Supplementary material for 'A Kaupapa Māori approach to a community cohort study of heart disease.

This supplementary material accompanies the paper:

Pitama, S., Wells, J.E. Faatoese, A., Tikao-Mason, K., Robertson, P., Huria, T., Gillies, T. Doughty, R., Whalley, G., Troughton, R., Sheering, I., Richards, M., Cameron, V.A. A Kaupapa Māori approach to a community cohort study of heart disease in New Zealand with two indigenous samples (rural and urban) and an urban non-indigenous sample: Design, methods, and response rates. Submitted to the Australian and New Zealand Journal of Public Health.

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Determination of sex from New Zealand electoral rolls

The Hauora Manawa/Heart Health; The Community Heart Study (hereafter referred to as the Hauora Manawa Project) had samples from a rural area (Wairoa District) and an urban area (Christchurch City Council). The samples selected from the electoral roll for this study were stratified by age and sex. However sex is not a field on the electoral roll. Mostly it can be determined by title but if this was missing or ambiguous (e.g. Dr.) then it was imputed from a list of female English first names: investigation of the number of female names in relation to unambiguous sex on electoral rolls from Wairoa and Christchurch showed that 100% of those with three female names were female, 99.9% of those with two female names were female, 94.2% of those with one female name were female, and 9.8% of those with no female names were females, mainly because of non-English names. To determine sex the title field was used if this was filled in and unambiguous. If not, people were assumed to be female if they had at least one female name. Sex and age were used to stratify the electoral rolls, prior to sample selection. Participants were asked their gender so inappropriate allocation from the electoral roll was corrected. However no such correction was possible with non-participants so for calculation of response rates it was necessary to use sex as determined from the electoral roll.

Final Disposition Codes and Response Rates

Disposition Codes

The final disposition codes and counts are shown in Table 1 for each of the three samples:

- Wairoa Māori Descent sample
- Christchurch Māori Descent sample

- Christchurch Non-Māori Descent sample

'Non-Māori Descent' means that the Māori Descent field on the electoral roll was N for 'No'. A fuller title would be 'People not of Māori Descent'.

Table 1. Final disposition codes and counts

	Outcome	Code	Counts		
			Wairoa	ChCh MD[1]	ChCh NMD[2]
1.	**Interview (attended a clinic)**	**1.0**	**254**	**267**	**257**
	Complete **(**interviewed and examined)	1.1	254	267	257
	Incomplete	1.2	0	0	0
2.	**Eligible non-interview**	**2.0**	**96**	**135**	**104**
	Refusal and breakoffs (not interested)	2.10	87	134	103
	Non-contact but eligible (known to be living in the area, unable to contact)	2.20	9	1	1
3.	**Unknown eligibility, non-interview**	**3.0**	**91**	**151**	**88**
	Moved from address	3.1	0[3]	76	55
	No contact, do not know if still in area	3.2	91[3]	75	33
4.	**Not eligible**	**4.0**	**85**	**95**	**71**
	Out of sample (definitely known to live outside area)	4.1	72	91	62
	In prison	4.3	6	0	0
	Away/unavailable e.g. East Timor	2.25	7	4	9
	Other	**2.30**	**16**	**12**	**11**
	Dead	2.31	2	1	1
	Physically or mentally handicapped	2.32	14	11	10
	Language	2.33	0	0	0
Total			**542**	**660**	**531**

[1] Christchurch Māori Descent sample
[2] Christchurch Non-Māori Descent
[3] The distinction between [3.2] and [3.1] was not made until the Christchurch samples

The final disposition for each person selected was coded according to the American Association for Public Opinion Research (AAPOR) guidelines for in-person household surveys. Slight modifications were made to account for eligibility for a cohort study, instead of a cross-sectional survey ([2.30] codes counted as Not Eligible), and because sampling was from the Electoral Roll and was not an areal sample (this altered the meaning of codes [3.1] and [3.2]).

