Determinants of Lung Cancer Trends in Hungary

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Date: April 1998

1. Introduction

Extending a method originated by Swartz[1], we have in previous reports [2-11] used a mathematical model based on smoking histories to predict trends in lung cancer mortality in US, UK and a number of other countries. In this report, we apply the same method to Hungary.

2. Methods

2.1 Observed rates

Observed lung cancer rates were calculated from the WHO database, and standardised to the WHO European Standard (old) Population. The latest available data are for 1995. Smoothed rates based on 5-year moving averages are also presented. Use of smoothing is particularly appropriate in those sex/age groups where lung cancer deaths are rare (i.e. males 35-44 and females 35-44, 45-54).

2.2 Risk prediction

The multistage carcinogenesis models, the simple smoking statistics and the estimated background (non-smoker) risk are as described in previous reports. For the multistage models, the values of the parameters used were the same as those used in previous main analyses, namely:

K-1	(number of stages)	4.5
d_1:d_2	(ratio between stages)	1:0, 5:1, 2:1, 1:1, 1:2, 1:5, 0:1
R	(risk of smoking)	10, 20, 30, 40
L	(lag time in years)	5

The 'standard model' has d_1:d_2=1:2, and R=20.

The dose (from cigarettes) in year i, Z_i, is based on

(1) the number of cigarettes smoked per smoker (CPS) U_i, with U*=20 denoting the standard number, and

(2) the tar level per cigarette P_i, with P* denoting the earliest estimated tar level.

The dose variants used were:

Constant dose	$Z_i = 1$ throughout
Dose depends on cigarette consumption:	$Z_i = U_i / U^*$
Dose depends on tar and cigarette consumption	$Z_i = U_i \ P_i / U^* \ P^*$

Risk prediction was carried out using both the Individual and Aggregate methods as previously described. For the aggregate method, the "Swartz without drift" smoking sub-model was used with S′ (assumed earliest age of smoking) = 15.

2.3 Sexes, ages and years studied

Both sexes were studied. The age groups and years that could be studied were limited by the availability of smoking data. The main age groups studied were 35-44 and 45-54. In the aggregate analyses, for age 35-44, the period studied was 1968-1995, subdivided into 1968-1980 and 1980-1995; for age 45-54, the period studied was 1978-1995, but for consistency, tables are generally presented for 1980-1995 only. In the individual analyses, the same years are presented in the tables where possible, with additional years for females only shown graphically. Some analyses are also presented for age 55-64, for the period 1988-1995, although this period is too short for useful conclusions to be drawn.

2.4 Presentation of results

The tables give the percentage change over a number of years (15 years if possible) in the observed rate and in the predicted risk, for each sex/age group/period studied. A positive change indicates a rise, while a negative change indicates a fall in risk. In describing a change, we always refer to a rise being greater than any fall.

Graphs are presented showing the observed and predicted rates over the 30 year period 1965-1995, relative to the 1980 rate. Thus all lines meet at a single point in the centre of the graph. A greater change appears as a ***lower*** line in the left-hand side of the graph, and as a ***higher*** line in the right-hand side of the graph.

3 Smoking data

3.1 Hungarian General Practitioners Study (HGPS)

A sample of 1109 males and 1503 females, representative of the population registered with family practices in Hungary, was interviewed from October 1995 to March 1996. The study methodology has been described elsewhere.[12] Questions covered many aspects of health and lifestyle, including smoking.

The cigarette smoking data used in this report were:

Smoking status (current, ex, never)

For ever smokers - Age started smoking

For ex-smokers - Years since stopped smoking

For all these data items, smoking status was self defined (i.e. not specified as to regular, daily etc).

Additional smoking data from HGPS which were not used in this report included pipe and cigar smoking (not useable because starting and stopping not available), amount of cigarettes smoked (not useable because only related to current or maximum ever smoked), brands of cigarettes smoked (not useable because only available for current smokers).

12 subjects (4 male and 8 female) for whom the smoking status was missing were excluded from this analysis. The distribution by sex and 10-year birth cohort of the subjects included is shown in Table 1. The earliest 10-year birth cohort with at least 20 persons (the criterion used for the aggregate method) is 1920-29 for both sexes. The earliest single-year birth cohort with 10 persons (for the individual method) is 1925 for males and 1921 for females.

