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The New Zealand Hepatitis B Screening Programme: screening coverage and prevalence of chronic hepatitis B infection

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Abstract

Aim To report on screening coverage and the distribution of HBsAg (a marker of chronic hepatitis B virus infection) among participants in the New Zealand Hepatitis B Screening Programme.

Method Coverage and crude and age-standardised prevalence rates of HBsAg by age group, sex, ethnic group, and region were calculated from data held by the two providers and the New Zealand 2001 Census.

Results 177,000 people were tested for hepatitis B virus infection (51% of the programme targets and 27% of Census 2001 eligible population), with highest coverage among women (28.9%) and Pacific people (34.9%). Overall, 5.7% (10,176) of participants were HBsAg-positive and there were significant regional, ethnic group, and gender differences. 5.6% of Maori, 7.3% of Pacific people, and 6.2% of Asians were HBsAg-positive, and men were more likely to test HBsAg-positive (6.1%) than women (5.4%).

Conclusions Previous estimates of HBsAg prevalence among Maori and Pacific people from smaller surveys were confirmed and new information obtained about the distribution of hepatitis B virus infection among Pacific Islands and Asian populations in New Zealand. Opportunistic screening of adults in these populations should continue in order to identify others with (as yet undetected) infection. Regular follow-up of people with chronic hepatitis B virus infection should also continue. Ongoing outcome monitoring is now needed to judge whether this unique programme has been an effective component of New Zealand's hepatitis B control strategy and whether it is a worthwhile investment of resources.

An estimated 350 million people worldwide are chronically infected with hepatitis B virus (HBV).[1] While international comparative data suggest that New Zealand falls into the 'lowest' prevalence category, numerous studies in New Zealand over the past 30 years have shown that there is considerable variation in the prevalence of chronic hepatitis B virus infection (CHB) for specific regions, towns, ethnic groups, workforce, and age groups.[2–9]

All studies have shown high rates of hepatitis B exposure and CHB in Maori, with estimates of CHB ranging from 5.4% in Maori police and customs workers in the late 1980s[8] to around 16% in Maori children in the Eastern Bay of Plenty in the early 1980s (prior to the introduction of infant hepatitis B immunisation).[2,5,6]

In contrast, rates of CHB among European populations have been no higher than 3% and generally less than 1%.[6–8] The largest survey, undertaken in the Eastern Bay of Plenty in the mid 1980s, tested 7901 people (some were children).[5] There are limited

data on CHB in Pacific and Asian people in New Zealand, but hepatitis B infection is known to be endemic in the Pacific Islands and most Asian countries.[10]

The most reliable data for Pacific people in New Zealand come from an analysis of 1987 police and customs workforce records, indicating a CHB prevalence of 4.4%.[8] CHB was found in 3.9% of 'others', presumably including people of Asian ethnic heritage.[8] Variations in prevalence by geographic region have also been noted in several studies, suggesting a north-south gradient, with higher rates in northern New Zealand than in the south.[3,4]

Universal infant hepatitis B vaccination introduced in New Zealand in the late 1980s will ultimately have the greatest impact on the control of hepatitis B and its sequelae. Meanwhile there are an estimated 40,000 people with CHB in New Zealand[11]—most of whom are unaware of their hepatitis B status unless detected on a routine laboratory test or presenting at a late stage with clinical manifestations of chronic liver disease or hepatocellular carcinoma (HCC).

Approximately 10–20% of people with CHB develop cirrhosis.[12,13] A Maori male with CHB is estimated to have a 10–15% probability of developing hepatocellular carcinoma (HCC) by age 70.[14] The burden of disease caused by HBV infection is unevenly distributed: over 50% of all chronic liver disease mortality among Maori and Pacific people in New Zealand has been shown to be attributable to CHB, compared to only 10% among Europeans.[15]

A risk to the public health also exists, especially to susceptible individuals in high prevalence populations. These include older children and teenagers inadequately immunised as infants, especially many Maori and Pacific children among whom immunisation coverage is sub-optimal.[16]

Screening of people for hepatitis B status has previously been carried out in an *ad hoc* manner. In the 1980s and 1990s the Hepatitis Foundation, a Whakatane-based non-governmental organisation, screened high-risk populations in several areas of the North Island.[5,6] Antenatal screening has included a test for hepatitis B (HBsAg) since the early 1980s and blood donors have also been screened since this time.