Response rates

Response rates were calculated conservatively using Response Rate 1 which includes all persons of unknown eligibility in the denominator (http://www.aapor.org/uploads/Standard_Definitions_04_08_Final.pdf).

$$\text{Response Rate = RR} = \frac{[1.1]}{[Total]-[4.0]-[2.30]} = \frac{[1.1]}{[1.1]+[2.0]+[3.0]}$$

$$\text{Wairoa Māori Descent Sample RR} = \frac{254}{542-85-16} = \frac{254}{441} = 57.6\% \text{ (95\% CI 53.0, 62.2)}$$

$$\text{Christchurch Māori Descent Sample RR} = \frac{267}{660-95-12} = \frac{267}{553} = 48.3\% \text{ (95\% CI 44.1, 52.4)}$$

$$\text{Christchurch Non-Māori Descent Sample RR} = \frac{257}{531-71-11} = \frac{257}{449} = 57.2\% \text{ (95\% CI 52.7, 61.8)}$$

In the response rates above those incapable of taking part **[2.30]** were judged ineligible. The deaths occurred prior to sampling so are appropriately excluded. Those who were physically or mentally impaired [2.32] were not eligible for the cohort study and so were excluded. However if they are included in the denominator the response rates decrease only slightly

Wairoa Māori Descent Revised RR = (254/(441+14)) = 55.8% instead of 57.6%.
Christchurch Māori Descent Revised RR = (267/(553+11) = 47.3% instead of 48.3%
Christchurch Non-Māori Descent Revised RR = (257/(449+10) = 56.0% instead of 57.2%

Cooperation Rates

The cooperation rate is the proportion of people contacted who agreed to attend a clinic to be interviewed and examined.

$$\text{Cooperation Rate = CR} = \frac{[1.1]}{[1.1]+[2.10]}$$

$$\text{Wairoa Māori Descent Sample CR} = \frac{254}{254+86} = \frac{254}{340} = 74.7\% \text{ (95\%CI 70.1, 79.3)}$$

$$\text{Christchurch Māori Descent Sample CR} = \frac{267}{267+134} = \frac{267}{401} = 66.6\% \text{ (95\%CI 62.0, 71.2)}$$

$$\text{Christchurch Non-Māori Descent Sample CR} = \frac{257}{257+103} = \frac{257}{360} = 71.4\% \text{ (95\%CI 66.7, 76.1)}$$

Cohorts

To belong to either of the Māori cohorts an individual had to be listed on the Electoral Roll as of Māori descent and, at interview, to confirm descent and list Māori as their sole ethnicity or as one of their multiple ethnicities. To be in the non-Māori cohort required not being of Māori descent and not listing Māori ethnicity. Exclusions ensured appropriate cohort membership for all subsequent analyses.

Wairoa Māori exclusions: Two participants, one who was much older than 64 years of age and another who did not report Māori ethnicity. Three participants had turned 65 by the time they attended a clinic but had been under 65 at the time of sample selection; these were counted as still in the 50-64 age group.
Christchurch Māori exclusions: The 24 participants of Māori descent who did not report Māori ethnicity.
Christchurch Non- Māori exclusions: One participant selected as not of Māori descent who reported being of Māori descent and ethnicity at interview
After exclusions the cohort numbers were 252 for Wairoa Māori, 243 for Christchurch Māori and 256 for Christchurch non-Māori, namely 751 in total. The exclusions were retained in the study for treatment and follow-up but excluded from cohort analyses.

The socio-demographic characteristics of the three cohorts are shown in Table 2.

The Wairoa sample was, on average, 3.0 years older than the Christchurch Māori sample and 2.1 years older than the Christchurch non-Māori sample. Selection for the two Christchurch samples was stratified by age group and sex, and non-response did not significantly disrupt this equality of the age group distributions.

The baseline cohort contains more females than males because, as shown in Table 1, there were more ‘females’ than ‘males’ selected from the Electoral Roll for each sample, reflecting the composition of the roll, more ‘females’ were not excluded, slightly more ‘females’ responded, and then more ‘males were actually female than the reverse (8 versus 1).