3.2 Derivation of smoking data from HGPS

Tables 2 and 3 show the average age of starting and the average years since stopping smoking by sex and birth cohort.

To determine past smoking habits, each subject who had ever smoked was assumed to have smoked continuously from their age of starting to smoke until interview, or, for ex-smokers, until the end of the year in which they gave up smoking. For the few subjects with missing data for starting or stopping smoking, the cohort average was assumed.

Prevalence estimates at each calendar year could then be calculated. These are presented by birth cohort in Table 4 and Figure 1. This shows that smoking prevalence was fairly stable for successive male cohorts born 1920-29 to 1950-59, but has declined for more recently born cohorts. For females, there was a considerable increase in smoking for cohorts born 1940-49 and later compared with those born 1920-1939. Although not directly relevant to this report, estimates by age group at selected years are also presented (Table 5). This allows comparison with other contemporary surveys, although the age distribution of subjects within an age group will not be the same as in the general population.

For 1995, the average number of cigarettes per smoker was also calculated (Table 6).

3.3 Other smoking data

Data on the sales of cigarettes in Hungary are available from USDA from 1960 onwards.[13,14] The proportions of sales as plain/filter cigarettes are given by Maxwell and WHO.[15-17] These data are shown in Table 7. However, illegal sales may be as much as 25% of total sales.[18]

There does not seem to be any source of consistent data on trends in smoking habits in Hungary. A collection of data from disparate sources on the prevalence and level (CPS) of smoking since the 1960s is presented in Appendix A. Papers from that Appendix cited in the main body of this report are referenced by "A" followed by the reference number.

We are not aware of any data on the sales-weighted average tar (SWAT) level of Hungarian cigarettes. General comments in the literature suggest that few low-tar cigarettes were smoked[19] and that in 1992, the most popular brands had tar levels in the range 18-24mg.[17] A recent shift towards low tar cigarettes since the early 1990s has been reported, with the market share increasing from 3% to 28%.[20]

3.4 Comparison of smoking data derived from HGPS with other smoking data

The current prevalence of smoking among adults derived from the HGPS, 34% males and 28% females, is somewhat lower for males than suggested by other recent surveys (see Appendix A for details and references), although the prevalence for females is similar. There are no recent sex-specific estimates of CPS for comparison with the HGPS figures of 18 (males) and 13 (females). The only possible comparison is with a market research survey,[A17] possibly Amer Nielsen, which gives notably higher sexes-combined estimates (50% prevalence, 20 CPS). Grossing up to the whole population from these data and comparing with sales data (Table 7), HGPS represents 50% of consumption while Amer Nielsen represents 106%. We have previously found[21] that a comparison factor between 60%-80% is common in many countries.

For past prevalence of smoking, it is only possible to compare with age-specific data, because the recalled data from HGPS is subject to a progressively lower age limit. The only good-quality studies for comparison are the WHO-Monica studies[A14-15] for age 25-64. These show the male prevalence similar to HGPS at ages 25-44, but about 10% higher for ages 45-64. The female prevalence from WHO-Monica in Budapest was 5-10% higher than HGPS, while the WHO-Monica in Pecs showed a much steeper age gradient.

As an alternative approach to comparison, the recalled prevalence from HGPS in the 1960s was extrapolated to older age by making assumptions about the smoking of earlier cohorts. For the results to match the early studies[A7,A10], the prevalence of smoking by earlier cohorts would have had to have been higher for men, and slightly higher for

women than the earliest (1920-29) cohort studied. This seems implausible since it was lower in all other countries where we have been able to study earlier cohorts[2,4,5,9].

Taken together, these comparisons suggest that there has been somewhat more understatement of smoking in the HGPS than is commonly seen in surveys of smoking. This might well be explained by the health context in which the survey was conducted.

3.5 Estimated 'dose' from cigarettes for use in modelling

Accepting the HGPS prevalence estimates, the sales-corrected estimates for CPS in 1995 are approximately 35 for males and 25 for females. Taking guesstimates of the prevalence of smoking in 1960 as 50% for males and 15 % for females, and assuming as previously[21] that female CPS is 80% of male CPS, the sales-corrected estimates for 1960 are 20 for men and 15 for females. This is close to the only early survey[A10] which was unsystematic and unrepresentative. No information is available for earlier years, and we have guesstimated CPS as 10 for men and 5 for women in 1920. Intermediate years are estimated by linear interpolation.

