Trends in mortality from chronic obstructive pulmonary disease in Alberta: Back to the future?

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TL GUIDOTTI. Trends in mortality from chronic obstructive pulmonary disease in Alberta: Back to the future? Can Respir J 1995;2(2):97-103.

Trends in mortality from chronic obstructive pulmonary disease (COPD) in Alberta over 60 years, from 1927 to 1987, for ages 15 and above of both sexes, were examined. There was a striking decline in mortality among older adults in the 1930s and 1940s, a nadir that lasted almost 10 years in the 1950s, and a striking increase thereafter. By 1970, most age groups had returned to levels of the 1930s. This overall trend was observed in both the younger age groups (aged 15 to 50) and older adults, although mortality from COPD in the former disproportionately reflected asthma-related deaths. Subsequently, mortality climbed still higher in older age groups, but not in the younger age groups. The sustained rise in mortality in older age groups after the Second World War is presumably related to smoking habits. Historical trends in Alberta were then compared with Canada as a whole for both sexes over 50 years of age. Although Alberta had a much lower mortality from COPD than Canada as a whole, this difference disappeared by 1980. There is no obvious explanation that would explain all of the observed trends, but they appear more likely to be a consequence of social and environmental conditions, including changes in health-related behaviour, than of major changes in medical management at the time.

Key Words: *Alberta, Asthma, Chronic obstructive pulmonary disease, Mortality, Smoking*

Tendances dans la mortalité causée par la maladie pulmonaire obstructive chronique en Alberta : Un retour dans le futur ?

RÉSUMÉ : Les tendances dans la mortalité causée par la maladie pulmonaire obstructive chronique (MPOC) en Alberta sur 60 années, de 1927 à 1987, dès l'âge de 15 ans et plus chez les deux sexes ont été examinées. Il y a eu une chute remarquable de la mortalité chez les adultes plus âgés dans les années 30 et 40. La mortalité est demeurée à son plus bas niveau pendant presque 10 ans jusqu'aux années 50 pour ensuite augmenter considérablement. En 1970, la mortalité dans la plupart des groupes d'âge égalait celle observée dans les années 30. Cette tendance globale a été observée dans les groupes d'âge plus jeunes (15 ans à 50 ans) et chez les adultes d'âge plus avancé, bien que la mortalité liée à la MPOC dans les groupes plus jeunes ait reflété de manière disproportionnée les décès liés à l'asthme. Subséquemment, la mortalité a encore grimpé dans les groupes d'âge plus avancé, mais pas dans les groupes d'âge plus jeunes. L'augmentation soutenue de la mortalité dans les groupes d'âge plus avancé après la Seconde Guerre mondiale est probablement liée à la consommation du tabac. Les tendances historiques en Alberta ont ensuite été comparées à celles de l'ensemble du Canada pour les hommes et les femmes de plus de 50 ans. Bien qu'en Alberta la mortalité liée à la MPOC ait été largement inférieure à celle de l'ensemble du Canada, cette différence n'existe plus en 1980. Il est difficile d'expliquer l'ensemble des tendances observées, mais il semble plus vraisemblable qu'elles résultent des conditions environnementales et sociales, y compris les changements dans les habitudes sanitaires, que de changements majeurs intervenus dans la prise en charge médicale pendant cette période.

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CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) IS A familiar, common, and relatively intractable problem in respiratory medicine. The principal risk factor, cigarette smoking, is well recognized, as are the hereditary component and the role of other risk factors such as early lung infection (1,2). There have been major advances in medical management in recent years, including lung transplantation and, particularly, home oxygen therapy (3,4). However, management of this condition remains mostly a matter of 'fine-tuning' because of the essentially irreversible nature of the underlying disease when emphysema predominates, as it usually does in older age groups. For the foreseeable future, the only sensible strategy for reducing mortality and morbidity from COPD is to emphasize prevention, particularly by discouraging smoking, and optimal treatment of those patients who have developed COPD.

Monitoring trends in mortality from this cause may therefore appear to be an unrewarding enterprise. It may be too much to hope that an examination of mortality trends for this cause will yield insights as useful as those for asthma. On the other hand, it is always helpful to put the problem into perspective.

We have developed a data base on mortality in Alberta in order to support our studies in occupational and environmental epidemiology (5). We used this data base to examine trends in mortality from airways disorders in the province over 60 years (6). The unexpected observation of a sharp decline in mortality from COPD earlier in this century led us to examine mortality from airways disorders in greater detail and to compare Alberta's experience with that of Canada as a whole.