As expected from the age range of 20 to 64 years, the majority in each sample were employed (over 70%), with only 4% or less in full-time study. In Wairoa the number without a job last week was 9.5% but in Christchurch it was 5.8 or 5.9%. Employment status did not differ significantly in any comparisons of the samples. Among those who were employed, personal income was lowest for Wairoa Māori and highest for Christchurch Non-Māori, with Christchurch Māori intermediate. The differences are particularly marked for high incomes with only 2.2% of Wairoa Māori earning over $70,000 per annum in contrast to 11.9% of Christchurch Māori and 22.2% of Christchurch Non-Māori. The pattern for household income was similar.

Table 2. Characteristics of the three cohorts at baseline

	Wairoa Māori (a) (N=252)	Christchurch Māori (b) (N=243)	Christchurch Non-Māori (c) (N=256)	P values for pair-wise comparisons (χ^2 tests)		
	%	%	%	(a) vs (b)	(a) vs (c)	(b) vs (c)
Age						
20-29	11.9	15.2	13.7	.01[1]	.11[1]	.79[1]
30-39	22.2	27.2	27.3			
40-49	25.0	30.9	28.5			
50-64	40.9	26.8	30.5			
Sex						
Male	40.5	45.3	48.8	.28	.06	.43
Female	59.5	54.7	51.2			
Employment status						
Employed	72.2	79.8	79.3	.12	.26	.60
Full-time Study	4.0	1.7	3.5			
No Job Last Week	9.5	5.8	5.9			
Other[2]	14.3	12.8	11.3			
Personal income if employed						
≤ $15,000	11.0	6.7	8.4	.0004[3]	<.0001[3]	.05[3,4]
$15,001-$25,000	19.2	10.3	6.9			
$25,001-$50,000	50.0	49.0	39.9			
$50,001-$70,000	15.4	20.6	21.2			
$70,001 +	2.2	11.9	22.2			
Missing[5]	2.2	1.6	1.5			
Household income						
≤ $25,000	19.8	9.5	8.2	<.0001[3]	<.0001[3]	.004[3]
$25,001-$50,000	34.5	23.6	15.2			
$50,001-$70,000	19.1	19.4	19.9			
$70,001-$100,000	10.7	24.4	19.5			
$100,001 +	8.7	18.2	32.0			
Missing[5]	7.1	5.0	5.1			

[1] Means (sd) for age for the three samples were: Wairoa Māori 45.7 (11.5); Christchurch Māori 42.7 (11.2); Christchurch Non-Māori 43.6 (11.5). a) vs b) p=.003, a) vs c) p=.04, b) vs c) p=.34

[2] Over the three samples: Looking after children at home without pay (68), voluntary work (13), working in a family business without pay (4), retired (11)

[3] Calculated excluding missing values

[4] Kolmogorov-Smirnov test, which takes account of order of income categories p=.02

[5] Almost all "Don't know", rather than "Refused"

Weighting

The differential response rates raised the issue of weighting. However there were a number of options for weighting. In addition, as the study was designed as a cohort study with two year follow-up, if weighting was used at baseline then it would need to be applied at follow-up and modified by loss to follow-up.

One option was to weight to the age and sex distribution of the electoral rolls at the time the samples were selected from them. This has an implicit assumption that those who had moved from the area had been replaced by people of a similar age and sex. A non-trivial proportion was known to have moved from each area: Wairoa Māori 15.7%, Christchurch Māori 14.4%, Christchurch non-Māori 13.4%. For all three samples older people were less likely to be known to be living outside the area. Comparison of 2002 and 2006 census figures (http://www.stats.govt.nz/Census/2006-census-data/2006-census-reports/final-counts-tables.aspx) shows that in Wairoa the population declined by 4.8% whereas in Christchurch it increased by 7.5% so the replacement assumption is questionable. Nonetheless it is usual to weight to the roll, register or most recent census distribution, so this option was used and is called "Weighted to Electoral Roll".

The option which would have had the least effect on the baseline means and prevalences would have been to weight to the selected sample known to be eligible. This option did seem reasonable for Wairoa because those people completely untraceable in such a small rural community probably did not live there anymore as no-one knew of them, including neighbours who were contacted in person if there was an address on the Electoral Roll and not just a Post Office Box Number. However it was not justifiable for Christchurch City.

