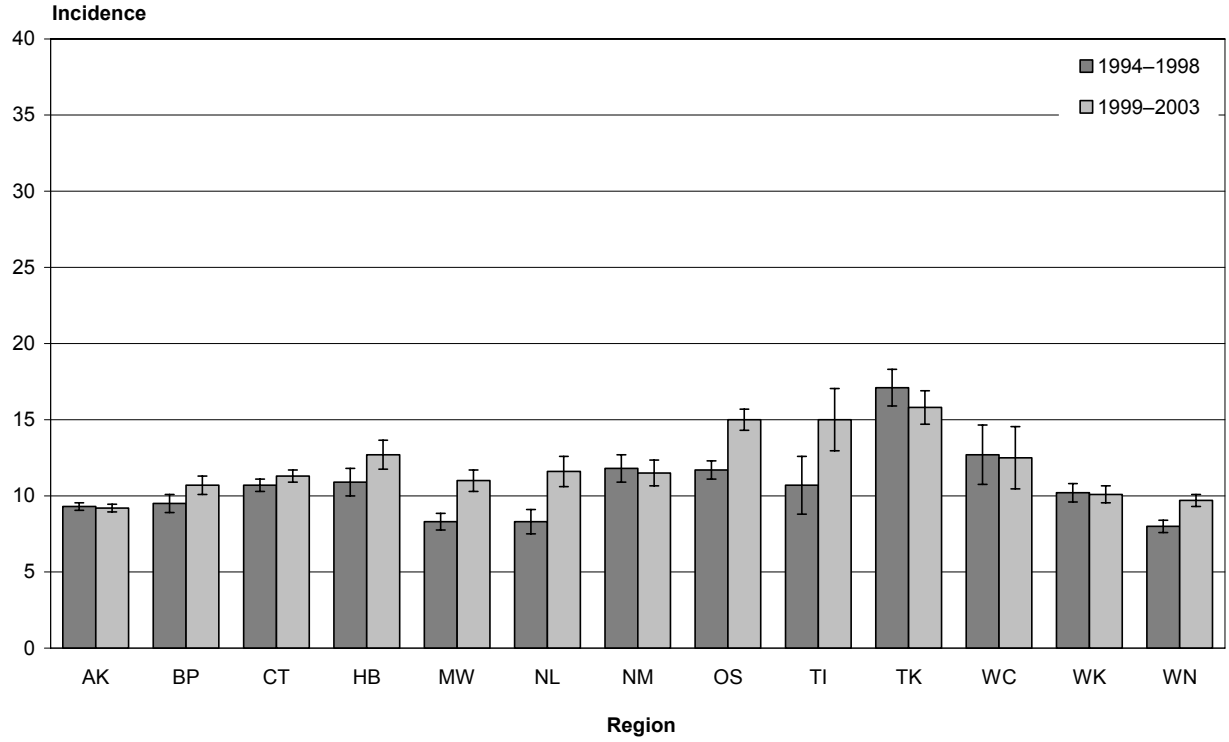


Figure 24: Age-standardised incidence by region (non-Māori women)



Almost all regions experienced a rise in incidence between 1994–1998 and 1999–2003. A decrease in Māori incidence is observed in Otago and Southland and Waikato.

The highest increase in incidence was observed for Tairawhiti and Northland. This was true for both Māori and non-Māori women. Crude (and age-standardised) incidence in Tairawhiti increased by 38% (38%) for Māori women and 41% (69%) for non-Māori women. Corresponding increases in crude (age standardised) incidence in Northland was 41% (49%) for Māori women and 40% (67%) for non-Māori women.

With regard to magnitude in the most recent period (1999–2003), the regions with the highest HSIL incidence for both Māori and non-Māori women were Taranaki, Tairawhiti, Nelson-Marlborough and Otago and Southland. Wellington and Auckland had the lowest levels of HSIL incidence in 1999–2003.