In our data (5,6) deaths attributed to this cause among children are almost all caused by fatal status asthmaticus. We have previously described trends for asthma in this age group as part of a larger comparison study (6). Deaths from 'COPD' among children presumably reflect a different distribution of risk factors than they would in older age groups. Our earlier analysis confirmed that trends for children did not show as clear a pattern as for teenagers and younger adults. Rates for death from COPD at younger ages are also rare and tend to be unstable. We therefore excluded children from this study. On the other hand, we present data for all deceased persons over the age of 15 in the present study because trends for teenagers and young adults before 1970 did tend to parallel those observed among older adults, despite much lower rates and a preponderance of asthma, rather than other conditions, within the rubric of COPD. Also, later trends for younger subjects showed a revealing comparison with trends for older adults.

PATIENTS AND METHODS

The investigation was restricted to deaths from COPD among Alberta residents aged 15 years and above, for both sexes. Deaths coded under the International Classification of Diseases under the general category 'chronic obstructive pulmonary disease and allied conditions' (490-496 in the ninth revision, ICD-9) include chronic bronchitis, emphysema, asthma, bronchiectasis, extrinsic allergic alveolitis, and 'chronic airway obstruction, not elsewhere classified'.

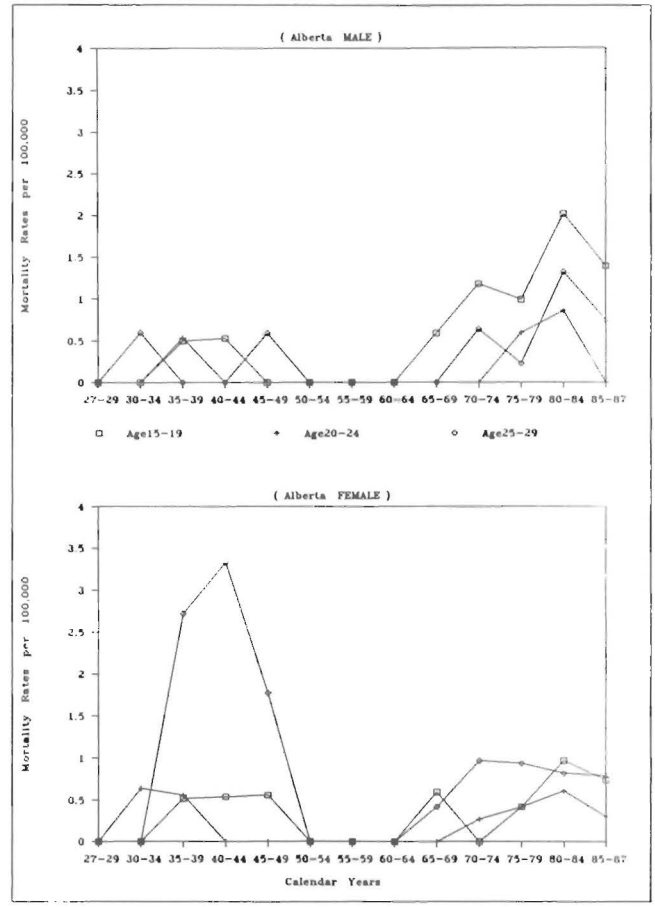

Figure 1) *Mortality (per 100,000 persons per year) from chronic obstructive pulmonary disease in Alberta, 1927 to 1987, for both sexes in age groups 15 to 19, 20 to 24 and 25 to 29 years. Note nadir in the 1950s despite small numbers and unstable rates*

Cystic fibrosis is excluded, as are other genetic disorders such as alpha$_1$-antitrypsin deficiency.

Mortality codes as ICD-9 490 to 496 among residents of Alberta from 1927 to 1987 aged 15 years and above were examined geographically, comparing trends by age over time. These data were not fully compiled in machine-accessible format at the time of the original epidemiological studies. Mortality statistics and population figures were compiled directly from the records of Alberta Vital Statistics by cause of death for each year, aggregated into five-year intervals, during the 61-year period. At the conclusion of this exercise, the general population mortality experience, both male and female, was summarized in a data set designated the 'Alberta Mortality Data Base'. This has been published separately (5) and has been the basis for several descriptive and cohort studies.

The coding systems used in Alberta and the ICD coding revisions used during this period were converted to ICD-9 codes by constructing a 'dictionary' of equivalent codes. Cause of death rubrics used in Alberta for chronic obstructive lung disease have been stable over this time period. Small differences in diagnostic or nosologic criteria would be unlikely to affect the findings in the study. In particular, because asthma, bronchitis, emphysema and bronchiectasis are aggre-