In the absence of any firm information, we have assumed that the average tar level of Hungarian cigarettes in 1995 was 20 mg, that the tar level of cigarettes in 1960 was 35mg (the same as the earliest data for USA), that the tar level did not vary before 1960, and that the drop in tar level between 1960 and 1995 was proportional to the switch from filter to plain cigarettes. The resulting estimates are shown in Table 8.

4 Results

4.1 Observed Rates

For males, lung cancer rates have risen throughout the whole period studied in all three age groups. The rate of increase has fallen slightly in the last 5-10 years. For females, rates in all three age groups were initially level and have risen since about 1970-75 (Table 9, Figure 2) . The apparent difference in pattern for females age 35-44 between the actual and smooted rates shown in Figure 2F is due to the unusually low rate in 1980 (based on only 18 deaths), the year to which rates are scaled.

4.2 Aggregate Method

Table 10 shows the percentage changes in the predicted risk for the multistage models with various values of the ratio d_1:d_2 and R, and with either a constant dose of 20 cigarettes per smoker per day, a variable dose from cigarettes uncorrected for tar, or a variable dose fully corrected for tar (as described in section 3.5). Figure 3 shows the results for the 1:2(20) models for the age groups 35-44 and 45-54, with the colour representing the dose model (red=constant, blue=variable/no tar, green=variable/full tar).

For males, with constant dose the predicted trends rise gently or are level, thus showing a considerable discrepancy when compared with the observed trends. At ages 35-44 and 45-54, greater rises are predicted when the variable dose (CPS) model is used, but these are still considerable lower than those observed; if tar correction is also applied then the predictions are lower than uncorrected, and are in fact very similar to those from the constant dose model. Exceptionally for the age group 55-64 the discrepancy is virtually eliminated when the variable dose model is used (although this age group can only be studied over a short period). Models making partial correction for tar, such as the square root correction used in previous reports[8-10] have not been tried, but would predict trends intermediate between the uncorrected and the fully corrected models, and would thus not affect the conclusions.

For females, all models predicted rising trends. There is relatively little difference between the constant dose model and the variable CPS model, while the model with variable CPS and full tar correction predicted lower rises. In the earlier period (1968-1980, only studied for age 35-44) predicted trends are quite similar to the observed trends. In the later period, larger rises are predicted, but not as large as those observed. This discrepancy is particularly clear for age 35-44, and is in the same direction as the discrepancy seen for males.

4.3 Individual Method

Predicted changes using the individual method and constant dose are summarised in Table 11, and, for the 1:2(20) model, are shown in Figure 4. For males, trends predicted using the individual method and constant dose were very similar to those predicted by the equivalent model and the aggregate method. For females at age 35-44 and 45-54, the predicted rises were somewhat higher than those predicted by the aggregate method, but still lower than observed.

No data are available on an individual basis for variation in numbers of cigarettes smoked in the past and this restricts further use of the individual method.

4.4 Simple smoking statistics

In Table 12 changes in a number of simple smoking statistics, derived from the aggregated smoking data, are presented. As previously described,[2] these are compared with changes in the excess lung cancer rate, that is after subtracting the estimated background rate.

These comparisons showed similar discrepancies to those seen with the multistage models.

5 Discussion

In this report, we have applied methods of risk estimation previously used in a number of other countries including USA and UK to Hungary.

Data from the HGPS were used to estimate smoking prevalence, both currently and in the past. In previous reports[9] we have investigated the use of recalled smoking histories to provide indirect estimates of past smoking prevalence, and concluded that indirect estimates provide a suitable indication of time trends with respect to sex, age and cohort when direct estimates are not available. Although the HGPS study was well conducted, the health context in which the questions were asked may have tended to cause a high level of understatement of smoking. The study was noted to have substantially

understated alcohol consumption.[12] Only those registered with a family practice were included in the sampling, and it is not known whether this group differ from the general population in terms of their smoking histories.

No data on past CPS were available from HGPS, and very little other information was found on CPS or on the tar levels of cigarettes in Hungary. Consequently the estimates of CPS and of tar used in variable dose models are highly speculative.

Using a multistage model and aggregated smoking data failed to predict the rises in lung cancer rate that have been observed in Hungary. This discrepancy was particulary large for males age 35-54 throughout the period studied, and for females age 35-44 since 1980.

