



Trends in major cardiovascular risk factors in Auckland, New Zealand: 1982 to 2002-2003

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Abstract

Aim To describe recent trends in cardiovascular risk factors between 1982 and 2002–2003 in Auckland, New Zealand.

Methods Data on non-Māori and non-Pacific adults aged 35–74 years were derived from four population-based surveys carried out in 1982, 1986–88, 1993–94, and 2002–3 using similar protocols.

Results Systolic blood pressure levels continue to decline since the 1982 survey, together with a reduction in the proportion of people with raised blood pressure who were untreated. The downwards trend in cigarette smoking observed between 1982 and 1993–94 appears to have halted. Serum total cholesterol declined from 6.18 mmol/L in 1982 to 5.62 mmol/L in 2002–3 in men; and from 6.26 mmol/L in 1982 to 5.37 mmol/L in 2002–3 in women. HDL-cholesterol levels continued to rise over this time period. Use of lipid lowering medications increased from 0% in the 1982 and 1986–88 studies to 1.3% in men and 2.6% in women in the 1993–4 survey, and to 6.3% in men and 2.7% in women in the 2002-3 survey. The age-standardised mean body mass index increased from 25.6 (25.4–25.8) kg/m² in 1982 to 27.2 (26.9–27.6) kg/m² in 2002–3 in men; and from 24.5 (24.2–24.9) kg/m² in 1982 to 26.6 (26.2–27.0) kg/m² in women in 2002–3. The prevalence of overweight and obese people increased from 52.8% (49.7–55.9) to 70.9% (67.7–74.1) in men and from 36.5% (32.5–40.5) to 57.0% (53.4–60.6) in women.

Conclusions Trends in systolic blood pressure, raised blood pressure, serum cholesterol, HDL-cholesterol levels, and use of antihypertensive and cholesterol-lowering drug use in non-Māori and non-Pacific adult Aucklanders between 1982 to 2002–04 have been favourable. However, these favourable trends were, in part, counterbalanced by less favourable trends in body mass index, obesity, and cigarette-smoking. These findings suggest that the decline in cardiovascular mortality rates in New Zealand over the past 35 years may not be sustained.

Coronary heart disease, other diseases of the heart, and cerebrovascular disease are the leading causes of death in New Zealand.¹ The death rates for coronary heart disease and stroke have been declining since the 1970s.² Part of this decline is attributed to reductions in cardiovascular disease risk factor levels and increased treatment.³

Three previous cross-sectional surveys (the 1982 Auckland Risk Factor Study, the 1986-1988 Heart Study, and the 1993–1994 Auckland Heart and Health Study) conducted in the Auckland area measured cardiovascular risk factors and described their trends over time in non-Māori and non-Pacific people.^{3–5} These studies

demonstrated a decline in the prevalence of untreated and under treated raised blood pressure,³ together with a decrease in blood pressure levels. The reduction in mean blood pressure levels was not explained by increased drug treatment, but may have been due to increased leisure time physical activity.⁶ These studies also showed a clear reduction in the prevalence of self-reported cigarette smoking, and mean serum total cholesterol levels in Aucklanders aged 35–64 years.⁵

This report updates these previous surveys and describes the trends in cardiovascular disease risk factor levels from 1982 to 2002–2003 in Auckland.

Methods

Three cross-sectional surveys measuring cardiovascular risk factors have been undertaken in the Auckland metropolitan area since 1982 as part of the World Health Organization MONICA project. The methodology has been fully described elsewhere.^{4,5} The initial study was the 1982 Auckland Risk Factor Study involving 1568 people aged 35 to 64 years.

In 1986–88, 888 people aged 35–64 years participated in the Auckland Heart Study; and in 1993–94, 1893 people aged 35–74 years were involved in the Auckland Heart and Health Study. In each survey, age- and gender-stratified random samples were selected from the Auckland general electoral rolls. Response rates in these three studies were between 72% and 85%. Māori were excluded because approximately half were enrolled on the Māori electoral roll and those on the general roll were not considered to be representative of all Māori. Other non-Europeans were excluded from the analyses because of small numbers and concern regarding their incomplete electoral roll registration.

The fourth study, the Auckland Diabetes, Heart and Health Survey, was carried out between December 2001 and November 2003. Adults aged 35–74 years were recruited from 2 sampling frames: one was a cluster sample where random starting point addresses were obtained from Statistics New Zealand and the probability of selection was proportional to the number of people living in that mesh block (response rate 61.3%); and the other was a random sample taken from the November 2000 Auckland electoral rolls stratified into 5-year age bands and included all people living in the Auckland area, but excluding Franklin and Rodney (response rate 60%).

Out of the 2024 non-Māori and non-Pacific participants interviewed, 942 were from the cluster sample, and 1082 were from the electoral roll. Māori and Pacific participants were not included in this report because there is no historical data to compare them to. However, the data collected will provide baseline data for future surveys.

Ethical Committee approval was obtained from the Auckland Ethics Committees. Similar standardised data collection methods were used in all four surveys. In the first three surveys, interviews were carried out at central study centres. In the fourth survey, interviews were carried out in halls or clinics close to participant's homes.

Personnel were trained in the administration of the questionnaires and in taking blood pressure and other measurements. In the first three surveys, blood pressure was measured twice (5 minutes apart) with regularly calibrated Hawksley random zero sphygmomanometers, and in the fourth survey, Omron-Hem-706 oscillometric blood pressure pulse monitors were used. The Omron monitor read 1.74 mmHg ($p=0.04$) higher for systolic and 1.26 mmHg higher for diastolic blood pressure ($p=0.04$) than the random zero sphygmomanometer in a group of 237 people.

The data have not been adjusted for this difference, so results will be conservative. Correlations between the two monitors were 0.76 for systolic and 0.82 for diastolic blood pressure levels. Normal and obese cuff sizes were used in all of the studies.