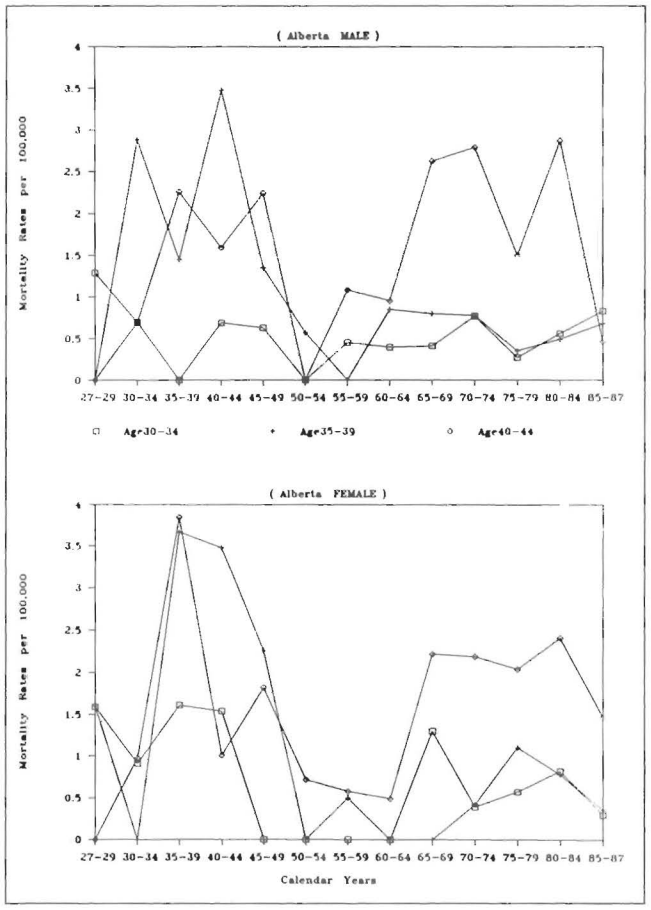

Figure 2) *Mortality (per 100,000 persons per year) from chronic obstructive pulmonary disease in Alberta, 1927 to 1987, for both sexes in age groups 30 to 34, 35 to 39 and 40 to 44 years. Note conspicuous relative deficit in the 1950s*

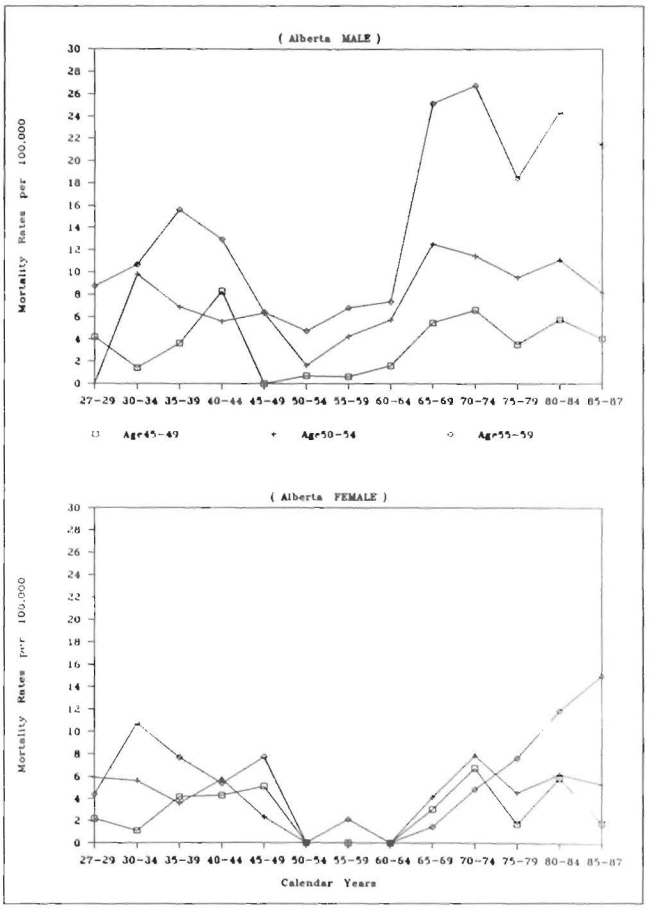

Figure 3) *Mortality (per 100,000 persons per year) from chronic obstructive pulmonary disease in Alberta, 1927 to 1987, for both sexes in age groups 45 to 49, 50 to 54 and 55 to 59 years. Note conspicuous relative deficit in the 1950s and massive increase in the 1960s for men aged 55 to 59 years and in 1970s for women aged 55 to 59 years*

gated under the general rubric for COPD, misclassification among these categories would not affect the overall rate for COPD.

The rates calculated for Alberta from 1950 to 1984 were compared with published data covering this time period for Canada as a whole (7). The rates were then compared graphically. For convenience, the comparison was restricted to ages 50 and above, the age division in which COPD is clearly the clinical entity most familiar to clinicians.