Another option investigated was to weight to the age and sex distribution of the selected sample, minus those known to not be eligible. This corresponds to using the inverse of the response rate because for both the Response Rate and this way of weighting, those of unknown eligibility are included. This form of weighting is called "Weighting to Inverse of Response Rate".

For both "Weighted to Electoral Roll" and "Weighting to Inverse of Response Rate" the weight was calculated for each age-sex cell. The cell sizes of 36 to 106 are small for establishing weights in this way.

Because younger people were both more likely to have left the district and more likely to not have responded, "Weighting to the Electoral Roll" weights up younger people more than "Weighting to Inverse of Response Rate" because the latter includes only nonresponse, as those ineligible have been excluded.

Table 3 enables comparison of results from

- unweighted analyses
- weighting to the inverse to the response rate
- weighting to the Electoral Roll

for key clinical variables, age and sex, and self-reported heath measures. For these comparisons the three cohorts are combined, as the purpose is to show the effects of the three different weighting options.

Table 3. Comparison of means and percentages unweighted and with weighting (N=751)

Measure	N	Unweighted Mean	Weight = 1/(RR)[1] Mean	Weighted to Electoral Roll Mean
Clinic measures				
Creatinine[2]	710	80.2	80.2	80.2
Cholesterol[2]	710	5.24	5.17	5.15
Triclycerides[2]	710	1.39	1.38	1.37
High Density Lipoprotein (HDL)[2]	710	1.28	1.27	1.27
Low Density Lipoprotein[2]	703	3.33	3.28	3.26
Ratio Total Cholesterol:HDL[2]	703	4.24	4.22	4.21
Height	750	169.4	169.7	169.9
Weight	750	82.2	81.6	81.4
BMI	750	28.6	28.3	28.2
Self-report				
Age	751	44.0	41.4	40.5
Gender (% Male)	751	44.9	46.1	46.3
Self-reported doctor diagnosis				
Hypertension (%)	751	19.8	17.6	16.8
High Cholesterol (%)	751	19.8	17.1	16.2
Skin disease (%)	751	14.4	14.0	13.9
Asthma (%)	751	19.8	20.7	21.0
Cardiovascular Risk [3] (%)	751	32.5	28.6	27.2
Self-reported health service use				
Regular Medication in last 3 months (%)	749	46.3	43.9	43.2
Saw a family doctor in last 3 months (%)	751	53.5	51.3	50.6
Saw a family doctor in last 12 months (%)	751	79.2	77.7	77.4
Saw a specialist in last 12 months (%)	747	34.1	35.0	35.1

[1] RR = Response rate
[2] Determined from fasting bloods
3 Cardiovascular risk = Type 2 Diabetes or Hypertension or High Cholesterol

As the effect of weighting is primarily to weight up younger people, the mean age decreases from 44.0 to 41.4 to 40.5. As the response rate did not differ much between males and females the percentage male increased only from 44.9% to 46.1% to 46.3%.

For all other variables except for height the means or percentages were very similar or decreased from unweighted estimates to response rate weighting to electoral roll weighting (height increased because younger people tend to be taller). The largest decrease was seen in the percentage with cardiovascular risk which declined from 32.6% to 28.6% to 27.2%; this reflects the strong increase in cardiovascular risk with age.

It was decided not to weight the data at baseline in this cohort study. There was no information about who did not respond other than age group and sex. Therefore there is no way of knowing whether those who were unhealthy were more or less likely to become participants. Also weighting

made little difference to means and to most prevalences. Finally age and sex will be included in subsequent analyses so that weighting would be relatively unimportant when comparisons do include age and sex in each model.

Personal Health, Family Health and Health Service Use

Tables 4 and 5 provide information relevant to the questions of whether those who participated were already unwell, or from families with health problems, particularly heart problems. The personal health questions asked about ever having been diagnosed or ever experiencing an event or intervention and the family health section asked the same questions about any family member. Table 4 presents results summed across the three cohorts whereas Table 5 presents results for each cohort. Percentages quoted below in text for each cohort are unadjusted but significance was evaluated in models including sample, age group and sex, unless otherwise stated.