Despite the reservations about the smoking data, these discrepancies are so substantial, that it seems unlikely that they can be attributed to inadequacies in the data. Nor can they be attributed to the details of the multistage models chosen, since they are also seen in the simple smoking statistics.

Lack of appropriate data limited the use of the individual method. In view of the small difference for the constant dose model between the aggregate and individual methods, and our earlier findings[10] for the UK, that using the individual method tended to reduce the discrepancy between observed and predicted trends but only slightly, it also seems unlikely that use of the technically inferior aggregate method has contributed significantly to the discrepancy.

Over the period 1965-1995 lung cancer death rates in men and women aged 35-44 and 45-54 have increased over 3-fold. Such a dramatic rise is not predicted, even closely, by trends in cigarette smoking in any of the analyses conducted. The discrepancy seems unlikely to be due to limitations in modelling or weaknesses in the data used, and it strongly suggests that factors other than cigarette smoking may have made an important contribution to the observed rise in the recorded death rate from lung cancer.

References

1 Swartz JB. Use of a multistage model to predict time trends in smoking induced lung cancer. *J Epidemiol Community Health* 1992;**46**:311-5.

2 Lee PN, Forey BA. *Determinants of trends in US lung cancer mortality rates. An evaluation and extension of the work of Swartz.* Internal report; 1994 June.

3 Lee PN, Forey BA. *Determinants of trends in US lung cancer mortality rates. Supplementary report.* Internal report; 1994 November.

4 Lee PN, Forey BA. *Determinants of trends in lung cancer mortality. Italy and Norway.* Internal report; 1995 January.

5 Lee PN, Forey BA. *Determinants of trends in lung cancer mortality in Germany and Switzerland.* Internal Report; 1995 December.

6 Lee PN, Forey BA. *Determinants of trends in lung cancer mortality. A. Additional analyses for US and Italy. B. Passive smoking.* Internal report; 1996 January.

7 Lee PN, Forey BA. *Determinants of trends in lung cancer mortality. Do our models satisfactorily explain variation in risk by age, sex, country and smoking status?* Internal report; 1996 February.

8 Lee PN, Forey BA. Trends in cigarette consumption cannot fully explain trends in US lung cancer rates [Abstract]. *Statistician* 1996;**45**:448.

9 Forey BA, Lee PN. *Estimating past smoking habits. An investigation into a method based on recall, with application to Great Britain.* Unpublished; 1996.

10 Lee PN, Forey BA. Trends in cigarette consumption cannot fully explain trends in British lung cancer rates. *J Epidemiol Community Health* 1998;**52**:82-92.

11 Lee PN, Forey BA. *Trends in cigarette consumption cannot fully explain trends in US lung cancer rates or trends in the US/UK ratio of lung cancer rates.* Unpublished; 1996.

12 Scientific Association of Hungarian General Practitioners. *Several relationships between the health status and life-style of the Hungarian population.* Unpublished; 1996.

13 Creek L, Carehart T, Grise V. *U.S. tobacco statistics, 1935-92.* Washington DC: US Dept of Agriculture, Economic Research Service; 1994. Statistical Bulletin No 869.

14 Horne B. Tax screw being tightened in Hungary. *Tobacco Journal International* 1996;**(2)**:48-9.

15 Lee PN. Carbon monoxide yield of cigarettes. *BMJ* 1979;**2**:1584.

16 Ramstrom LM. Worldwide changes and trends in cigarette brands and Consumption. In: Zaridze DG, Peto R, editors. *Tobacco, a major international health hazard. Proceedings of an international meeting of the All-Union Cancer Research Centre and IARC, Moscow, 1986.* Lyon: IARC; 1986. Scientific Publication No.74: p. 135-42.

17 World Health Organisation. *Tobacco or health: A global status report.* Geneva: WHO; 1997.

18 Horne B. New tobacco legislation in Hungary. *Tobacco Journal International* 1992;**4**:30,32.

19 Zatonski W. Country reports. *World Smoking and Health* 1991;**16**:12-21.

20 Anonymous. Hungarians flock to light cigarettes. *Tobacco Reporter* 1998;**125**:6.

21 Nicolaides-Bouman A, Wald N, Forey B, Lee P. *International smoking statistics. A collection of historical data from twenty-two economically developed countries.* London, Oxford, New York, Tokyo: Wolfson Institute of Preventive Medicine and OUP; 1993.