These data represent what is called a 'time series'. The analysis of a time series consists of identifying a trend in a data set that is serially dependent (ie, each value is related to the one preceding and the one following it) and depends on an assumption of 'stationarity', which is essentially the idea that the actual probability of an event occurring remains the same throughout the time period, an assumption that is not strictly correct. Because of these characteristics, the statistical analysis of a time series is a complicated undertaking, subject to considerable bias depending on which segments of the time period are selected for analysis (8). The analysis is also not particularly informative for mortality data. Confidence intervals are not provided because a time series is a set of data complete in itself, not a sample, and sampling theory therefore does not apply.

RESULTS

Figures 1 to 5 present the mortality experience for Alberta residents in five-year intervals from 1927 to 1987, by age group and sex from age 15 years. In reading these graphs, it is important to note that the vertical scale changes in order to accommodate the exponentially increasing mortality from COPD with increasing age. (Tables presenting these data for all age groups in a different format, and a different graphic presentation in the form of a cohort analysis, have been published elsewhere as part of a comparison with mortality from asthma [6].)

Mortality from COPD shows a consistent pattern. In all age groups, the historical profile featured a relatively high mortality before about 1950 followed by a nadir that lasted approximately 10 years and then an increase sustained through the 1980s. For younger age groups up to age 50, in which asthma would be expected to have predominated, this increase tapered off and became more or less of a plateau after the early 1960s. However, for older age groups, the

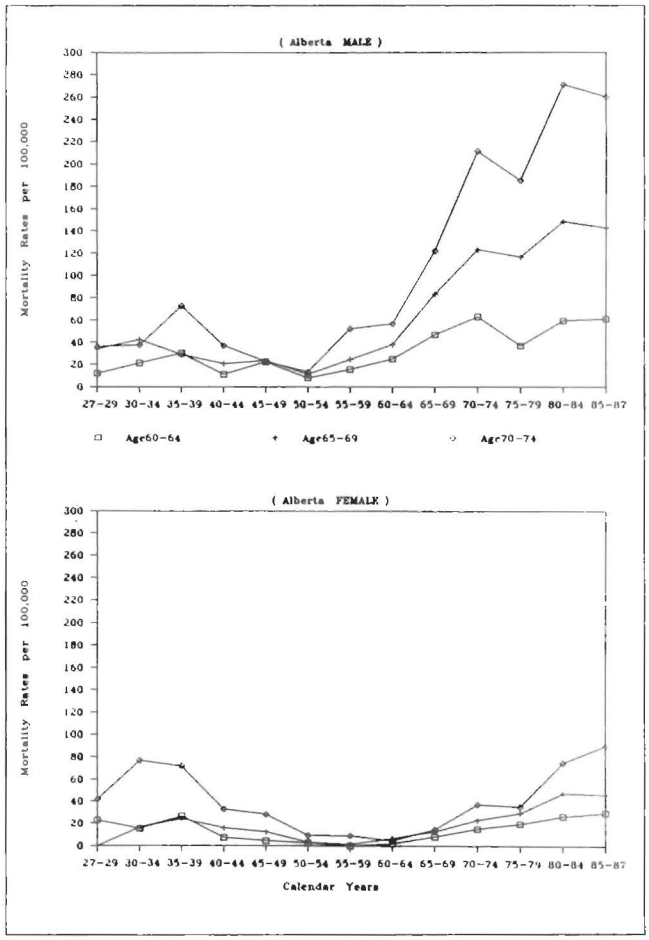

Figure 4) *Mortality (per 100,000 persons per year) from chronic obstructive pulmonary disease in Alberta, 1927 to 1987, for both sexes in age groups 60 to 64, 65 to 69 and 70 to 74 years. Note relative deficit in 1950 to 1954 followed by massive sustained increases beginning in 1950s for men and in 1960s for women*