In the early 1990s, the Hepatitis Foundation campaigned energetically for organised hepatitis B screening because of concerns about the impact of CHB in high-risk populations, especially Maori. A working party on hepatitis B was convened by the Ministry of Health in 1994 to consider the evidence for an organised hepatitis B screening programme in New Zealand and concluded that there were insufficient grounds to recommend in it's favour.[17]

Following further lobbying from the Foundation, two international experts reviewed the Working Party findings and recommended that a pilot screening programme be conducted in a defined geographic area. This proposal was developed further by a 1996 Working Party and led to the Ministry of Health proposing a pilot-screening programme for South Auckland and a Northland district. However, in 1998 Cabinet overturned this decision and instead providers were asked to specify what they could deliver for the available funding 'in areas of the country with the greatest prevalence of infection.'[17]

Contracts were awarded to two separate agencies: the Northern Region Hepatitis Consortium (comprising Auckland District Health Board, Ngati Whatua, and Maori

and Pacific primary care and public health organisations),responsible for screening and follow-up (immunisation, counselling and surveillance) of Maori, Pacific and Asian people aged 15 years and over in the Northland and Auckland regions; and the Hepatitis Foundation, responsible for screening and follow-up in all other regions in the North Island.

Due to its much smaller Maori, Pacific, and Asian populations, the South Island was not included. The 15 to 40 year age-group was a particular focus of the programme as this group was seen to have most to gain from both immunisation if non-immune, and surveillance if HBsAg-positive. The aim was to screen 70% of the eligible population. According to the 1996 Census there were nearly 500,000 people in these groups and the total number of screenings targeted was therefore 345,750. This paper reports on overall coverage and the distribution of HBsAg among participants in the New Zealand Hepatitis B Screening Programme.

Methods

The Hepatitis Foundation employed teams of phlebotomists to work directly with communities using local facilities such as marae, or purpose-built caravans as screening centres. The Foundation began screening in July 1999 and completed screening in June 2002. The Northern Consortium's strategy was based primarily on supporting general practitioners and Maori and Pacific providers to recruit individuals. Contact with individuals was either opportunistic, by invitation letter or phone call, or resulting from wider community promotion of the service on radio, at meetings in churches or marae. Where appropriate, screening was also undertaken by outreach teams in community venues and events. The Northern Consortium did not begin until April 2000 and completed screening in December 2002.

After receiving informed consent, a blood sample was taken from participants, and the serum was then transported (within defined time and temperature limits) to one of two designated laboratories for testing. All blood samples were tested for HBsAg. Those that were HBsAg-positive were also tested for e antigen (HBeAg) status; alanine aminotransferase (ALT), a marker of active hepatitis; and alpha fetoprotein (AFP), a marker of HCC. People who were HBsAg negative were tested for anti-HBs.

In a small number of cases, individuals who had been previously identified as having CHB were included in the programme by using the results of a recent test. All assays on sera collected from participants were performed in Whakatane at the Hepatitis Foundation Laboratory or at Middlemore Hospital Laboratory using identical analysers and techniques: HBsAg, anti-HBs, and AFP assays were performed on Abbott Architect 2000 analysers using chemiluminescent microparticle immunoassay; HBeAg on Abbott AxSym using Microparticle Enzyme Immunoassay; and ALT on Abbott Aeroset using a colorimetric assay.

Both organisations maintained a SQL/Access database that included demographic details of every participant together with the results of the blood tests and all follow-up received. Regions were defined by aggregating territorial local authorities (based upon communities of interest) rather than using regional authority areas (based upon environmental needs). Ethnicity data were collected from consent forms according to standard Ministry of Health codes with each person self-identifying a single ethnic affiliation that was then aggregated to 'Maori,' 'Pacific,' 'Asian,' and 'Other' ethnic groupings.

Data from the 2001 Census for ethnicity, age groups, region, and gender were used for the denominator in coverage calculations. To be comparable with screening data, prioritised ethnic groupings from the census were used. Where coverage rates for more specific ethnic groups are given, such prioritisation is not possible and denominators are therefore slightly inflated. Direct age- and gender-standardised rates were calculated for each ethnic group. Direct age-standardised rates were calculated for Maori in each region but there were insufficient people of other ethnic groups screened in many regions to present age-standardised regional rates for those groups.

The 2001 New Zealand Census population was used in each case as the standard population. Although some children under 15 years were screened (largely as household contacts of people found to have CHB) they were not a primary target group and were less likely to be representative of the general population. Therefore the standardised rates given are for the adult population only. Because the 'response rate' was only 27%, sensitivity analyses were undertaken as outlined by Greenland[19] around

these prevalence estimates to provide a valid range within which the true population prevalence lies. These are based on the alternative assumptions that people in the target groups who were not recruited were either 50% more likely or 33% less likely to have CHB than those that were recruited.