Table 10: Regional trends in (crude) HSIL incidence

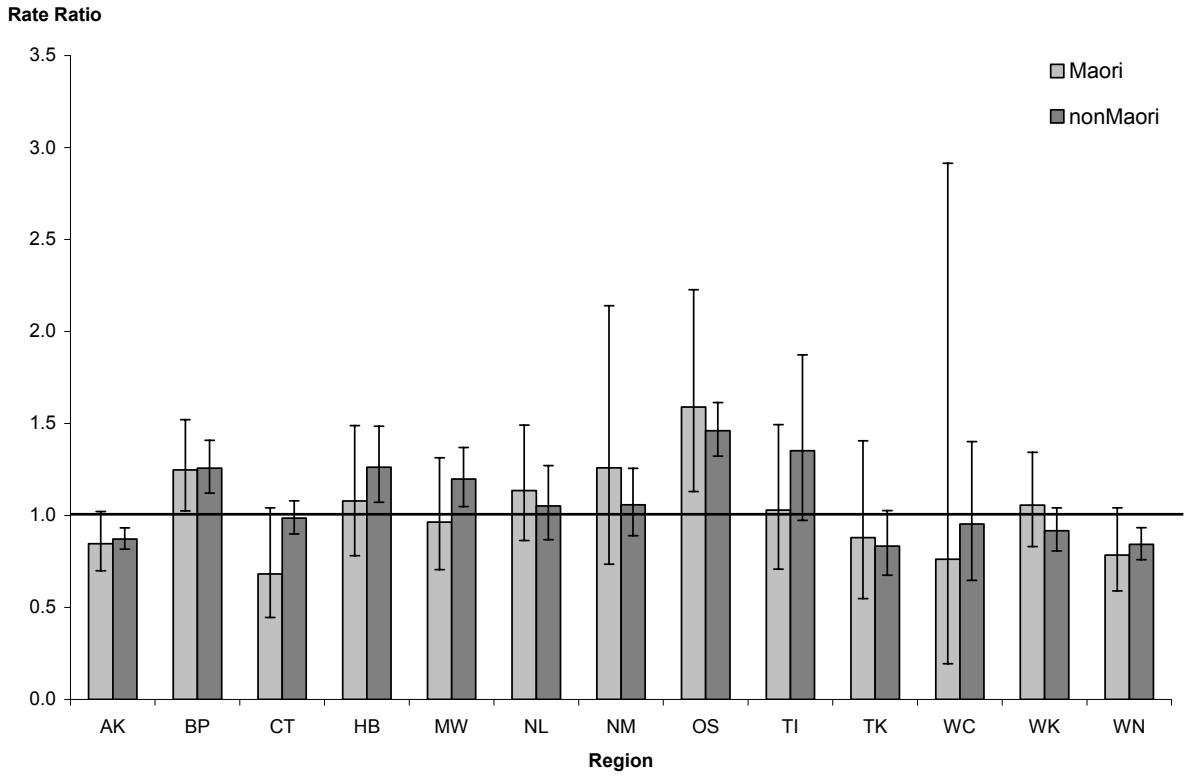
Region	Māori			Non-Māori		
	1994–1998	**1999–2003**	**Relative change in incidence**	**1994–1998**	**1999–2003**	**Relative change in incidence**
AK	14.9 (13.7, 16.1)	15.8 (14.6, 17)	5.9%	9.3 (9.1, 9.6)	9.2 (9.0, 9.5)	-1.2%
BP	16.8 (15.1, 18.4)	19.1 (17.4, 20.8)	14.0%	9.5 (8.9, 10.1)	10.7 (10.1, 11.3)	12.6%
CT	17.8 (14.9, 21.0)	21.4 (18.3, 24.9)	20.6%	10.7 (10.3, 11.1)	11.3 (10.9, 11.7)	5.7%
HB	15.5 (13.2, 18.1)	20.1 (17.4, 23.0)	29.4%	10.9 (10.0, 11.8)	12.7 (11.8, 13.7)	16.7%
MW	16.8 (14.6, 19.2)	21.1 (18.6, 23.9)	26.2%	8.3 (7.8, 8.9)	11.0 (10.3, 11.7)	31.8%
NL	12.7 (10.9, 14.7)	17.9 (15.7, 20.3)	40.7%	8.3 (7.5, 9.1)	11.6 (10.6, 12.6)	39.5%
NM	20.7 (15.4, 27.2)	23.9 (18.3, 30.5)	15.2%	11.8 (10.9, 12.7)	11.5 (10.7, 12.4)	-2.0%
OS	25.2 (21.1, 29.9)	23.5 (19.6, 27.9)	-7.0%	11.7 (11.1, 12.3)	15.0 (14.3, 15.7)	28.4%
TI	15.1 (12.5, 18.2)	20.9 (18.0, 24.2)	38.2%	10.7 (8.9, 12.7)	15.0 (13.1, 17.2)	40.7%
TK	23.7 (19.5, 28.5)	26.8 (22.5, 31.8)	13.3%	17.1 (15.9, 18.3)	15.8 (14.7, 16.9)	-8.0%
WC	14.7 (7.3, 26.3)	19.5 (10.7, 32.8)	32.8%	12.7 (10.8, 14.7)	12.5 (10.6, 14.7)	-1.1%
WK	18.7 (16.7, 20.6)	16.2 (14.4, 17.9)	-13.5%	10.2 (9.6, 10.8)	10.1 (9.5, 10.6)	-1.4%
WN	13.1 (11.5, 14.9)	14.7 (12.9, 16.6)	11.7%	8.0 (7.6, 8.4)	9.7 (9.3, 10.1)	21.9%