A person was arbitrarily classified as having raised blood pressure if the mean of the two measured blood pressures was >150 mmHg systolic or >90 mmHg diastolic, or if they reported taking medication for raised blood pressure.

As done previously,⁶ the population prevalence of raised blood pressure was calculated by classifying the population into four groups based on blood pressure levels and use of blood pressure lowering medication:

- Blood pressure >150/90 mmHg and on no medication.
- On blood pressure lowering medication with a blood pressure >150/90 mmHg.
- On blood pressure lowering medication with a blood pressure ≤150/90 mmHg.
- Blood pressure ≤150/90 mmHg on no blood pressure lowering medication.

Serum cholesterol was measured using the enzymatic methods of Allain et al,⁷ and HDL-cholesterol was measured using after precipitation of apolipoprotein B-containing lipoproteins with magnesium phosphate⁸ in the first three surveys and using a combination of a polyion and a divalent cation (Roche) in the last survey. The latter directly measures HDL-cholesterol and has been shown to estimate levels 0.1 mmol/L higher than for HDL-cholesterol measured by precipitation.⁹ Results have not been adjusted to take account of these differences.

At the time of the 1986–88 survey, it became apparent that the 1982 cholesterol results were consistently lower than expected, based on the 1986–88 results. As described elsewhere, repeat measurement of 200 frozen 1982 serum samples were carried out and the 1982 results have been adjusted using the equation: $0.1352892 + (1.061393 * \text{crude value})$.^{3,5}

Cigarette smoking status was self-reported by the participant using similar questions in all four surveys. The 5-year risks of cardiovascular disease were calculated according to the New Zealand Guidelines Group¹⁰ for the 2002–3 survey as not all the required risk factor levels were measured in earlier surveys.

Weight and height were measured to the nearest 0.1 kg and 0.5 cm, respectively. Body mass index (BMI) was calculated as weight (in kg) divided by the square of height (in m). Obesity was defined as a body mass index >30 kg/m², and overweight as a body mass index between >25 and 30 kg/m².

Participant data from the most recent survey were weighted according to the sampling frame that they were obtained from and means, standard errors and prevalences calculated using dual frame sampling methodology.^{11–13}

SAS survey procedures (SURVEYMEANS, SURVEYREG, and SURVEYFREQ) were used to calculate weighted means, adjusted means and percentages.¹⁴ To make comparisons between the four surveys, means and prevalence estimates were then directly age standardised to the 1986 New Zealand population after taking into account the sample design, and 95% confidence intervals calculated using standard methods.

Results

Mean systolic and diastolic blood pressure levels for the four surveys in men and women by age groups are reported in Table 1. In the fourth survey, one person was excluded due to missing blood pressure measurements and four were excluded as they were outside the age range, thus leaving 2019.

Figures 1 and 2 show that, in general, in both men and women, there was a downwards trend in systolic blood pressure levels between 1982 and 2002–03 in all age groups.

For diastolic blood pressure, levels decreased in both men and women between 1982 and 1993–94, but have since remained approximately stable.

Table 1. Mean (SE) systolic and diastolic blood pressure of 2019 participants by age group and gender in the periods of the four surveys (with 95% confidence intervals)

Systolic blood pressure (mmHg)				
Men				
Age group (years)	35–44	45–54	55–64	65–74
1982	126.6 (124.7–128.4)	132.9 (131.3–134.5)	139.9 (137.9–141.9)	–
1986–8	124.9 (122.6–127.5)	128.2 (126.0–130.4)	137.8 (135.5–140.1)	–
1993–4	121.5 (119.7–123.3)	124.2 (122.1–126.3)	135.8 (133.5–138.1)	143.8 (142.0–145.8)
2002–2003	118.6 (116.7–120.4)	123.9 (121.7–126.2)	130.9 (128.5–133.4)	141.2 (138.0–144.3)
Women				
1982	117.9 (115.9–119.9)	125.8 (123.3–128.3)	137.8 (135.1–140.5)	–
1986–8	117.0 (117.7–122.3)	128.7 (124.7–132.4)	139.0 (136.1–141.9)	–
1993–4	111.3 (109.5–113.1)	123.8 (121.6–126.0)	135.2 (135.2–137.7)	144.9 (143.2–146.7)
2002–2003	105.1 (103.5–106.8)	116.0 (113.7–118.3)	122.5 (120.1–124.9)	133.1 (130.4–135.8)
Diastolic blood pressure (mmHg)				
Men				
1982	79.5 (78.0–81.0)	83.8 (82.7–84.9)	83.5 (82.3–84.7)	–
1986–8	81.5 (79.5–82.5)	81.1 (79.7–82.5)	82.2 (80.8–83.6)	–
1993–4	73.3 (71.8–74.8)	75.4 (74.0–76.8)	76.8 (75.4–78.2)	73.5 (72.4–74.8)
2002–2003	75.9 (74.7–77.1)	78.4 (77.1–79.7)	79.2 (77.8–80.6)	78.9 (77.4–80.4)
Women				
1982	74.0 (72.6–75.4)	78.5 (76.9–80.1)	81.5 (79.8–83.2)	–
1986–8	75.5 (72.5–78.5)	79.3 (77.1–81.5)	81.3 (79.6–83.0)	–
1993–4	67.1 (65.6–68.6)	73.8 (72.3–75.3)	73.2 (71.7–74.7)	74.4 (73.3–75.4)
2002–2003	70.4 (69.3–71.5)	74.1 (72.8–75.3)	73.8 (72.6–75.0)	73.2 (71.9–74.5)

To examine time trends in the prevalence of raised blood pressure, the following analyses were restricted to participants aged 35–64 years and prevalence estimates were directly age-standardized to the 1986 New Zealand census population.