Results

Screening coverage

Table 1 shows the number of people in the target groups and the number of people screened by the programme. 177,328 people were screened, of which 153,605 (87%) were Maori, Pacific, or Asian adults.

Table 1. Coverage of the Hepatitis B screening programme by age, gender, ethnicity, region, and provider

Category	Variable	Target population	Number screened (all participants)	Number screened in target ethnic and age-group populations	Coverage (%)
Age	<15	-	3107		
	15-40	366567	118779	106560	29.1
	>40	199269	55406	47044	23.6
Gender	Male	266688	79195	66937	25.1
	Female	299169	97794	86397	28.9
Ethnicity	Maori	288873	81219	79924	27.7
	Pacific	122700	43734	42834	34.9
	Asian	154263	31484	30846	20.0
	Other	na	18838	na	na
	Pacific groups:				
	-Samoan	65250	19298	18865	28.9
	-Cook Islands	28554	7041	6867	24.0
	-Tongan	22329	10478	10154	45.5
	-Niuean	11472	1995	1959	17.1
	-Tokelauan	3417	1080	1047	30.6
	-Fijian	4290	1109	1070	24.9
	Asian groups:				
	-Southeast Asian	20091	2950	2764	13.8
	-Chinese	72363	14160	13837	19.1
	-Indian	49692	7497	7320	14.7
Region	Northland	27381	9092	7423	27.1
	Auckland	285690	81036	73763	25.8
	Waikato	56292	20149	16963	30.1
	BOP	45567	18907	16298	35.8
	Gisborne	13203	7666	6770	51.3
	Taranaki	10374	1311	1082	10.4
	Hawke's Bay	24255	8581	6781	28.0
	Man*-Wanganui	31347	5245	4276	13.6
	Wellington	71727	22441	19522	27.2
Provider	NRHC	313071	89839	79192	25.3
	Hepatitis Foundation	252765	87489	74413	29.4
Total		**565836**	**177328**	**153605**	**27.1**

BOP=Bay of Plenty; NRHC=Northern Region Hepatitis Consortium; *Manawatu; na=not applicable.

Using the 2001 census the target population had increased to over 565,000 people (largely due to the growth in New Zealand's Asian population). Overall coverage among the target group was 27.1%, with higher coverage rates among women and 15-40 year olds than among men and the over 40 age group. The highest coverage achieved was among Pacific people, in particular among the Tongan community from which nearly half participated. Coverage among Asian people was relatively low.

Table 2. HBsAg prevalence by age, sex, ethnicity and region

Category	Variable	Sample size	Number of HBsAg-positive participants	HBsAg+ prevalence (%)	95% CI
Age	<15	3107	109	3.5	2.9–4.2
	15-40	118779	6492	5.5	5.3–5.6
	>40	55406	3575	6.5	6.2–6.7
Sex	Male	79195	4835	6.1	5.9–6.3
	Female	97794	5318	5.4	5.3–5.6
Ethnicity	Maori	81219	4081	5.6	5.4–5.7
	Pacific	43734	2633	7.3	7.0–7.5
	Asian	31484	1522	6.2	5.9–6.5
	Other	18838	462	2.8	2.6–3.0
	Pacific groups:				
	-Samoan	19298	867	4.5	4.2–4.7
	-Cook Islands	7041	446	6.3	5.7–6.9
	-Tongan	10478	1370	13.1	12.4–13.7
	-Niuean	1995	172	8.6	7.3–9.8
	-Tokelauan	1080	41	3.8	2.6–4.9
	-Fijian	1109	38	3.4	2.3–4.4
	Asian groups:				
	-SE Asian	2950	240	8.1	7.1–9.1
	-Chinese	14160	1258	8.9	8.4–9.3
	-Indian	7497	44	0.6	0.4–0.7
Region	Northland	9092	430	4.7	4.3–5.2
	Auckland	81036	5650	7.0	6.8–7.1
	Waikato	20149	765	3.8	3.5–4.1
	BOP	18907	887	4.7	4.4–5.0
	Gisborne	7666	349	4.6	4.1–5.0
	Taranaki	1311	42	3.2	2.3–4.2
	Hawke's Bay	8581	343	4.0	3.6–4.4
	Man*-Wanganui	5245	221	4.2	3.7–4.8
	Wellington	22441	801	3.6	3.3–3.8
Total		**177328**	**10176**	**5.7**	**5.6–5.8**

BOP=Bay of Plenty; SE Asian=South-East Asian (e.g. Thai); CI=confidence interval; *Manawatu.

The programme had considerably more success in some regions than in others. In particular, the coverage rates achieved by the Hepatitis Foundation in the eastern part of the North Island were higher than those in the western part.