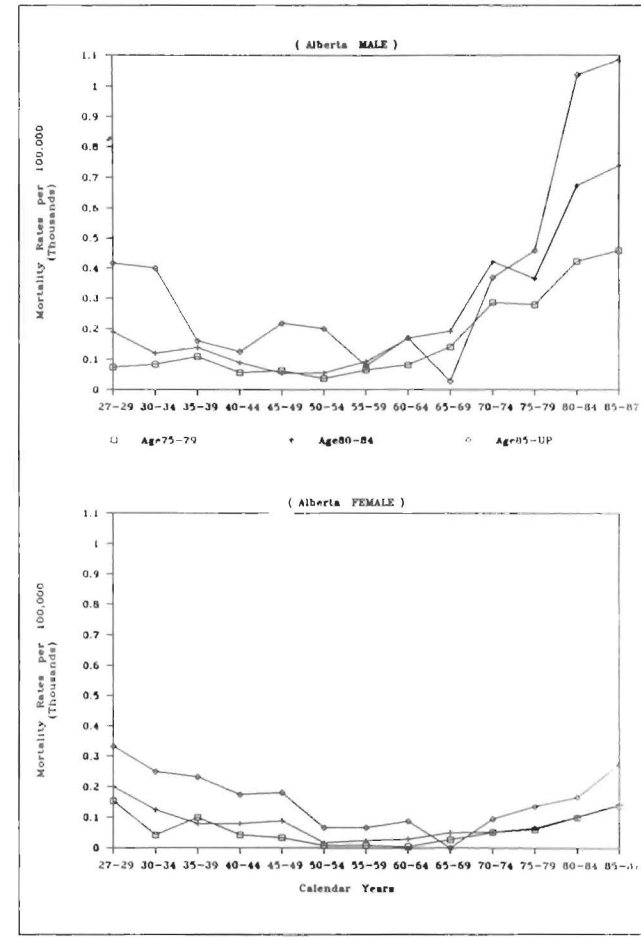

Figure 5) *Mortality (per 100,000 persons per year) from chronic obstructive pulmonary disease in Alberta, 1927 to 1987, for both sexes in age groups 75 to 79, 80 to 84 and over 85 years. Note less dramatic nadir in 1950s for men and in late 1960s for women, followed by a massive increase for men*

TABLE 1
Mortality from chronic obstructive pulmonary disease in Alberta (top figure) compared with all of Canada (bottom figure) (deaths per 100,000 per year)

Time period	Male Age groups								Female Age groups							
	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
1950-54	1.6	4.7	8.0	11.3	13.4	36.4	55.2	200.0	–	–	2.8	3.3	9.2	8.2	16.7	66.7
	16.8	24.4	42.4	59.4	80.3	103.8	143.1	225.7	5.4	7.5	10.9	19.0	31.4	40.3	69.2	123.0
1955-59	4.2	6.8	15.7	24.6	52.1	65.1	92.3	77.8	–	2.1	–	1.5	9.1	9.0	24.2	66.7
	16.0	29.8	51.6	78.0	101.4	141.5	163.6	222.8	5.1	6.8	11.7	15.9	23.1	40.7	57.7	108.0
1960-64	5.7	7.3	24.9	37.9	56.6	80.7	167.9	169.2	–	–	2.2	6.7	4.8	4.5	29.2	88.0
	16.0	31.6	62.4	94.6	131.5	169.4	226.3	262.1	5.3	7.3	9.5	15.2	22.3	37.0	49.4	95.1
1965-69	12.5	25.2	46.8	83.6	122.2	139.3	191.2	27.8	4.1	1.4	8.1	12.6	14.6	27.2	50.0	–
	18.3	40.8	78.4	130.6	189.4	261.4	315.7	391.4	6.8	10.2	13.8	20.8	30.3	40.8	58.1	98.6
1970-74	11.4	26.8	63.0	123.2	211.5	285.7	419.4	367.3	7.9	4.8	15.1	23.1	37.2	51.3	51.9	94.9
	18.8	41.0	86.6	154.7	249.4	342.0	436.5	509.4	8.3	13.3	20.0	29.0	40.4	53.4	71.8	104.4
1975-79	9.5	18.4	36.8	116.6	185.3	279.0	364.7	458.2	4.5	7.6	19.8	29.5	35.2	60.0	64.4	136.0
	16.1	38.3	80.1	156.1	254.0	396.2	544.1	691.0	7.0	15.6	21.0	38.4	52.3	64.8	91.7	135.2
1980-84	11.0	24.4	59.6	148.6	271.2	422.1	674.4	1037.0	6.2	11.8	26.4	47.3	74.8	100.0	102.8	166.3
	11.6	27.7	64.9	138.0	253.2	432.7	638.3	908.8	7.1	12.7	24.2	42.0	64.5	90.6	114.5	162.8