Table 11: Regional trends in (age-standardised) HSIL incidence

Region	Māori			Non-Māori		
	1994–1998	1999–2003	Relative change in incidence	1994–1998	1999–2003	Relative change in incidence
AK	12.3 (11.1, 13.4)	13.3 (12.2, 14.4)	8.5%	8.3 (8.1, 8.6)	9.0 (8.8, 9.3)	8.5%
BP	14.0 (12.5, 15.5)	16.7 (15.1, 18.2)	19.3%	9.1 (8.5, 9.6)	12.0 (11.3, 12.7)	32.5%
CT	13.2 (10.6, 17)	17.5 (14.6, 21.2)	32.4%	9.7 (9.3, 10.1)	11.3 (10.9, 11.8)	17.0%
HB	13.2 (11.0, 15.9)	17.4 (15, 20.2)	32.2%	10.7 (9.9, 11.6)	14.4 (13.3, 15.5)	33.7%
MW	13.7 (11.8, 16.2)	17.8 (15.5, 20.4)	29.4%	8.1 (7.5, 8.6)	11.8 (11.1, 12.6)	46.8%
NL	10.9 (9.3, 12.9)	16.3 (14.3, 18.6)	49.1%	8.3 (7.5, 9.2)	13.9 (12.7, 15.1)	67.4%
NM	17.7 (12.4, 25.9)	21.7 (16.2, 29.0)	22.7%	11.3 (10.4, 12.2)	12.9 (11.9, 13.9)	14.1%
OS	18.2 (14.9, 23.3)	18.4 (15.0, 23.2)	1.3%	11.0 (10.4, 11.5)	15.3 (14.6, 16.0)	39.2%
TI	13.9 (11.2, 17.3)	19.1 (16.4, 22.3)	37.6%	10.3 (8.5, 12.4)	17.4 (15.0, 20.1)	69.1%
TK	19.7 (15.8, 25)	24.2 (20.1, 29.1)	22.4%	16.7 (15.5, 17.9)	17.7 (16.4, 19.0)	5.8%
WC	9.9 (4.7, 26.2)	19.2 (9.7, 36.6)	94.5%	12.0 (10.2, 14.1)	13.8 (11.6, 16.4)	15.1%
WK	15.1 (13.5, 17.1)	14.1 (12.5, 15.9)	-6.7%	9.6 (9.0, 10.1)	10.5 (9.9, 11.0)	9.3%
WN	10.9 (9.3, 12.9)	11.7 (10.2, 13.6)	8.0%	7.0 (6.6, 7.3)	9.4 (9, 9.8)	34.7%

The figures and tables above compare rates across different regions. Variance in regional rates will be a function of region (and/or provider) specific effects, coupled with varying age structures across regions. Age-standardised rate ratios for 2004 are therefore presented in Figure 25. Here the age standardised regional rates are compared to the age standardised national rate. This provides insight into which regions are below or above average (having adjusted for the differing age structures in the various regions) for each ethnic group.

Figure 25: Age-standardised regional rate ratios by ethnicity



Overall, it appears that (with the exception of Otago and Southland) Māori incidence across regions is comparable (when compared to the pooled Māori incidence). In other words, there is no significant difference between regions. For non-Māori, the above is true for most regions, with the exception of Wellington and Auckland (which are below the non-Māori average) and Manawatu, Bay of Plenty and Hawke's Bay (which are above the non-Māori average).