Table 2 shows the prevalence of raised blood pressure by treatment category and by gender for the 1982, 1986–88, 1993–94, and 2002–2003 studies. The proportion of people with untreated blood pressure levels >150/90 mmHg fell by more than 83% in men and women between 1982 and 2002–03. The total proportion of people with blood pressure levels <150/90 increased by approximately 20% over the period.

Figure 1. Trends in systolic and diastolic blood pressure in men by age group

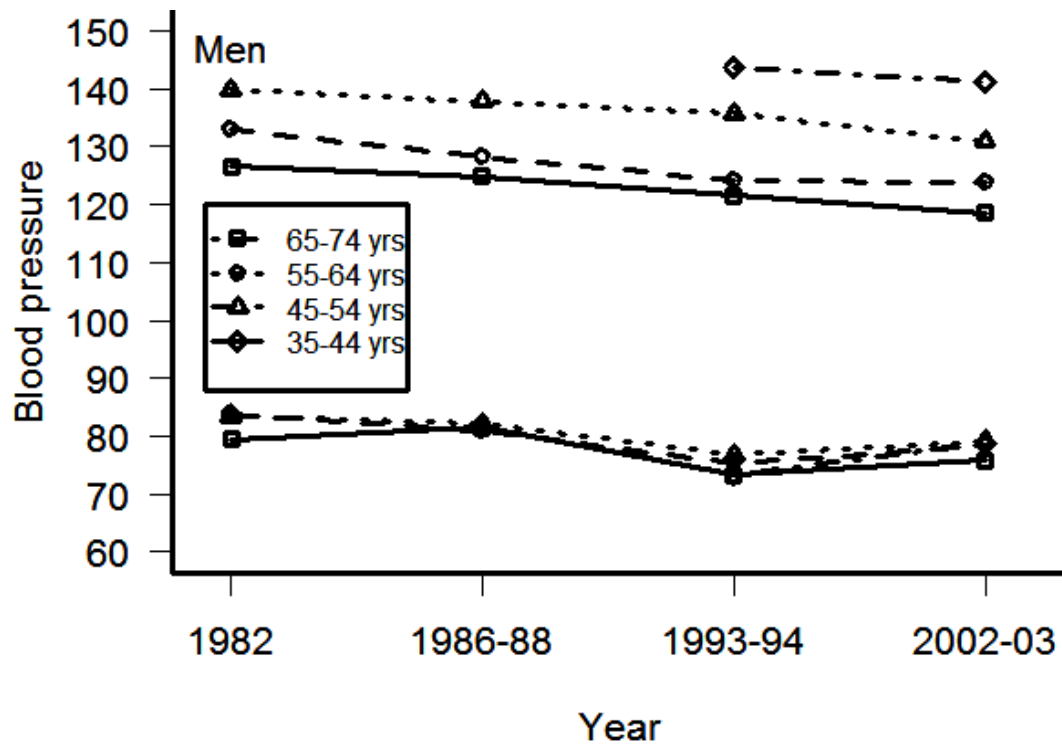
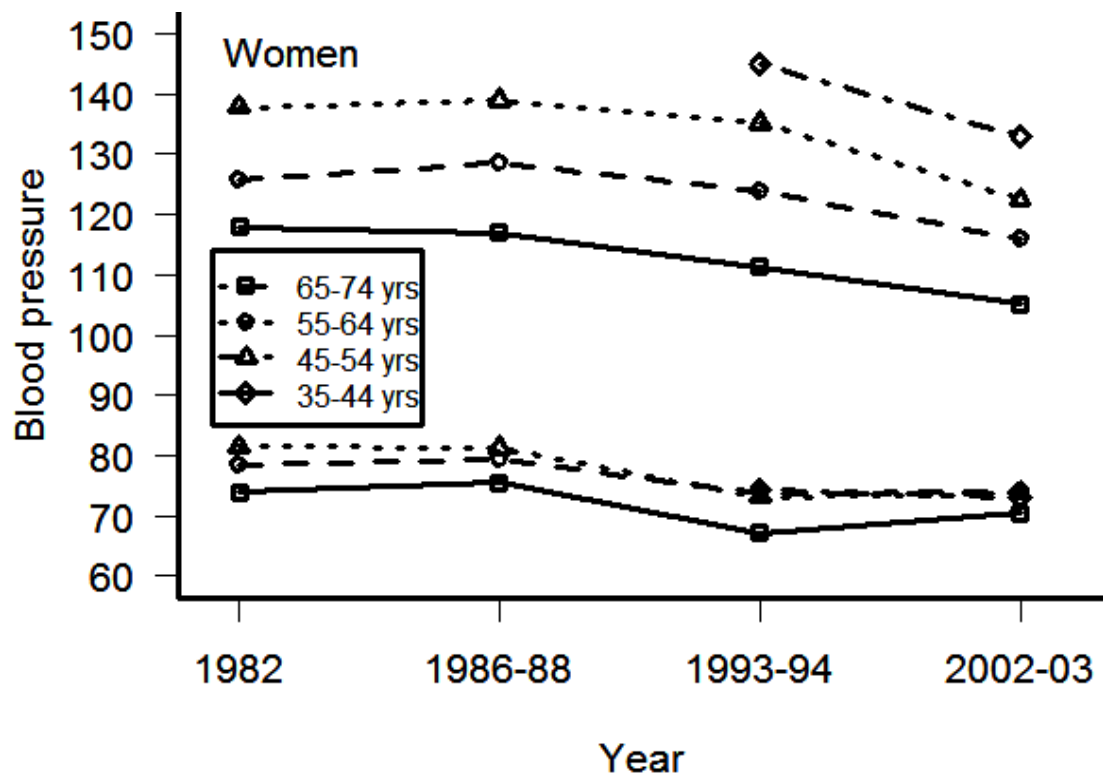


Figure 2. Trends in systolic and diastolic blood pressure in women by age group



The percentage of people on treatment with blood pressure >150/90 mmHg also declined over the 20-year period, particularly in women. The proportion of men and women with treated blood pressure below 150/90 mmHg increased over the period, particularly in men. There was a small increase in the total prevalence of treatment in men and a small decrease in women.