Data from reference 7

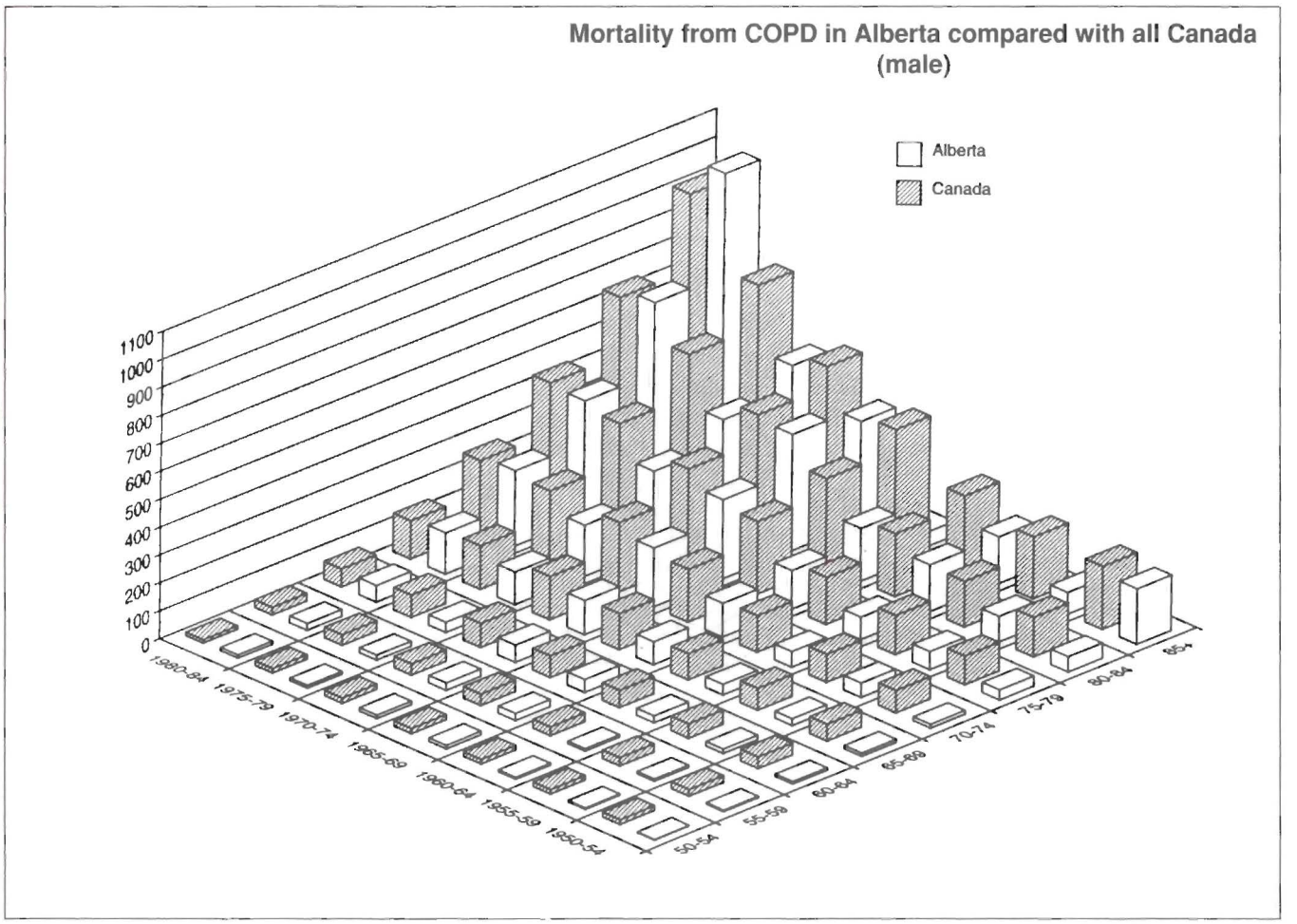

Figure 6) *Mortality (per 100,000 persons per year) from chronic obstructive pulmonary disease (COPD) among men in Alberta, 1950-1984, compared with Canada overall. Note relative deficit that disappears over time*

increase accelerated in the 1960s and was still rising in some age groups in 1985 to 1987. By the late 1960s and 1970s, mortality from COPD had returned to the levels of the 1930s.

Table 1 presents mortality rates for COPD among Alberta residents and compares them with rates for Canadians in general, as published by Manfreda et al in 1989 (7). Figures 6 and 7 present the mortality rates over time graphically, demonstrating the differences.

It is apparent that a substantial discrepancy between Alberta and Canadian rates existed in earlier years. In the interval 1950 to 1954, mortality from COPD in Alberta was reported to be as low as one-tenth to one-fifth that for Canada as a whole for residents below the age of 75 years, for both sexes. This considerable difference gradually disappeared. By the interval 1980 to 1984, mortality for both men and women in Alberta appeared to 'catch up' with rates for Canada overall and even exceeded overall Canadian rates for many age groups of both sexes.

DISCUSSION

Mortality from COPD in Alberta dropped substantially early in this century, reached a nadir in the 1950s, and rose rapidly again until by the 1970s rates had returned to 1930 levels. Both sexes showed this trend in all age groups 15 years and above. However, teenagers and younger adults (to age 50) show a subsequent plateau, consistent with our earlier observation that in Alberta, specifically, mortality from asthma has not increased in recent years (6). In contrast, mortality from COPD among older adults has continued to rise, to become the epidemic we now face. For reasons as yet unexplained, Alberta has shown a historically low rate of deaths from COPD compared with Canada as a whole, at times by huge margins, but the province lost this advantage by 1980. During the 1950s, 1960s and 1970s, mortality in Alberta from COPD steadily increased relative to Canada as a whole. In the early 1950s, the mortality from COPD in Alberta was as low as one-sixth or less that for Canada as a whole in certain age groups. Mortality in Alberta has converged with that of Canada as a whole, both because Alberta's age-specific rates have risen more sharply and because the rate of rise of mortality for Canada as a whole appears to be decreasing in some age groups.