Table 4. Age and self-reported personal health, family health problems, and health service use (N = 751)

	Age in years						
	20-29 (n=102)	30-39 (n=192)	40-49 (n=211)	50+ (n=246)	Total (N=751)	Wald[1]	
	%	%	%	%	%	$\chi^2(3)$	p[1]
Personal Health							
Cardiac risk factor[2]	6.9	15.6	32.7	56.1	*32.5*	96.9	<.0001
Previous cardiac event[3]	0.0	0.5	5.2	8.9	*4.5*	23.3[5]	<.0001[5]
Cardiac Intervention[4]	0.0	0.0	1.9	3.7	*1.7*	10.6[5]	.01[5]
Asthma	26.5	21.9	13.7	20.7	*19.8*	8.4	.04
Rheumatic fever	2.0	3.1	5.2	6.9	*4.8*	5.5	.14
Family History							
Cardiac risk factor[2]	78.4	83.3	83.9	77.2	*80.8*	4.5	.21
Previous cardiac event[3]	64.7	68.8	72.5	76.8	*71.9*	8.8	.03
Cardiac Intervention[4]	18.6	26.0	23.2	20.7	*22.5*	2.5	47
Asthma	60.8	46.4	44.6	49.6	*48.9*	7.8	.05
Rheumatic fever	9.8	9.4	12.8	19.5	*13.7*	8.2	.04
Personal use of health services							
On regular medication in past 3 months	35.3	37.0	39.5	64.1	*46.3*	44.8	<.0001
Attended GP in past 3 months	43.1	43.2	49.8	69.1	*53.5*	36.7	<.0001
Attended GP in past 12 months	74.5	72.9	75.8	89.0	*79.2*	19.9	.0002
Attended specialist or hospital in past 12 months	40.2	35.8	26.7	36.7	*34.1*	8.2	.04

[1] Wald χ^2 and p for age from a logistic regression model with sample, four age groups, and sex
[2] Type 2 Diabetes Mellitus, hypertension, high cholesterol
[3] angina, myocardial infarction (heart attack), heart failure, or stroke
[4] Pacemaker, PCI (stent/angioplasty), bypass surgery, or Other (specified and checked as appropriate)

[5] Sparse data so could not fit model with age, sex and sample. Even with age group by outcome, $\chi^2(3)$ possibly invalid for cardiac intervention but comparing those aged <50 and ≥ 50, Fisher exact test 2 tailed, p=.01, as for $\chi^2(3)$.

For personal health it was expected that the percentage ever diagnosed with cardiovascular risk factors or events, or given cardiac interventions, would rise steeply with age whereas the percentage who had ever had health problems such as asthma or rheumatic fever would be more constant over the age groups. Tables 4 and 5 do show the expected patterns for personal health. There were some significant differences across the cohorts in self-reported health problems. Asthma was marginally more common in Christchurch Māori than in Christchurch Non-Māori (24.3% vs 16.8%; Wairoa Māori 18.7%). Rheumatic fever was most common in Wairoa (9.5%), intermediate in Christchurch Māori (4.1%) and lowest in Christchurch Non-Māori (0.8%). The percentage with any cardiovascular risk factor was only marginally different across the cohorts (Wairoa Māori 38.1%, Christchurch Māori 32.5%, Christchurch 27.0%). Numbers affected were too small for modelling of cardiovascular events and cardiovascular interventions so simple cohort by event cross tabulations were carried out. These showed higher percentages of cardiovascular events in the Māori cohorts (7.5%, 4.5%, 1.6%) and a marginally non-significant trend for cardiac interventions (3.2%, 1.7%, 0.4%).