HBsAg Prevalence

5.7% of participants were HBsAg-positive. These rates were significantly higher for older people compared to younger, males compared to females, and for Pacific people compared to Maori and Asians (Table 2). There were significant regional variations

with Auckland having a high overall prevalence and Waikato, Taranaki, and Wellington having a low prevalence. Within the ethnic groupings there was considerable variation, from a low of 0.6% in Indians to 13% in Tongans.

Analysis by sex and ethnic group showed that Pacific people had a higher age-standardised prevalence than Maori or Asians, and that males in all ethnic groups also had significantly higher HBsAg prevalence than females (Table 3).

Table 3. Adult age-standardised HBsAg prevalence by sex and ethnic group

Gender	Ethnicity	HBsAg prevalence (%)	95% CI (%)	Sensitivity analysis
Female	Maori	4.1	3.9–4.4	3.1–5.6
	Pacific	6.2	5.8–6.6	4.9–8.2
	Asian	5.2	4.8–5.6	3.8–7.3
	Other	2.0	1.6–2.4	
Male	Maori	7.0	6.6–7.4	5.3–9.5
	Pacific	8.8	8.3–9.3	6.9–11.7
	Asian	7.2	6.7–7.7	5.3–10.1
	Other	3.0	2.6–3.4	

Comparative age-standardised analysis of regional data was limited to Maori because of insufficient numbers for Asian and Pacific peoples in many regions. This highlights significant regional variation, with Maori in Auckland having the highest prevalence, and Maori in Taranaki the lowest

Table 4. Adult age standardised HBsAg prevalence for Maori by region

Region	Prevalence (%)	95 % CI (%)
Northland	5.6	4.9-6.3
Auckland	6.4	5.8-7.0
Waikato	3.8	3.4-4.1
Bay of Plenty	5.1	4.7-5.5
Gisborne	4.6	4.1-5.2
Hawke’s Bay	4.6	3.9-5.3
Taranaki	2.6	1.6-3.6
Manawatu-Wanganui	6.2	4.4-8.0
Wellington	4.1	3.6-4.6

Discussion

To our knowledge, the New Zealand Hepatitis B Screening and Follow-Up Programme is the largest community-based hepatitis B screening programme ever conducted anywhere in the world, and provides the most robust HBsAg prevalence data available for Maori, Pacific, and Asian people in New Zealand. The programme in effect sampled 27% of the targeted populations. From a screening programme perspective, this is a disappointing result, especially in light of the initial target of 70% participation;[18] however, experience from cervical and breast screening in New

Zealand indicates that this target was always going to be difficult to attain within the time and resources available.

To obtain high participation levels, prolonged promotion and provision of the service is required. The national breast-screening programme, BreastScreen Aotearoa, for example, took 4 years to achieve 58% coverage, with considerably lower rates among Maori and Pacific women.[20] The rapid growth in Asian communities in Auckland in the late 1990s and early 2000s made it even more challenging to achieve high levels of coverage among these groups.

Despite different recruitment models, both provider organisations achieved remarkably similar levels of coverage. The Hepatitis Foundation achieved higher rates of uptake than the Consortium in the areas where they had existing relationships with communities, such as the Bay of Plenty. However, there were some areas (for example in Taranaki) where they were less successful. The Consortium programme was most successful with Pacific populations in Auckland (especially among Tongans) and among smaller Maori communities in Northland but struggled to involve large numbers of urban Maori. More detailed accounts of the delivery models are being published elsewhere.

More than 10,000 (5.7%of the 177,328 people screened) tested positive for HBsAg. There were marked differences between and within ethnic group. For example, within Pacific and Asian populations prevalence varied markedly according to the region or country people originated from, and for Maori there were significant regional variations. The very high prevalence among Tongans (13%) is particularly concerning but it is pleasing that this group had the highest levels of coverage, approaching 50%.

Our findings align with previous studies in New Zealand showing men to have higher HBsAg prevalence than women, perhaps reflecting the predominant mode of transmission in these populations, which is hypothesised to be playground accidents in early childhood.[5] The increasing HBsAg prevalence with age is almost certainly a cohort effect rather than reflecting new infections during adult life. The data do not support the previously reported north-south prevalence gradient.[7,9]

There are several possible sources of bias in our analyses. We have assumed that prevalence rates in the participants reflect true community prevalence. However, only 27% of the target population was screened and the extent to which the screened group is representative of the total population is uncertain. This was not a survey of randomly selected individuals. Some participants may have participated because they perceived themselves or were considered by providers to be at ‘high risk’. This is certainly the case for children (under 15 years) and people identifying as ‘Other’ ethnic group who had higher rates than those previously reported, reflecting the fact that most were recruited (appropriately) as contacts of people with CHB.

