Reduced tobacco consumption, improved diet and life expectancy for 1988–1998: analysis of New Zealand and OECD data

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ABSTRACT

AIM: We compared changes in tobacco consumption and diet in relation to changes in life expectancy in 1988–1998 in 22 OECD (Organisation for Economic Cooperation and Development) countries.

METHOD: Between 1985 and 1995 using regression analysis we estimated differences in tobacco consumption per adult and the differences in the sum of atherogenic and thrombogenic indices against life expectancy. Each index was derived from the various fats per gram of food from standard texts, and from the annual measurements of fat in the food balance sheets of each country.

RESULTS: In 1985–1995, New Zealand showed the largest decrease in tobacco consumption per adult (41%) and the greatest decrease (except for Switzerland) in the sum of atherogenic and thrombogenic indices (17%) as a measure of diet. New Zealand ranked first for life expectancy increases from 1988–1998 for men (3.6 years), women (2.8 years) and both sexes combined. Regression analyses revealed that increases in life expectancy across the OECD for males, but not females, were strongly associated with decreases in tobacco consumption, with a weaker effect of diet improvement.


In New Zealand, life expectancy at birth extended 3.6 years for males when measured in 1998 by changes over the previous 10 years. Life expectancy at age one was approximately half a year less than at birth, suggesting that the large gains in reducing sudden unexpected death in infancy (SUDI) below the three per 1,000 death rate in 1989–1990 did not affect life expectancy as much as might be expected.1 Notwithstanding the steady annual decline in tobacco consumption per adult, large changes seen in tobacco deaths continued in the 1985–1995 period (Table 1). Tobacco was a major cause of death (4,137 annually in 1980–85).2 In 1990, smoking caused 38% of male cancer deaths and 16% of female cancer deaths.3 Disregarding deaths under age 35 years of age, when tobacco deaths were rare except for some due to SUDI, tobacco deaths under 80 years of age accounted for at least one quarter and up to one third of all male deaths, and for one sixth to over one quarter of all female deaths. The last column of Table 1 shows that 27% of reductions in tobacco-related deaths in 1985–1995 would have accounted for the large gains in life expectancy seen in this period.

Secondly, to express these data differently, the mean years of life lost per death from smoking in Peto’s data3 showed that in 1990 the average smoker in New Zealand lost 14 years compared with non-smokers. (For Australia, the average smoker lost 14 years, in the UK, 13 years, and smokers in the US and Canada lost 15 years, compared with non-smokers.) These lost years would otherwise have been added to life expectancy. However, the percentage of male deaths due to tobacco declined consistently
over five-year periods, but the percentage of female deaths did not, possibly explaining why changes in tobacco in 1985–1995 were a factor in explaining the life expectancy of males but not females.

The atherogenic and thrombogenic indices, measuring the types of fat consumed, improved (ie, decreased) with reference to causing heart disease and stroke, more or less in parallel from 1961 to 2000. The atherogenic index comprises the weights of the lighter saturated fats (denoted by the length of their carbon chains as C12.0, C14.0 times 4, and C16.0) divided by all unsaturated fats. A high value on this measure predisposes to atheroma of the coronary arteries. The thrombogenic index is the heavier saturated fats divided by monounsaturated and polyunsaturated fats and marine polyunsaturated fats added in. Higher values mean predisposition to sudden cardiac events. These formulae were devised in 1991 by Ulbricht and Southgate.

Because both tobacco and fat consumption were decreasing between 1985 and 1995 in New Zealand, the extent to which each might be responsible for the gains in life expectancy is unclear. Thus we analysed data from OECD countries to determine whether changes in tobacco consumption or atherogenic and thrombogenic indexes were more strongly associated with life expectancy gains.

**Method**

We compared the percentage decrease in tobacco consumption per adult and the percentage decrease in the dietary indices for the 1985–1995 period with the gain in years of life expectancy in years for the period 1988–1998, across 22 countries. This difference in time periods allows for some delay for life expectancy gains to show. Life expectancy is the average number of years that an individual of a given age group is expected to live if current mortality rates continue to apply. This form of (period) life expectancy enables comparison across countries. Period life expectancy is unlike life expectancy of a cohort, which does not incorporate future death rates that a cohort would expect if death rates continued to decline. Nor does it take account of reductions in lung cancer and other tobacco-caused diseases before or after the years in question, 1988–1998.