Table 1

Number of subjects in HGPS, by sex and birth cohort

Year of birth	Males	Females
1900-1909	1	0
1910-1919	7	10
1920-1929	128	214
1930-1939	199	238
1940-1949	219	303
1950-1959	215	305
1960-1969	149	195
1970-1979	176	214
1980-1989	11	16
Total	1105	1495

Table 2

Number of ever smokers and average age of starting to smoke cigarettes

Year of birth	Males		Females	
	N	Age	N	Age
1920-1929	82	19.7	39	25.0
1930-1939	136	18.6	46	24.1
1940-1949	153	18.3	131	23.0
1950-1959	153	17.8	160	19.8
1960-1969	78	17.7	99	18.3
1970-1979	63	16.2	64	17.1

Note. Excluding subjects born before 1920 or after 1979. Excluding 3 male and 4 female subjects with age of starting to smoke missing.

Table 3

Number of ex smokers and average years since stopped smoking

Year of birth	Males		Females	
	N	Years	N	Years
1920-1929	58	20.2	20	14.5
1930-1939	81	19.3	21	11.2
1940-1949	71	12.4	49	12.9
1950-1959	51	11.2	65	9.4
1960-1969	21	6.1	31	6.9
1970-1979	10	2.4	16	4.5

Note. Excluding subjects born before 1920 or after 1979. Excluding 1 male and 2 female subjects with years since stopping missing.

Table 4

Prevalence of cigarette smoking by 10-year cohorts, at selected years derived from HGPS

Sex/year of birth	Year												
	1935	1940	1945	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995
Males													
1920-29	5	14	36	52	57	55	53	51	47	39	32	25	20
1930-39			5	21	47	58	60	56	50	46	40	36	28
1940-49					6	25	54	64	61	59	55	46	38
1950-59							3	28	58	63	59	53	47
1960-69									3	21	40	44	38
1970-79											2	16	30
Females													
1920-29	0	3	7	11	14	15	14	14	15	14	14	13	9
1930-39			0	3	8	13	16	17	17	17	16	14	11
1940-49					1	5	20	31	34	35	35	30	27
1950-59							1	13	35	41	42	39	31
1960-69									1	17	38	40	35
1970-79											0	8	22

Table 5

Prevalence of cigarette smoking (number in age group) by age at selected years derived from HGPS

		Age									
Sex	Year	16-24		25-34		35-49		50-64		65+	
Males	1940	34.8	(46)								
	1945	35.4	(127)								
	1950	42.5	(167)	57.9	(57)						
	1955	47.3	(184)	55.6	(142)						
	1960	47.3	(201)	57.2	(187)	55.0	(60)				
	1965	53.6	(194)	60.3	(209)	51.7	(147)				
	1970	51.5	(198)	63.1	(222)	52.3	(239)				
	1975	57.7	(196)	62.0	(213)	48.2	(299)	48.3	(60)		
	1980	52.0	(152)	61.8	(220)	52.7	(319)	36.7	(147)		
	1985	37.9	(132)	59.2	(213)	51.1	(325)	34.7	(239)		
	1990	33.1	(157)	49.7	(159)	48.5	(330)	32.8	(299)	25.0	(60)
	1995	30.4	(158)	36.7	(150)	45.3	(316)	31.7	(319)	18.9	(148)
Females	1940	6.8	(88)								
	1945	7.1	(211)								
	1950	6.6	(212)	15.8	(114)						
	1955	8.9	(214)	12.8	(235)						
	1960	10.4	(268)	11.9	(236)	18.8	(117)				
	1965	20.5	(273)	17.2	(244)	14.3	(245)				
	1970	27.8	(284)	23.9	(285)	15.3	(340)				
	1975	33.3	(273)	36.7	(305)	16.3	(375)	16.2	(117)		
	1980	37.6	(210)	39.0	(323)	25.1	(390)	14.3	(245)		
	1985	38.5	(174)	40.5	(294)	31.3	(444)	14.7	(340)		
	1990	23.1	(182)	40.3	(226)	34.1	(469)	15.2	(375)	12.8	(117)
	1995	22.8	(189)	33.7	(199)	30.2	(453)	18.2	(390)	9.3	(246)