Table 2. Age standardised[†] percentage (95% confidence interval) of raised blood pressure among Europeans by gender for the four surveys

Men	1982	1986–88	1993–94	2002–03
Number	1019	537	712	997
1. BP >150/90, no Rx	20.0 (17.54–22.5)	20.2 (16.8–23.6)	10.6 (8.3–12.9)	3.3 (2.0–4.6)
2. BP >150/90, on Rx	4.7 (3.4–6.0)	3.1 (1.6–4.6)	2.6 (1.4–3.8)	3.0 (1.8–4.2)
3. BP <150/90, on Rx	3.5 (2.4–4.6)	4.6 (2.8–6.4)	5.0 (3.4–6.6)	7.8 (5.9–9.7)
Total on Rx	8.3 (6.6–10.0)	7.8 (5.5–10.1)	7.6 (5.7–9.5)	10.8 (8.6–9.5)
4. BP <150/90, no Rx	71.7 (68.9–74.5)	2.1 (68.3–76.0)	81.8 (79.0–84.6)	85.8 (83.3–88.3)

Women	1982	1986–88	1993–94	2002–03
Number	569	361	685	1022
1. BP >150/90, no Rx	12.4 (9.7–15.1)	12.6 (9.2–16.0)	6.8 (4.9–8.7)	0.9 (0.2–1.6)
2. BP >150/90, on Rx	4.6 (2.9–6.3)	5.3 (3.0–7.6)	2.3 (1.2–3.4)	1.9 (0.9–2.9)
3. BP <150/90, on Rx	7.0 (4.9–9.1)	5.8 (3.4–8.2)	6.1 (4.3–7.9)	7.4 (5.5–9.3)
Total on Rx	11.6 (9.0–14.2)	11.1 (7.9–14.3)	8.4 (6.3–10.5)	9.3 (7.2–11.4)
4. BP <150/90, no Rx	76.0 (72.5–79.5)	76.3 (71.9–80.7)	84.8 (82.1–87.5)	89.8 (87.6–92.0)

BP=blood pressure; †Directly age-standardised to the 1986 New Zealand population; Rx=treatment.

Trends in mean lipid levels and lipid-lowering medication use in men and women by age group and study year are shown in Table 3. In every age group for men and women, serum cholesterol levels declined from 1982 to 2002–3, together with a generally increasing trend in levels of HDL-cholesterol and an approximately decreasing trend in the cholesterol to HDL ratio. There was also a general trend of increasing use of lipid-lowering medications over time and with increasing age.

Table 3. Trends in mean (SE) levels of lipids and lipid-lowering medication use in Auckland men and women by age group in 1982, 1986–8, 1993–4, and 2002–3

Men	35–44	45–54	55–64	65–74
Total cholesterol (mmol/L)				
1982	6.09 (0.070)	6.26 (0.050)	6.27 (0.054)	–
1986–8	6.06 (0.108)	6.10 (0.081)	6.29 (0.076)	–
1993–4	5.58 (0.066)	5.86 (0.066)	5.83 (0.063)	5.61 (0.064)
2002–3	5.57 (0.068)	5.64 (0.066)	5.62 (0.067)	5.37 (0.066)
HDL-cholesterol (mmol/L)				
1982	0.98 (0.020)	1.00 (0.014)	1.00 (0.015)	–
1986–8	1.25 (0.031)	1.25 (0.023)	1.26 (0.022)	–
1993–4	1.09 (0.020)	1.09 (0.020)	1.13 (0.019)	1.09 (0.019)
2002–3	1.28 (0.022)	1.28 (0.022)	1.36 (0.022)	1.40 (0.022)
Cholesterol/HDL				
1982	6.44 (0.146)	6.58 (0.106)	6.70 (0.112)	–
1986–8	5.27 (0.156)	5.11 (0.117)	5.31 (0.109)	–
1993–4	5.43 (0.115)	5.72 (0.114)	5.52 (0.109)	5.53 (0.111)
2002–3	4.60 (0.080)	4.61 (0.078)	4.36 (0.079)	4.05 (0.078)
Triglycerides (mmol/L)†				
2002-3	1.92 (0.089)	1.65 (0.086)	1.64 (0.088)	1.48 (0.090)
Lipid-lowering medications				
1982 & 1986–8	0.0%	0.0%	0.0%	–
1993–4	0.0%	1.3%	3.2%	2.0%
2002–3	3.8%	7.1%	9.4%	19.8%

Women	35–44	45–54	55–64	65–74
Total cholesterol (mmol/L)				
1982	5.72 (0.074)	6.48 (0.077)	6.90 (0.081)	–
1986–8	5.59 (0.205)	6.37 (0.120)	6.98 (0.088)	–
1993–4	5.25 (0.071)	5.59 (0.067)	6.17 (0.068)	6.36 (0.065)
2002–3	4.95 (0.060)	5.50 (0.060)	5.92 (0.058)	5.96 (0.062)
HDL-cholesterol (mmol/L)				
1982	1.21 (0.021)	1.27 (0.022)	1.16 (0.023)	–
1986–8	1.50 (0.072)	1.60 (0.039)	1.59 (0.028)	–
1993–4	1.37 (0.025)	1.43 (0.024)	1.40 (0.024)	1.37 (0.023)
2002–3	1.52 (0.025)	1.60 (0.025)	1.66 (0.024)	1.66 (0.026)
Cholesterol/HDL				
1982	4.97 (0.105)	5.35 (0.111)	6.20 (0.120)	–
1986–8	3.84 (0.254)	4.21 (0.137)	4.66 (0.100)	–
1993–4	4.01 (0.108)	4.18 (0.102)	4.84 (0.102)	4.99 (0.099)
2002–3	3.40 (0.065)	3.61 (0.065)	3.73 (0.063)	3.81 (0.067)
Triglycerides (mmol/L)†				
2002-3	1.01 (0.046)	1.23 (0.046)	1.37 (0.045)	1.53 (0.047)
Lipid-lowering medications				
1982 & 1986–8	0.0%	0.0%	0.0%	–
1993–4	1.9%	0.9%	5.5%	2.0%
2002–3	0.0%	1.6%	7.9%	15.3%

†Fasting triglycerides not measured in the previous surveys.