There is no evidence to suggest that the trends observed are artefacts of reporting or coding. In Alberta, coding practices over this period preserved the general rubric of chronic obstructive lung disorders intact. There were no major depar-

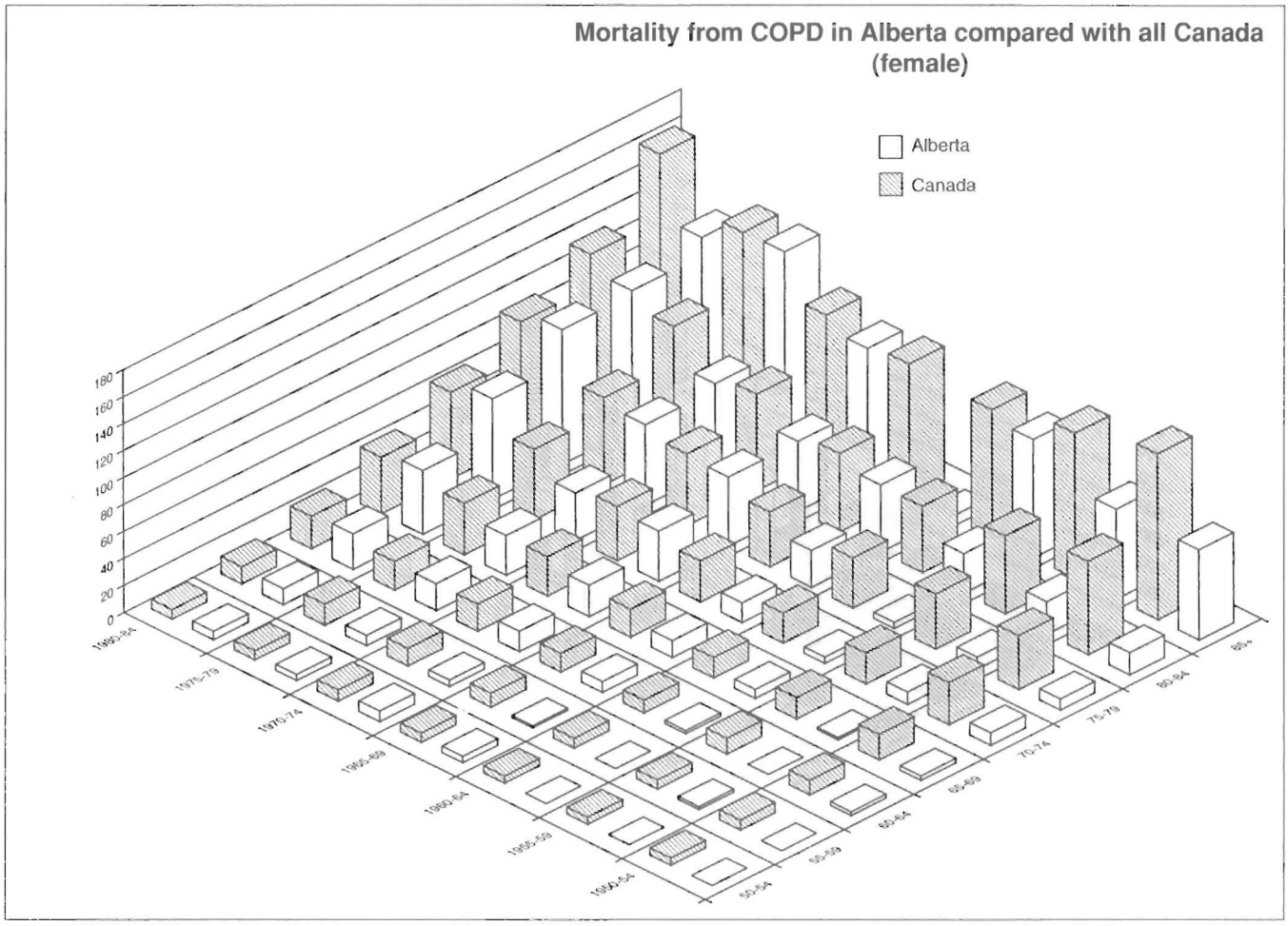

Figure 7) *Mortality (per 100,000 persons per year) from chronic obstructive pulmonary disease (COPD) among women in Alberta, 1950-1984, compared with Canada overall. Note relative deficit that disappears over time*

tures from standard practices that we could document (5,6). Likewise, trends in Canada as a whole are 'smooth' through various revisions of the ICD and show no evidence of major discontinuities in coding practices (7,9).