The 22 countries of the OECD were Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK and the US.

For the independent variables, percentage changes for tobacco consumption for 1985–1995 were obtained for each country from the Health New Zealand Tobacco control international database, 1960–2000, divided by United Nations population data. Percentage changes in 1985–1995 of the atherogenic and thrombogenic indices per capita were taken from tables based on standard composition of nutrients per gram and food consumption per capita based on food balance tables of the Food and Agricultural Organisation included in the Health New Zealand Food and Nutrition International database. The atherogenic and thrombogenic indices were summed

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**Table 1:** Tobacco consumption per adult and tobacco deaths as a percentage of all deaths of any cause, age 35–79 years, New Zealand 1985–2000.

<table>
<thead>
<tr>
<th>Year</th>
<th>Tobacco consumption per adult*</th>
<th>% of deaths due to tobacco</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>1985</td>
<td>2,493</td>
<td>32.0</td>
</tr>
<tr>
<td>1990</td>
<td>1,972</td>
<td>28.9</td>
</tr>
<tr>
<td>1995</td>
<td>1,477</td>
<td>27.6</td>
</tr>
<tr>
<td>2000</td>
<td>1,357</td>
<td>19.9</td>
</tr>
</tbody>
</table>

*Consumption measured in sticks of tobacco weighing 0.7g for manufactured and 1g for hand-rolled cigarettes. Hand-rolled were in the minority: 8% in 1985 rising to 19% in 1995. Source: Peto R et al 2015.
and expressed as atherogenic-thrombogenic indices. Regression analyses were then performed to determine the extent to which changes in life expectancy across the OECD could be explained by changes in tobacco consumption and atherogenic-thrombogenic indices.

Results

Among the 22 OECD countries, New Zealand ranked first for changes in life expectancy in 1988–1998 for men, women and both sexes combined, and for 1985–1995 showed the largest decrease in tobacco consumption per adult. New Zealand also showed a greater decrease in atherogenic and thrombogenic indices, to measure improved diet with respect to their fat consumption, than any OECD country with the exception of Switzerland.

Smoking prevalence data for the 22 countries did not allow calculation of separate estimates for males and females. Life expectancy at age 40 years for males and females did not differentiate male versus female or total response to changes in tobacco consumption per adult in 1985–1995.

Tobacco consumption per adult began to decrease from 1975. The 41% decrease in tobacco consumption between 1985 and 1995 corresponded for New Zealand with the 35% decrease in cigarettes smoked (from 23 to 15 per day) during this period; and the cigarettes per day (not subject to under-reporting) by estimation from smoking prevalence, decreased also.

In New Zealand, life expectancy at birth for 1998 was 80.4 for women and 75.2 for men, and compared with 10 years previous, the life expectancy for women was 2.8 years greater, for men 3.6 years greater, and was 3.2 years greater for both sexes combined. For the 22 countries of the OECD, this was the largest increase that year as the life expectancy 10 years previously had been 77.6 for New Zealand women and 71.6 for men. New Zealand men were now ranked 10th and women 16th across the OECD.

The increase in life expectancy for men (3.6 years) was greater than for women (2.8 years), narrowing the life expectancy measured by sex at birth. This was in line with a striking reduction in tobacco consumption per adult in New Zealand in 1985–1995, and with a higher tobacco death rate among men as in Table 1. Averaged across the OECD countries, life expectancy increased overall, but significantly more for males (2.20%) than for females (1.73%), \(t(21)=3.64, p=.002, d=.72\). Changes in life expectancy were negatively correlated with decreases in tobacco consumption and atherogenic-thrombogenic index, significantly for males, \(r=-.81, p<.001\) and \(r=-.66, p=.001\), but not for females, \(r=-.30, p=.17\) and \(r=-.27, p=.22\).