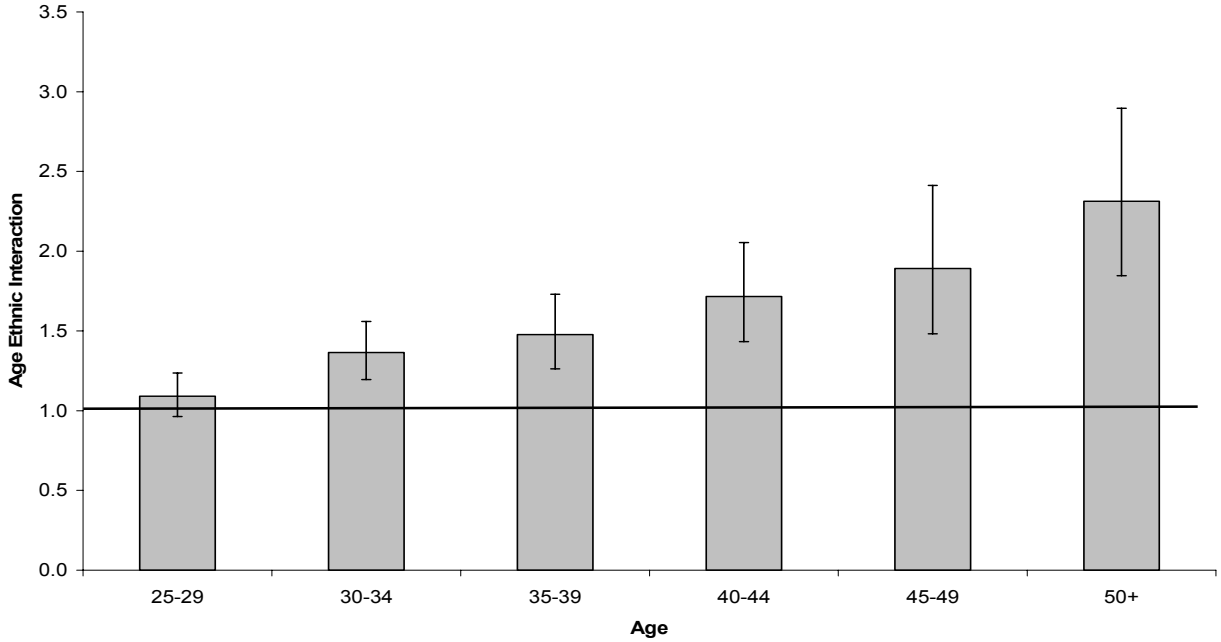
Regression results

Poisson regression models were used to analyse the effects of age and period for each ethnic group and region. The 1993–2004 period was divided into three four-year periods (1993–1996, 1997–2000 and 2001–2004) to avoid cells with zero cases.

In brief, the expected patterns were found for ethnicity, age, region and period as main effects. No significant interactions where found between ethnicity and region. That is, the regional trends (*not* magnitude) in HSIL incidence are not significantly different between Māori and non-Māori.

Figure 26 illustrates the ethnic by age interaction effects. The interaction is significant for every age group except the 25–29 year age group. This means that the age specific trend for Māori women over the age of 30 is different to that of their non-Māori counterparts (ie, the Māori:non-Māori rate ratio increases with age – Table 11). In other words, the decline in HSIL incidence with increasing age after age 30) is less steep for Māori than for non-Māori women.

Figure 26: Age by ethnic interactions



Note: Reference group for age is 20–24, and ethnicity is non-Māori.

Table 12: Age by ethnicity interactions: Māori: non-Māori HSIL incidence rate ratios by age, 2001–04

Age group	Rate ratio
20–24	1.05
25–29	1.14
30–34	1.43
35–39	1.55
40–44	1.81
45–49	1.99
50+	2.43

Conclusions

Cervical screening protects women by detecting and treating asymptomatic precancerous (HSIL) lesions, so preventing progression of most of these lesions to invasive cervical cancer. If the National Cervical Screening Programme is operating effectively, an increase in the HSIL detection rate, with a corresponding decrease in the invasive cancer registration rate, should be seen over time. This is what the study found, ie over the first decade of the programme the HSIL rate increased by 40% while the cancer rate decreased by an equivalent amount. This pattern provides evidence that the decline in cervical cancer over the decade was in fact attributable to the programme.

Monitoring HSIL trends is also useful for assessing progress towards reducing inequalities. The study has shown that HSIL rates are highest among Māori, among deprived communities and in some regions of New Zealand. Cervical cancer rates as well as other indicators of the programme should be continued to be monitored in populations and regions to assess progress in reducing the incidence of cervical cancer in New Zealand.

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