Table 6

Current cigarettes per smoker by sex and age, derived from HGPS

Sex	Age							
	15-19	20-24	25-34	35-44	45-54	55-64	65+	15+
Male	9.0	14.6	17.5	20.8	20.0	16.9	17.2	18.2
Female	8.7	11.2	12.3	14.7	13.8	14.3	13.1	13.3

Table 7

Sales of cigarettes and proportion as filter cigarettes, from 1960

Year	Sales	% filter
1960	15782	
1961	16793	
1962	16449	
1963	15812	6.4
1964	16393	10.5
1965	18478	14.0
1966	20525	16.5
1967	20936	19.5
1968	21836	23.2
1969	20772	27.3
1970	22502	37.2
1971	24008	41.4
1972	26135	46.8
1973	23603	52.0
1974	23593	56.7
1975	25783	61.0
1976	26250	67.7
1977	25700	72
1978	25525	
1979	26050	
1980	28598	
1981	28190	
1982	26435	84
1983	24850	
1984	27540	
1985	27280	
1986	27133	
1987	27242	
1988	26628	
1989	27415	
1990	29062	
1991	26530	
1992	25985	
1993	27769	
1994	28579	93
1995	28850	

Sources:
Sales 1960-1990, Reference13
1991-1995, Reference 14
% filter 1963-1976, Maxwell quoted by Reference 15
1977, 1982, Maxwell quoted by Reference 16
1994 (based on production), Reference 17

Table 8

Estimated tar level of Hungarian cigarettes

Year	Tar
1960	35.0
1973	27.4
1982	22.2
1995	20.0

Table 9

Observed lung cancer rates[1], at selected years

Sex	Age		Year 1965	1970	1975	1980	1985	1990	1995
Male	35-44	Actual	82	81	127	183	232	308	318
		Smoothed	76	99	131	188	237	297	332
	45-54	Actual	355	382	561	845	1116	1353	1469
		Smoothed	370	427	581	859	1173	1342	1505
	55-64	Actual	1471	1491	1558	1992	2664	3292	3376
		Smoothed	1458	1500	1610	2091	2696	3176	3359
Female	35-44	Actual	35	45	47	26	62	95	127
		Smoothed	31	33	40	47	67	107	127
	45-54	Actual	94	109	115	172	198	272	383
		Smoothed	101	100	118	162	200	271	353
	55-64	Actual	240	253	246	382	396	535	686
		Smoothed	254	250	273	331	416	530	650

1. Rates per million. Smoothed rates are 5-year moving averages, latest available data 1995.

Table 10

Percentage changes (by sex, age and period) in the lung cancer rate observed and in that predicted using the aggregate method and differing assumptions

		Males				Females			
		35-44		45-54	55-64	35-44		45-54	55-64
		1968-1980	1980-1995	1980-1995	1988-1995	1968-1980	1980-1995	1980-1995	1988-1995
Observed changes (smoothed)		108.3	76.1	75.3	11.8	50.2	169.5	117.7	33.2
Predicted changes									
Dose	Model								
Constant	1:2(20)	9.8	-2.6	6.9	0.2	41.4	54.7	74.1	16.1
	1:2(10)	8.0	-2.7	5.3	-0.2	30.9	41.9	55.5	12.2
	1:2(40)	11.6	-2.2	8.6	0.8	50.4	66.6	90.1	19.2
	5:1(20)	12.8	0.2	11.4	3.3	27.2	52.9	64.5	14.8
	1:5(20)	9.0	-3.4	5.5	-0.8	46.5	55.3	78.0	16.7
Variable/ no tar correction	1:2(20)	34.0	25.5	40.8	13.7	47.2	65.4	86.1	21.4
	1:2(10)	28.1	20.7	33.0	10.8	33.3	48.9	61.4	15.0
	1:2(40)	39.5	30.4	48.3	16.3	61.1	81.4	110.3	26.9
	5:1(20)	37.7	33.1	51.5	18.5	29.8	59.0	73.1	19.9
	1:5(20)	32.6	22.9	3634	11.5	53.7	67.4	91.1	21.5
Variable/ full tar correction	1:2(20)	16.0	-6.0	6.9	1.6	32.7	29.6	46.8	10.4
	1:2(10)	12.9	-5.8	4.6	0.5	23.1	21.8	33.2	7.2
	1:2(40)	19.3	-5.7	9.5	2.9	42.2	37.0	60.1	13.7
	5:1(20)	21.2	-2.0	15.5	7.0	20.9	26.8	40.4	10.8
	1:5(20)	14.6	-7.0	4.3	-0.2	37.2	30.9	50.2	10.6