Family history is reported in Tables 4 and 5 because family history could have influenced the decision to participate, even if an individual did not have diagnosed personal health problems. Therefore any family history is reported in Table 3, not just family history in a single group of relatives such as parents, grandparents, siblings or other relatives. Most participants (80.8%) were aware of a family member with a cardiovascular risk factor, and 71.9% had a relative who had experienced a cardiac event, but only 22.5% reported any cardiac intervention. In contrast to the steep rise with age for personal cardiac risk factors, events or interventions, there was little change across the age groups for family history. The exceptions were that a family history of asthma was more common in the youngest age group and a family history of rheumatic fever was more common among older participants. Family history of asthma and of rheumatic fever also differed across the samples, as was found for personal history. A family history of asthma was reported by 58.3% of Wairoa Māori, 51.4% of Christchurch Māori and 37.1% of Christchurch non-Māori. A family history of rheumatic fever was much more common among Wairoa Māori (24.6%) than among Christchurch Māori (9.5%) or Christchurch non-Māori (7.0%). The Māori cohorts were slightly more likely than the non-Māori cohort to report a family history of cardiovascular risk: 82.9%, 84.0% and 75.8%. A family history of cardiac event differed across the three cohort, being highest for Christchurch Māori (77.9%) with lower percentages for Christchurch non-Māori (70.9%), and Wairoa Māori (67.9%). The three cohorts did not differ significantly in family history of cardiac intervention: Wairoa Māori 19.4%, Christchurch Māori 23.9%, Christchurch non-Māori 24.2%.

There was no difference in the service use within the three cohorts. Overall, participants did make use of health services with 79.2% having attended primary care in the past 12 months, and 34.1% having seen a specialist or been in hospital. In the past three months 53.5% had attended primary care and 46.3% had been on regular medication. Service use was highest in the 50-64 age group except for secondary care (hospital or specialist care) for which there was little difference across the age groups but with the lowest percentage in the 40-49 year age group. This pattern for specialist care was seen for females but not for males (interaction $\chi^2 = 7.1$, df = 3, p = .07), presumably because of pregnancy and child birth in younger women. There were no cohort differences in health service use except for a marginally significant difference in the percentage who had seen a doctor in the past 12 months: 84.9% for Wairoa Māori, 73.7% for Christchurch Māori, 78.9% for Christchurch non-Māori, (χ^2=5.8, df=2, p=.06).

Table 5. Age and self-reported personal health, family health problems, and health service use for each cohort

	Age in years						
	20-29 (n=102) %	30-39 (n=192) %	40-49 (n=211) %	50+ (n=246) %	Total (N=751) %	Test[1] $\chi^2(3)$	p
	Wairoa Māori cohort (n=252)						
Personal Health							
Cardiac risk factor[2]	10.0	5.4	34.9	66.0	*38.1*	69.8	.0001
Previous cardiac history[3]	0.0	0.0	11.1	1.7	*7.5*	10.7[5]	.01[5]
Cardiac Intervention[4]	0.0	0.0	3.2	5.8	*3.2*	-	-
Asthma	23.3	21.4	14.3	18.5	*18.7*	1.5	.68
Rheumatic fever	6.7	8.9	14.3	7.8	*9.5*	2.3	.51
Family History							
Cardiac risk factor[2]	76.7	85.7	87.3	80.6	*82.9*	2.4	.50
Previous cardiac history[3]	63.3	67.9	58.7	74.8	*67.9*	4.9	.18
Cardiac Intervention[4]	16.7	26.8	15.9	18.5	*19.4*	2.7	.45
Asthma	60.0	51.8	50.8	66.0	*58.3*	5.0	.17
Rheumatic fever	23.3	23.2	22.2	27.2	*24.6*	6.5	.88
Personal use of health services							
On regular medication in past 3 months	46.7	42.9	42.9	65.0	*52.4*	11.3	.01
Attended GP in past 3 months	43.3	51.8	50.8	69.9	*57.9*	10.9	.01
Attended GP in past 12 months	93.3	82.1	79.4	87.4	*84.9*	4.0	.26
Attended specialist or hospital in past 12 months	36.7	32.1	20.6	44.1	*34.7*	9.7	.02