Conversely, some participants may have been at lower risk of disease as is often the case with those who access preventive healthcare. As the real direction and extent of these effects is unknown and difficult to estimate, we have included simple sensitivity analyses around our prevalence estimates (Table 3) to provide a valid range within which the true prevalence is likely to lie. We also assumed that people who tested HBsAg-positive had CHB, a reasonable assumption because only a small number of HBsAg-positive adults in the target populations would be likely to have acute

infection.[5,6] On balance, we believe that these data provide the best available estimates of CHB prevalence in these populations.

Screening programmes should not proceed unless effective interventions are available that will reduce the impact of the disease for either the community or the individual.[18] In the case of hepatitis B, several effective interventions are now available that offer personal and public health benefits.

First, for those susceptible to hepatitis B, immunisation can be offered. Household and sexual contacts, in particular, should continue to be tested (and immunised if found to be non-immune because of their increased risk). The public health benefit of immunising susceptible adults at lower risk has been considered to be modest, due to the age-related reduction in likelihood of developing CHB after acute infection. However, immunisation of adults in high prevalence populations may be more worthwhile. Recent studies modelling hepatitis B transmission in endemic populations suggest that population protection may be afforded by much lower levels of immunisation coverage than previously thought, due to disruption of the positive feedback loop between age at infection and the proportion who develop CHB, that sustains endemicity at high levels.[21]

Second, people with CHB should be advised to reduce alcohol consumption and to reduce behaviours that risk virus transmission to others (e.g. unprotected sex). The population benefit of such counselling to promote individual behaviour change should not be underestimated as small changes in behaviours that lead to a reduction in transmission could also lead to large differences in CHB prevalence over time.[21]

Third, surveillance to detect the development of active hepatitis or of HCC in people with CHB can be offered. Hopkirk et al [22] demonstrated that the risks of active disease and cirrhosis are moderately high in people with CHB in the Bay of Plenty. For some, treatment with interferon or lamivudine brings about sustained viral suppression and may prevent progression to cirrhosis and even HCC.[23, 24] The public health benefit of treatment should also not be underestimated: lamivudine therapy leads to a marked reduction in infectivity and could, if prescribed more widely to individuals in high prevalence groups, lead to a significant fall in CHB prevalence in a shorter time period than immunisation programmes promise because of the existence of a threshold prevalence effect, below which endemicity may settle to a lower level.[21]

Finally, people diagnosed with early HCC can be offered resection or ablation of the tumour, or in some cases liver transplantation, with potential for improvements in life expectancy and/or quality of life. The evidence for the effectiveness of HCC screening using AFP alone or in combination with ultrasound is currently insufficient to support or refute it;[25] but despite this, HCC screening is recommended practice among hepatologists.[12,26]

A gap exists in hepatitis B control in New Zealand. Vigorous promotion of infant immunisation should continue to be the mainstay of the control strategy and the early management and follow-up testing of infants born to mothers with CHB optimised. Blood donor and antenatal screening should also continue. Screening for intending migrants is in the process of being introduced. Nevertheless, a pool of around at least 30 000 potentially infectious but unidentified people with CHB remains, and this means that eradication will take many generations to achieve, even with high levels of infant immunisation coverage.[27]

Primary care providers should be supported through education and funding to give attention to opportunistic screening of people from known high-prevalence populations, to immunise susceptible individuals and arrange counselling, surveillance and specialist review of those with CHB where appropriate. As primary health organisations mature, such activities will be able to be undertaken in a more systematic way than has been the case to date.

The most pressing challenge arising from the Hepatitis B Screening Programme is to ensure that the more than 10,000 people identified with CHB receive appropriate follow-up surveillance and care. The Hepatitis Foundation is now engaged in this exercise with some success. However, many people are difficult to trace and have been lost to follow-up. Specialist services to which primary care providers can make referrals are lacking or difficult to access in some areas.

Have the benefits of this programme outweighed the costs? In the short term, it is impossible to judge, and without a randomised controlled trial of screening the verdict is unlikely to be clear-cut.

A system for monitoring medium-to-long term outcomes such as HCC and liver failure among the screened population has recently been established in conjunction with the screening and surveillance providers, the Ministry of Health and the Liver Transplant Unit. Such ongoing outcome monitoring from this unique programme will help to judge whether it has been an effective use of healthcare resources and to assess possible impacts on reducing hepatitis B prevalence and sequelae overall, together with any impact on ethnic group inequalities.

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