Table 4 shows trends in mean levels of body mass index (and Figure 3), weight, height and prevalences of overweight and obesity by age group and year in men and women. Mean body mass index and weight show increasing trends over the studies. Mean height remained approximately constant across all surveys. In 1982, approximately 52.8% of men and 36.5% of women were overweight or obese; whereas in the 2002–3 survey, 70.9% of men and 57.0% of women were in these latter categories.

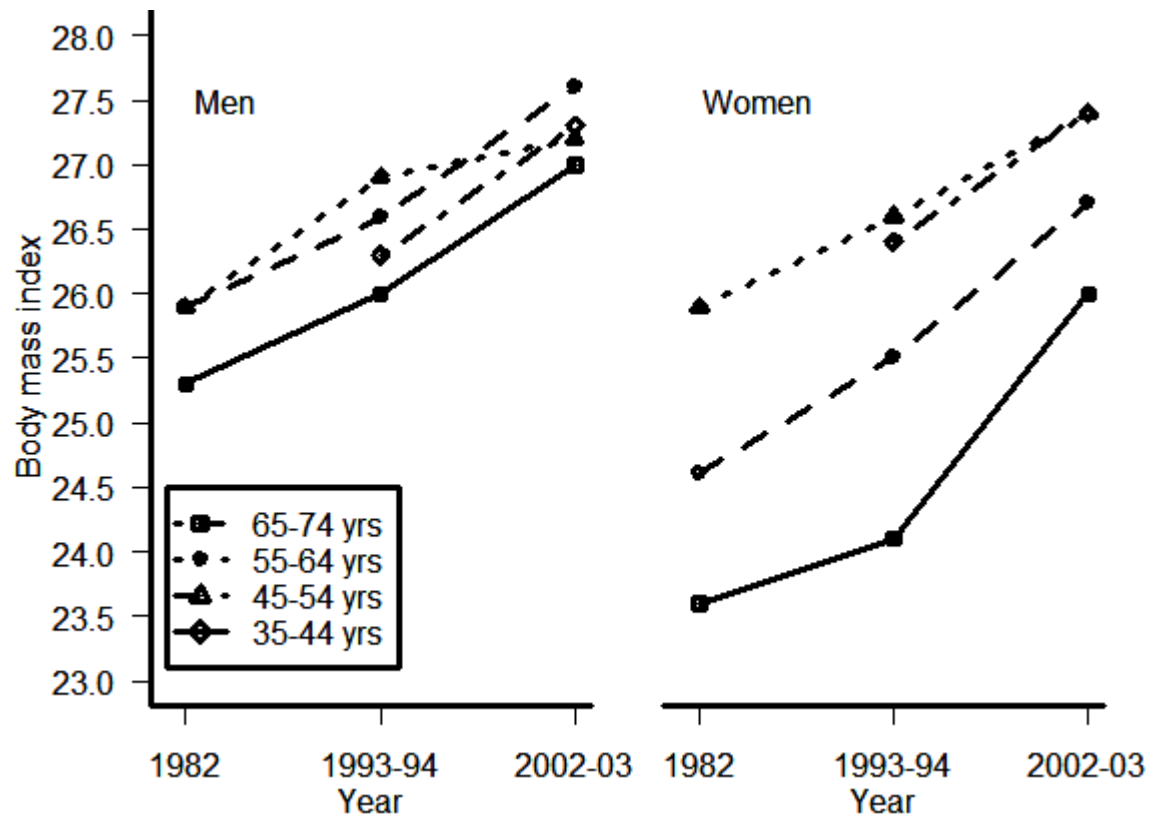
Table 4. Trends in mean (SE) levels of body mass index, weight, and height—and prevalences of overweight and obesity in Auckland men and women by age group in 1982, 1986-8†, 1993-4, 2002–3

Men	35–44	45–54	55–64	65–74
Body mass index (kg/m²)				
1982	25.3 (0.21)	25.9 (0.15)	25.9 (0.16)	–
1993–4	26.0 (0.23)	26.6 (0.23)	26.8 (0.22)	26.3 (0.22)
2002–3	27.0 (0.26)	27.6 (0.25)	27.2 (0.25)	27.3 (0.25)
Weight (kg)				
1982	77.6 (0.68)	76.9 (0.50)	76.2 (0.53)	–
1993–4	81.7 (0.80)	82.4 (0.79)	81.3 (0.75)	78.4 (0.77)
2002–3	84.8 (0.91)	85.6 (0.88)	83.0 (0.90)	82.1 (0.90)
Height (cm)				
1982	176.9 (0.44)	175.5 (0.32)	174.6 (0.35)	–
1993–4	177.1 (0.42)	175.9 (0.42)	174.3 (0.40)	172.2 (0.42)
2002–3	177.0 (0.45)	176.1 (0.43)	174.5 (0.44)	173.3 (0.44)
Overweight				
1982	42.5%	49.8%	45.0%	–
1993–4	45.4%	53.3%	53.5%	49.4%
2002–3	46.9%	47.5%	57.1%	49.2%
Obese				
1982	5.8%	8.8%	11.8%	–
1993–4	12.5%	13.4%	16.5%	14.7%
2002–3	20.9%	23.9%	18.0%	20.9%