	Age in years						
	20-29 (n=102) %	30-39 (n=192) %	40-49 (n=211) %	50+ (n=246) %	Total (N=751) %	Test[1] $\chi^2(3)$	p
	Christchurch Māori cohort (n=243)						
Personal Health							
Cardiac risk factor[2]	8.1	21.2	34.7	55.4	*32.5*	29.5	<.0001
Previous cardiac history[3]	0.0	1.5	5.3	9.2	*4.5*	6.6[5]	.09[5]
Cardiac Intervention[4]	0.0	0.0	2.7	3.1	*1.7*	-[5]	-[5]
Asthma	27.0	28.8	20.0	23.1	*24.3*	1.7	.64
Rheumatic fever	0.0	1.5	1.3	12.3	*4.1*	15.2[5]	.002[5]
Family History							
Cardiac risk factor[2]	91.9	84.9	88.0	73.9	*84.0*	7.6	.05
Previous cardiac history[3]	73.0	74.2	78.7	81.5	*77.4*	1.5	.68
Cardiac Intervention[4]	21.6	28.8	25.3	18.5	*23.9*	2.1	.55
Asthma	62.2	51.5	49.3	47.7	*51.4*	2.2	.53
Rheumatic fever	5.4	4.6	10.7	15.4	*9.5*	5.4	.15
Personal use of health services							
On regular medication in past 3 months	21.6	37.9	41.9	67.7	*44.6*	23.4	<.0001
Attended GP in past 3 months	40.5	36.4	45.3	69.2	*48.6*	16.3	.001
Attended GP in past 12 months	67.6	66.7	66.7	92.3	*73.7*	15.9	.001
Attended specialist or hospital in past 12 months	40.5	42.2	32.4	35.4	*37.1*	1.7	.64

	Age in years						
	20-29 (n=102) %	30-39 (n=192) %	40-49 (n=211) %	50+ (n=246) %	Total (N=751) %	Test[1] $\chi^2(3)$	p
	Christchurch Non-Māori cohort (n=256)						
Personal Health							
Cardiac risk factor[2]	2.9	18.6	28.8	43.6	*27.0*	23.9	<.0001
Previous cardiac history[3]	0.0	0.0	0.0	5.1	*1.6*	-[5]	-[5]
Cardiac Intervention[4]	0.0	0.0	0.0	1.3	*0.4*	-[5]	-[5]
Asthma	28.6	15.7	6.9	21.8	*16.8*	10.1	.02
Rheumatic fever	0.0	0.0	1.4	1.3	*0.8*	-[5]	-[5]
Family History							
Cardiac risk factor[2]	67.1	80.0	76.7	75.6	*75.8*	2.6	.45
Previous cardiac history[3]	57.1	64.3	78.1	75.6	*70.7*	7.3	.06
Cardiac Intervention[4]	17.1	22.9	27.4	25.6	*24.2*	1.5	.68
Asthma	60.0	37.1	34.3	29.5	*37.1*	10.1	.02
Rheumatic fever	2.9	2.9	6.9	12.8	*7.0*	6.8	.08
Personal use of health services							
On regular medication in past 3 months	40.0	31.4	34.3	59.7	*42.0*	15.0	.002
Attended GP in past 3 months	45.7	42.9	53.4	68.0	*53.9*	10.6	.01
Attended GP in past 12 months	65.7	71.4	82.2	88.5	*78.9*	10.8	.01
Attended specialist or hospital in past 12 months	42.9	32.9	26.0	28.2	*30.9*	3.5	.31

[1] χ^2 value from chi-square test for contingency tables, testing for differences between the age groups

[2] Type 2 Diabetes Mellitus, hypertension, high cholesterol

[3] Angina, myocardial infarction (heart attack), heart failure, or stroke

[4] Pacemaker, PCTA (stent/angioplasty), bypass surgery, or Other (specified and checked as appropriate)

[5] χ^2 may be invalid because of small numbers in some cells, or is not quoted for this reason

Note that age trends are broadly similar across the samples. The only obvious difference is in the prevalence of having ever had rheumatic fever. This did not differ with age in Wairoa, marginally increased with age in Christchurch non-Māori, and rose steeply with age for Christchurch Māori, possibly reflecting migration to Christchurch from higher prevalence areas.