A plausible explanation for these trends is that mortality from COPD early in the century may have been attributable mainly to chronic bronchitis, bronchiectasis and inadequately treated status asthmaticus. Improved housing standards may have resulted in a decline at mid-century, despite the Depression. The trend may also have reflected demographic shifts with rural to urban migration at the time, which would have affected both housing quality and access to medical care. Another possibility is that Albertans smoked less during the Depression than before, for financial or other reasons, but this explanation cannot be documented easily. In Alberta, as in most of the prairie provinces, hard economic times began well before 1929 and before the first data point in this study. (Ironically, the province was recovering financially just as the worldwide Depression began [10].)

Changing medical practices are a possible explanation for the decline in mortality early in the century. However, the use of antibiotics to treat respiratory infections and to suppress chronic bronchitis did not occur until the 1940s, with the availability of the sulpha drugs, which were not very effective for this purpose. Theophylline, as a single effective agent in controlled doses for the treatment of asthma, was introduced in the 1930s. The medical management of asthma, chronic bronchitis, and the fixed airflow obstructive component of COPD therefore did not change appreciably at the time when the major decline in mortality was first observed in the early 1930s, and there is no suggestion of an abrupt change in trend in the 1940s. It is therefore unlikely that advances in medical care had much to do with this declining trend. The increase in mortality after the 1950s, on the other hand, is clearly a reflection of the post-Second World War prevalence of cigarette smoking and probably reflects a lag time before the chronic effects of cigarette smoking were observed (1).

This observation is not unique to respiratory disorders. In the 1970s, mortality among males in the majority of population centres in Alberta was significantly below Canadian averages for all causes, cardiovascular diseases, respiratory disorders overall and malignant neoplasms (12). Some of these differences were quite substantial: between 1950 and 1984, male mortality in Alberta from obstructive pulmonary disease in the age group 60 to 65 years averaged only 51%

that of Canada as a whole, which in turn was comparable with that of the United States (9).

One explanation for the historically favourable mortality experience in Alberta may be a relative difference in risk factors predisposing to lung disease. Data from health risk factor surveys suggest that residents of Alberta have shown a somewhat lower prevalence of risk factors for cardiopulmonary disease than all Canadians. Data from the Alberta Heart Health Study, collected to support efforts at cardiovascular risk reduction, show that male residents of Alberta reported a lower prevalence of cardiovascular risk factors compared with other jurisdictions in North America, particularly in urban areas where the population is concentrated (13). Some of these same risk factors are significant in respiratory disease, most obviously smoking. To follow up on this lead, we examined the available prevalence surveys on smoking in Alberta compared with Canada as a whole.

Cigarette smoking, by far the most significant cardiopulmonary risk factor, shows a difference between residents of Alberta and Canadians in general. Alberta residents of both sexes and in certain age groups – 25 to 29 and 40 to 59 – have been found less frequently to smoke compared with other Canadians in studies conducted in 1986 (14) and in 1990 (13). In 1975, 1977 and 1979, however, the differences were slightly greater for men and there was not much difference among women in any age group (15). Going back further to the 1960s, data are only available by region and Alberta rates cannot be separated out. Even so, the prairie region showed lower rates of regular cigarette smoking among men in 1966 by as much as 11% for males aged 20 to 24 years (49.1% versus 60.1%); most differences were much smaller, however, and the differences for women were marginal or nonexistent.

The relatively small differences in smoking habits over the entire period, which are on the order of a few per cent, are clearly not sufficient to account for the large historical discrepancies. The available data do not permit us to reconstruct historical trends in the frequency and amount smoked. It is entirely possible that residents of Alberta smoked marginally less often but much less in amount than Canadians overall. Because these behavioural surveys are relatively new, data that document trends in cardiopulmonary risk factors over the entire time period of interest are not accessible. We cannot, therefore, document an explanation for the discrepancy in mortality over 35 years.

It is possible that over time the behaviour of residents of Alberta with respect to smoking and other risk factors became more like that of the rest of Canada with respect to quantity smoked, but it could also be that Canadian norms for smoking came to resemble Alberta more, particularly with increasing attention to fitness and health promotion. The most likely explanation, however, is that convergence occurred in both the province and the country as a whole. This explanation is the one most compatible with the mortality data, which shows sharply increasing trends in Alberta rising to meet relatively flattening trends in Canada as a whole. In the absence of serial data on health-related behaviours, it may be impossible to explain this anomaly conclusively.

In conclusion, an examination of trends in mortality from COPD in Alberta reveals two striking anomalies: the nadir in mortality rates that occurred in the 1950s and the gradual convergence of rates in Alberta with rates for Canada as a whole. These observations place mortality from this important cause in perspective and suggest that social and environmental factors may have played a greater role historically than medical management in controlling mortality from these conditions. However, there is insufficient evidence available on health-related behaviours to explain fully the discrepancy between mortality rates in Alberta compared with Canada as a whole, a discrepancy that seems now to have disappeared.

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