Women	35–44	45–54	55–64	65–74
Body mass index (kg/m²)				
1982	23.6 (0.30)	24.6 (0.30)	25.9 (0.32)	–
1993–4	24.1 (0.30)	25.5 (0.28)	26.6 (0.29)	26.4 (0.28)
2002–3	26.0 (0.31)	26.7 (0.31)	27.4 (0.30)	27.4 (0.32)
Weight (kg)				
1982	61.6 (0.75)	63.8 (0.76)	64.7 (0.81)	–
1993–4	64.5 (0.81)	68.4 (0.77)	69.4 (0.77)	67.3 (0.75)
2002–3	69.6 (0.90)	70.9 (0.89)	72.0 (0.87)	70.7 (0.91)
Height (cm)				
1982	163.1 (0.47)	163.5 (0.49)	161.6 (0.53)	–
1993–4	163.8 (0.43)	163.8 (0.40)	161.7 (0.41)	159.5 (0.43)
2002–3	163.4 (0.41)	162.9 (0.41)	161.9 (0.40)	159.4 (0.42)
Overweight				
1982	18.9%	25.8%	41.0%	–
1993–4	26.6%	35.2%	40.6%	35.1%
2002–3	32.4%	36.8%	37.1%	38.0%
Obese				
1982	7.5%	9.3%	12.7%	–
1993–4	8.4%	13.6%	19.7%	22.3%
2002–3	17.2%	21.7%	27.7%	27.3%

†Weight and height were not measured in 1986–8.

Figure 3. Trends in body mass index in men and women by age group



Prevalences of self-reported cigarette smoking, ex-smokers, never smokers, and mean number of cigarettes smoked per day in current smokers are reported in Table 5. The percentages of current cigarette smokers fell between 1982 and 1993–4 in both men and women in most age groups, but there appears to have been little change between 1993–4 and 2002–3. However, the proportion of never smokers increased between 1982 and 2002–3 in most age groups, whereas the proportion of ex-smokers increased until 1993–4, but fell slightly in most age groups subsequently. In general, the number of cigarettes smoked per day in current smokers appears to be declining.

Trends in leisure time physical activity and prevalences of previously diagnosed diabetes mellitus are shown in Table 6. There were trends towards higher moderate exercise, but lower vigorous exercise in 35–44 and 45–54 year old men and women in the most recent survey.

In contrast, less 55–64 and 65–74 year old men reported moderate exercise and more of these men reported more vigorous exercise than in the previous years. With the exception of 55–65 year old women, there were trends of higher prevalences of previously diagnosed diabetes in the most recent survey compared to the earlier years.

Table 5. Trends in cigarette smoking history and mean (SE) number of cigarettes smoked in Auckland men and women by age group in 1982, 1986-8, 1993-4, and 2002-3

Men	35-44	45-54	55-64	65-74
Current cigarette smokers				
1982	31.0%	26.7%	27.4%	–
1986-8	19.1%	23.2%	20.5%	–
1993-4	18.9%	14.3%	16.5%	10.2%
2002-3	18.8%	14.5%	16.7%	4.4%
Number of cigarettes smoked per day				
1982	21.8 (1.39)	23.5 (1.11)	21.3 (1.20)	–
1986-8	18.2 (2.07)	19.5 (1.62)	18.8 (1.56)	–
1993-4	19.2 (1.48)	21.0 (1.69)	15.7 (1.50)	18.1 (1.94)
2002-3	12.9 (0.83)	15.1 (1.10)	16.8 (0.82)	16.6 (0.70)
Ex-smokers				
1982	21.7%	37.0%	45.0%	–
1986-8	38.9%	37.4%	47.0%	–
1993-4	29.1%	39.8%	50.4%	57.5%
2002-3	28.5%	33.7%	42.9%	54.8%
Never smokers				
1982	47.3%	36.3%	27.6%	–
1986-8	42.0%	39.4%	32.5%	–
1993-4	52.0%	45.9%	33.1%	32.3%
2002-3	52.7%	51.8%	40.4%	40.8%

Women	35-44	45-54	55-64	65-74
Current cigarette smokers				
1982	25.9%	26.3%	21.3%	–
1986-8	29.3%	23.0%	21.2%	–
1993-4	16.8%	11.9%	12.8%	6.8%
2002-3	14.4%	11.5%	11.2%	4.6%
Number of cigarettes smoked per day				
1982	16.6 (1.16)	14.8 (1.16)	18.5 (1.46)	–
1986-8	15.6 (2.78)	14.4 (1.89)	1.61 (1.42)	–
1993-4	16.0 (1.49)	18.0 (1.69)	14.5 (1.63)	11.8 (2.16)
2002-3	11.3 (0.79)	12.9 (0.90)	13.0 (0.87)	12.4 (0.79)
Ex-smokers				
1982	21.9%	25.3%	28.7%	–
1986-8	24.4%	23.0%	21.2%	–
1993-4	26.6%	30.5%	31.1%	34.7%
2002-3	23.6%	28.5%	33.0%	32.6%
Never smokers				
1982	52.2%	48.4%	50.0%	–
1986-8	46.3%	54.0%	50.0%	–
1993-4	56.6%	57.6%	56.1%	68.5%
2002-3	62.0%	60.0%	55.8%	62.8%

Table 6 also reports baseline values for absolute 5-year cardiovascular disease risk (in %) by gender and age group, and the proportion of participants with 5-year cardiovascular risk >15%. As expected, 5-year cardiovascular risks were higher in men than women in the same age group, and increased with age.