Referral after Clinic Attendance

After clinic examination patients were triaged into those who did not require any referral, those referred for a free visit to their general practitioner only, and those referred for a free visit to a cardiologist (most of these were also referred to their general practitioner). The criteria for referral were based on the NZ Cardiovascular Guidelines (New Zealand Guidelines Group, 2009). Any results above the 'recommended range' lead to a GP referral. Triaging for a direct cardiologist referral was made through a clinical decision by cardiologists on the research team. Table 6 shows the percentage in each triage category by cohort, age group and sex. Percentages quoted below are simple summaries from Table 6. Tests of significance, however, are from models with all three factors included. Overall, out of the 751 in the three cohorts, 74 were referred to a cardiologist (9.9%), 427 to a general practitioner only (56.9%), leaving just 250 not referred (33.3%). Almost all those referred to a cardiologist were also referred to their general practitioner. Therefore models were first fitted to predict any referral.

For any referral, age (χ^2=49.7, df=3, p<0001), sex (χ^2=40.7, df=1, p<0001) and cohort (10.9, df=2, p=.004) were all significant. Males were more likely than females to be referred (78.9% versus 56.8%) and referral increased with age: 20-29 years, 44.1%, 30-39 years, 57.8%, 40-49 years 68.7% and 50-64 years, 81.3%. In a model with an age by sex interaction term added this term was marginally non-significant (χ^2=7.72 df=3 p=.052) and suggested that males tended to be referred at earlier ages than females with the difference being less marked in those aged 50 years or more. The percentage referred at all was 69.8% in the Wairoa Māori cohort, 70.8% in the Christchurch Māori cohort and 59.8% in the Christchurch non-Māori cohort. Taking account of age group and sex, the Christchurch non-Māori cohort was the least likely to be referred (versus Wairoa Māori χ^2=5.9 df=1 p=.02; versus Christchurch Māori χ^2=9.7 df=1 p=0.002) and the two Māori cohort did not differ (χ^2=.5 df=1 p=.50).

Referral to a cardiologist was also predicted by age (χ^2=8.4, df=3, p=.04), sex (χ^2=4.0, df=1, p=.045), and cohort (χ^2=7.0, df=2, p=.03). Across the age groups the percentage referred to a cardiologist increased from 5.9% to 7.3%, 9.5% and 13.2%. Males were more likely to be referred than females (12.5% versus 7.7%). Using the clinical judgement of the cardiologists within the research team, the percentage referred was lowest in the Wairoa Māori cohort (7.5%), intermediate in the Christchurch non-Māori cohort (8.6%) and highest in the Christchurch Māori cohort (13.4%). Taking account of age and sex the Christchurch Māori cohort were the most likely to be referred (versus Wairoa Māori χ^2=5.9, df=1. p=.01; versus Christchurch non-Māori χ^2=3.8, df=1, p=.05). The Wairoa Māori cohort and the Christchurch non-Māori cohort did not differ significantly (χ^2=0.3, df=1, p=.58).

Table 6. Percentage with each type of referral after clinic examination

	Males			Females		
Age group	No referral	GP	Cardiologist	No referral	GP	Cardiologist
			Wairoa Māori Cohort (N=252)			
20-29	50.0	40.0	10.0	75.0	25.0	0.0
30-39	34.8	56.5	8.7	54.6	45.4	0.0
40-49	4.6	86.3	9.1	34.2	56.1	9.8
50+	10.6	74.5	14.9	17.9	76.8	5.4
			Christchurch Māori Cohort (N=243)			
20-29	33.3	66.7	0.0	50.0	40.9	9.1
30-39	15.6	68.8	15.6	50.0	41.2	8.8
40-49	9.1	69.7	21.2	45.2	52.4	2.4
50+	10.0	56.7	33.3	22.9	62.9	14.3
			Christchurch Non-Māori Cohort (N=256)			
20-29	56.3	43.8	0.0	63.2	21.1	15.8
30-39	21.9	68.8	9.4	68.4	29.0	2.6
40-49	27.8	63.9	8.3	51.4	40.5	8.1
50+	24.4	70.7	4.9	27.0	54.1	18.9
			Total across the three cohorts (N=751)			
20-29	46.3	51.2	2.4	62.3	29.5	8.2
30-39	23.0	65.5	11.5	58.1	38.1	3.8
40-49	15.4	71.4	13.2	43.3	50.0	6.7
50+	15.3	68.6	16.1	21.9	66.4	11.7
All ages	21.1	66.4	12.5	43.2	49.0	7.7