We conducted regressions to compare changes in tobacco consumption and diet with changes in life expectancy. For males, decreases in tobacco consumption were strongly associated with increases in life expectancy, \(\beta=-.65, p<.001\), while decreased atherogenic-thrombogenic index approached significance, \(\beta=-.30, p=.06\), and together both variables explained \(R^2=.71, p<.001\). Of the 71.0% variance explained, 32.5% was uniquely associated with change in tobacco, 5.2% was uniquely associated with change in atherogenic-thrombogenic

Figure 1: Tobacco consumption and diet, New Zealand 1960–2000.
indices, and 33.3% of the variance was
shared by both predictors. However, for females, neither decreases in tobacco consumption or decreased atherogenic-thrombogenic indices were significantly associated with increases in life expectancy, $\beta = -.15, p = .58$ and $\beta = -.22, p = .41$, respectively, and the overall model was not significant, $R^2 = .11, p = .34$.

Figure 2 shows how tobacco consumption per adult affected male life expectancy at birth, after allowing for the atherogenic-thrombogenic indices as a measure of diet to affect the tobacco consumption per adult score on the y axis.

These results show that changes in tobacco consumption, and to a lesser extent improvements in diet, were responsible for the increases in male life expectancy from 1988–1998 and explain why New Zealand showed the greatest gains overall among the 22 OECD countries studied.

**Discussion**

New Zealand’s life expectancy was increased by reducing tobacco consumption and improving diet together. The health gains of the comprehensive programme to control tobacco consumption were substantial. In 1985–1995, policy changes in New Zealand resulted from increased tobacco excise and resultant tobacco industry-led increases in price, raising over the counter tobacco prices 230%. In addition, the passage of the Smoke-free Environments Act in 1990 completely phased out tobacco advertising and sponsorship between 1990 and 1995, and made office workplaces smokefree.

Gains in life expectancy were significantly greater for men than women. Although reasons for this result are unclear—in particular, we did not have tobacco consumption data separately for men and
women—one possibility is that it may be related to females’ overall lower cardiovascular risk.

Some limitations of our study should be noted. Because the research is correlational, it is not possible to rule out other variables that might have contributed to life expectancy gains. For example, differential improvements in quality of health care may have contributed to variance in life expectancy outcomes across the OECD from 1988–1998. Although we did not have a measure of health care quality, it seems unlikely that improvements in New Zealand over this period could entirely explain our results.

Another limitation is that the atherogenic and thrombogenic indices may not fully capture the link between dietary factors and health. New Zealand showed the greatest decrease after Switzerland in the sum of atherogenic and thrombogenic indices during 1985–1995. A more recent large study of pooled data with 24–28 years of follow-up from the US suggests that increased dietary intakes of individual saturated fats (length C12, C14, C16, C18) were positively associated with risk of coronary heart disease. Replacement of 1% of daily energy intake from the combined group of C12.0–C18.0, with equivalent energy from polyunsaturated fat, whole grain carbohydrates or plant proteins, was associated with a 6–8% reduced risk of coronary heart disease. Among the 22 countries analysed for the decade 1985–1995, New Zealand showed a 4.0% decline in the C12.0–C18.0 saturated fats but a 20.6% increase in polyunsaturated fat as a proportion of total calories, along with an increase of 14.9% in calories from grains and an increase in protein in vegetables and fruit.

New Zealand achieved these dietary changes through manufacturers, supermarkets and increased ethnic varieties of food providing a wider range of healthy food choices. From 1987 with the first Heart Food Festival and Department of Health funding, the Heart Foundation increased the frequency of Heartbeat programmes in schools, workplaces and communities. It began its “Pick the Tick” food labelling programme in 1991. The Cancer Society’s Fit Food campaigns and the 5+ a day campaigns highlighted the benefits of a diet high in fruit and vegetables. These changes resulted in increased polyunsaturated fat and lowered saturated fat. In future, analyses used by The Global Burden of Disease, citing low intakes of polyunsaturated fat as a risk factor for heart disease may need to be also considered. Our results, however, suggest that decreases in tobacco consumption were the most likely reason why New Zealand showed the greatest overall gains in life expectancy among the OECD countries in 1988–1998.

Competing interests:
Nil.

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