Table 6. Trends in leisure time physical activity (%) and people with previously diagnosed diabetes mellitus (%) by age group in 1982, 1986-8, 1993-4, and 2002-3. Mean 5-year cardiovascular disease risk and percentage of participants with 5-year cardiovascular risk >15% in 2002-3

Men	35-44	45-54	55-64	65-74
Moderate exercise				
1982	34.5	23.2	13.8	–
1986-8	28.0	35.0	46.0	–
1993-4	45.8	58.0	77.2	79.2
2002-3	62.6	68.4	66.3	69.8
Vigorous exercise				
1986-8	45.0	23.7	9.8	–
1993-4	47.6	39.0	21.7	11.8
2002-3	43.4	34.9	22.5	13.7
Known diabetes¹				
1986-8	1.5	1.5	3.9	–
1993-4	1.8	1.7	4.7	6.9
2002-3	1.9	3.3	5.0	14.0
5-year CVD risk (%)²				
2002-3	3.0 (2.4-3.5)	6.1 (5.5-6.8)	10.2 (9.5-11.0)	17.6 (16.4-18.8)
>15% 5-year risk²				
2002-3	2.4 (0.5-4.3)	7.1 (4.0-10.2)	21.6 (16.0-27.0)	58.6 (51.7-65.5)
Women	35-44	45-54	55-64	65-74
Moderate exercise				
1982	30.2	17.5	11.0	–
1986-8	23.0	14.2	8.6	–
1993-4	64.5	65.3	71.1	78.1
2002-3	72.9	71.5	75.5	64.9
Vigorous exercise				
1986-8	31.7	14.2	8.6	–
1993-4	37.9	26.7	22.6	8.8
2002-3	27.9	22.6	13.2	11.8
Known diabetes¹				
1986-8	2.4	2.7	2.3	–
1993-4	2.3	1.3	6.0	5.6
2002-3	2.6	3.7	6.0	11.5
5-year CVD risk (%)²				
2002-3	1.5 (1.1-1.8)	3.4 (2.7-4.0)	5.8 (5.1-6.5)	10.2 (9.2-11.2)
>15% 5-year risk²				
2002-3	0.9 (0-2.2)	5.2 (2.2-8.2)	9.5 (5.8-13.2)	26.5 (20.3-26.5)

¹Question not asked in the 1982 survey. ²Insufficient information collected in previous surveys for calculation of 5-year cardiovascular disease (CVD) risk with 95% confidence limits.

Discussion

The most recent data from the Diabetes, Heart and Health Survey indicate that the previously reported downward trends in several major cardiovascular risk factors in Auckland since the early 1980s continues, however, the downwards trend in cigarette smoking appears to halt between 1993-94 and 2002-3. There has also been a dramatic increase in body mass index in both men and women with the prevalence of obesity more than doubling over the 21-year period.

The major strengths of the current study are its size, and its community-based sample. Limitations to the current study (and previous studies) include the collection of a single measure of cholesterol, the measurement of blood pressure on a single occasion, and that cigarette smoking information was based on self-report. In addition, the falling response rates over time are a cause for concern. However, it has been shown in the Atherosclerosis Risk in Communities Study that differences between respondents and non-respondents tended to exaggerate real differences between respondents and the eligible population sampled.¹⁵

In general, non-responders were more likely to be current smokers, and to self-report a lower prevalence of hypercholesterolaemia and to self-report a higher prevalence of myocardial infarction, stroke, or diabetes.¹⁵ Another limitation is that blood pressure measurements were made in the morning in the 2002–2003 study during an oral glucose tolerance test, whereas they were taken during the both morning and afternoon in the previous studies under non-fasting conditions in the pre-2000 surveys, factors that are known to affect blood pressure levels.

Blood pressure—Overall mean systolic and diastolic blood pressure levels were lower in 2002–03 compared to those reported in the 1982 Auckland Risk Factor Survey,^{4–6} 1986–88 Auckland Heart Study,^{5,6} and the 1993–94 Auckland Heart and Health Study^{5,6} and showed a continued downward trend of blood pressure levels in Aucklanders aged 35 to 74 years.

Blood pressure levels were also lower in all age groups than the 1989 LINZ study,¹⁶ the 1988–90 Workforce Diabetes survey,¹⁷ the 1995–97 Workforce Diabetes Follow-up Survey,¹⁸ and the 1997 National Nutrition Survey.¹⁹

Furthermore, not only have systolic and diastolic blood pressures decreased, but also the pulse pressure (systolic minus diastolic blood pressure) has decreased over the studies. Pulse pressure is a marker of arterial stiffness which increases with hypertension, ageing and diabetes, but is also an independent marker of increased cardiovascular disease events.²⁰

The proportion of people with untreated blood pressure levels >150/90 mmHg fell significantly by more than 83% (CI: 79%–87%) in both men and women. This reduction was matched by an increase in the proportion of people with blood pressure levels < 150/90 mmHg in both genders.

When the age-standardised prevalences of raised blood pressure among participants aged 36–64 years in the 2002–3 study were compared to the 1982, 1986–88, and 1993–94 Auckland Heart studies, there was strong evidence ($p < 0.0001$) of a significant decline according to treatment status over time in both men and women. However, current cardiovascular disease guidelines¹⁰ recommend that treatment should be based on absolute risk as shown in Table 6, where we have presented baseline data for comparison with future studies, and not on individual risk factors in isolation of the others.

Although blood pressure measurements obtained at a single point in time may overestimate the prevalence of raised blood pressure, this potential problem was minimised by taking two separate measurements and averaging them, provided they were within 10 mmHg of each other, or taking further measurements until they were.

It is unlikely that the use of different blood pressure lowering instruments contributed to the falling blood pressure levels as the instrument used in the 2002–3 survey was shown to measure approximately 2 mmHg higher for both systolic and diastolic blood pressure levels than the random zero sphygmomanometer used in the previous studies.

Cholesterol—Previous Auckland cardiovascular disease studies suggested that the population mean serum cholesterol has decreased between 1982 and 1986–8.⁵ The 1997 National Nutrition Survey reported a 0.2 mmol/L reduction in total serum cholesterol since the 1989 LINZ survey,¹⁹ with a mean cholesterol level of 5.7 mmol/L in European and Other men and 5.8 mmol/L in European and Other women in the later survey. Prevalences of the use of lipid-lowering treatment and hypercholesterolaemia were also higher in the current study compared to the Workforce Diabetes Survey.¹⁸

It is possible that the different methods used to estimate lipid levels have contributed to variation between the surveys. The HDL-cholesterol method used in the last survey has been shown to estimate levels 0.1 mmol/L higher than for the HDL-cholesterol method used in the previous surveys.⁹

Body mass index—Because weight is an important determinant of serum cholesterol¹⁸ and blood pressure levels,²¹ the increase in body mass index in the Auckland area over time would be expected to be accompanied by increasing serum cholesterol and blood pressure levels. Surprisingly, however, systolic blood pressure and serum cholesterol levels still appeared to be declining in the current study, despite the unfavourable obesity trends.

Declining trends in fat and salt consumption and increasing consumption of fruits, vegetables, and low-fat dairy products might account for this anomaly, together with an increase in the number of younger people reporting leisure-time physical activity (Table 6).

The proportion of participants who were overweight and obese (70.9% of men and 57.0% of women) is higher than the 53.6% of men and 46.5% of women reported in the 1997 National Nutrition survey,¹⁹ thus confirming this upwards trend in body sizes.

Body mass index reflects the balance of dietary intake and energy expenditure. Increased body mass index influences other risk factors, such as diabetes, raised blood pressure, and hypercholesterolaemia. Attributable risk estimates, derived from the Framingham Study, showed that 78% of raised blood pressure in men and 65% in women could be attributed to obesity.²²

Weight control programs could have a major impact on the occurrence of raised blood pressure in young and middle-aged adults. Other measures recommended to reduce the occurrence of raised blood pressure include more exercise; avoidance of excessive alcohol intake; salt restriction; and maintenance of normal calcium, potassium, and magnesium intakes.²²

Kannel et al have suggested targeting interventions towards persons who are obese, have high normal blood pressure, or have a family history of high blood pressure, as they have been shown in clinical trials using weight reduction, exercise, and salt restriction to reduce the incidence of raised blood pressure.²² Such measures have

been reported to reduce the prevalence of raised blood pressure in the population by 20% to 50%.²²

Cigarette smoking—The downwards trend in cigarette smoking observed between 1982 and 1993–94 appears to have ceased. These findings are consistent with other recent New Zealand surveys²³ and indicate that it is time to reappraise current antismoking strategies. The most effective public health strategies for reducing tobacco consumption are price rises and legislation restricting where people can smoke.²³ Given the recent legislation to prevent smoking in pubs and restaurants, further price rises should be considered.

Leisure time physical activity—The age-standardised prevalences for moderate leisure-time physical activity were 25.8% in men and 21.4% of women in the 1982 survey, 34.6% in men and 16.7% in women in the 1986-8 survey, 60.1% and 67.8% in women in the 1993-4 survey, and 66.0% in men and 71.9% in the 2002-3 survey, and appear to have increased over the time period.

Similarly, the age-standardised prevalences of vigorous leisure-time activity were 29.5% in men and 20.4% for women in the 1986–8 survey; 35.2% in men and 27.7% in women in the 1993–4 survey; and 32.8% in men and 21.3% in women in the 2002–3 survey.

The 1996–7 New Zealand Health Survey reported that overall 61% of adults were physically active.²⁴ The 2003 New Zealand Health Survey reported age-standardised prevalence of regular physical activity in Europeans and Others of 57.5% in men and 49.1% in females, and that 79.2% of men and 70.6% of women were physically active.²⁵

Previously diagnosed diabetes—The age-standardised prevalences of self-reported previously diagnosed diabetes were 2.1% in men and 2.5% in women in the 1986–8 survey, 3.0% in men and 3.2% in women in the 1993–4 survey and 4.5% in men and 4.8% in women in the 2003–4 survey.

The Workforce Diabetes Survey carried out between 1988 and 1990 reported a prevalence of 1.1% for previously diagnosed diabetes in Europeans aged 40 years and over.²⁶ A door-to-door household survey carried out in 1992 in South Auckland reported an age-standardised prevalence of 2.8% in Europeans aged 20 years and over,²⁷ and when the survey was extended through to 1995, the same authors reported an age-standardised prevalence of 1.9% in Europeans.²⁸

The 1996–7 New Zealand Health Survey of adults aged 15 year and over reported an age-standardised prevalence of 3.1% in Europeans.²⁴ More recently, the 2003 New Zealand Health Survey reported age-standardised prevalences of self-reported diabetes in Europeans and Others aged 15 years and over of approximately 3.5% in men and 2.5 % in females.²⁵

Low socioeconomic status is known to have an adverse affect on many CVD risk factor levels.^{27,28} However, this is unlikely to have influenced the results reported here, as all studies had median socioeconomic status scores of 3 (on a 5-point scale).

In summary, the Diabetes, Heart and Health Survey found favourable trends in systolic blood pressure, serum cholesterol, HDL-cholesterol levels, and use of antihypertensive and cholesterol-lowering drug use in Auckland between 1982 and 2002–04. However, there were unfavourable trends in body mass index, obesity over

the 21-year time period, and a recent levelling of the previous decline in cigarette-smoking.

These findings suggest that the population burden of cardiovascular disease may increase in the future unless renewed efforts are made to tackle obesity and smoking, in particular.

Indeed, innovative and comprehensive programs targeted at reducing cigarette consumption, increasing physical activity, and reducing weight need to be implemented now.

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