Table 11

Percentage changes (by sex, age and period) in the lung cancer rate observed and in that predicted using the individual method and differing assumptions

		Males				Females			
		35-44		45-54	55-64	35-44		45-54	55-64
		1968-1980[1]	1980-1995	1980-1995	1988-1995	1968-1980	1980-1995	1980-1995	1988-1995
Observed changes (smoothed)		108.3	76.1	75.3	11.8	50.2	169.5	117.7	33.2
Predicted changes									
Dose	Model								
Constant	1:2(20)	5.1	4.9	5.1	5.3	20.9	68.0	99.3	2.2
	1:2(10)	6.2	4.2	4.7	5.5	16.5	52.1	72.0	2.0
	1:2(40)	3.2	5.6	5.2	4.8	23.7	82.4	125.3	2.0
	5:1(20)	-2.6	6.6	6.9	3.6	10.9	61.2	92.6	1.4
	1:5(20)	7.8	4.6	4.9	6.4	24.5	70.5	102.4	2.7

1. Predicted changes 1969-1980, males only. (More years are available for females, but are not shown here for consistency with other tables.)

Table 12

Percentage changes (by sex, age and period) in the excess lung cancer rate observed and in some simple smoking statistics

	Males				Females			
	35-44		45-54	55-64	35-44		45-54	55-64
	1968-1980	1980-1995	1980-1995	1988-1995	1968-1980	1980-1995	1980-1995	1988-1995
Observed excess changes (smoothed)								
	134.5	83.9	80.3	12.3	114.6	270.7	176.8	45.5
Smoking statistics changes - aggregate method								
% smkrs -overall[1]	13.5	-3.8	9.1	2.7	91.9	77.0	130.1	31.8
-first 10y	24.9	3.0	25.7	15.3	98.8	121.7	169.9	38.1
-last 10y	7.3	-8.8	0.8	-4.7	90.1	54.7	110.3	24.9
% smoking 20+ yrs	NA	NA	11.2	2.0	NA	NA	151.8	31.5
Average cigs/person (variable CPS/no tar correction)	37.7	22.4	38.4	13.7	124.1	99.1	165.1	41.5
Average tar corrected cigs/person (variable CPS)	23.0	-7.0	11.0	4.5	97.3	52.7	110.4	28.7

1. Equivalent to average duration of smoking.

Appendix A

A collection of survey-based smoking statistics for Hungary.

The tables show the prevalence of smoking and the level of smoking (cigarettes per smoker per day) by sex and age gathered from a variety of sources of survey based data. Each survey is identified by the year it was carried out (or the midpoint year if carried out over a period of years) and a source number. Brief notes on the nature of each source are given below in the *Notes* section, and full references for each source are given in the *References* section. Sources included in the tables are numbered 1-15.

The smoking product and the frequency of smoking are indicated in the tables by the codes:

Product:	A	All
	MC	Manufactured cigarettes
	UC	Cigarettes, type unspecified
	U	Unspecified
Frequency	A	All (i.e. including occasional)
	R	Regular or daily
	U	Unspecified

Data on smoking of pipes/cigars only have not been included.

The *Notes* section also includes some additional information which did not meet the criteria for inclusion in the tables. Sources not used in the Tables are numbered 16-21.

Notes

1 Benjamin (1978)
Quoting Statistical Yearbook of Hungarian Central Statistical Office 1975.
Age not stated (adults).

2 Chollat-Traquet (1992)

Quoting data supplied by member country to WHO. Female data only, product and frequency unspecified.

Mackay (1994) (see reference A22) gives the same data, males and females, daily smokers of MC, but no original source.

3 Chollat-Traquet (1992)

Quoting WHO Cross-National Study on Children's Health Behaviour (no detailed reference).

Regular=daily; all=daily+weekly; data on "less than weekly" and "do not smoke but have tried" have not been included. WHO (1997) gives ages as 15-16.

4 Geizerova and Masironi (1988)

No original source.

5 Józan (1995)

Health Behaviour Survey by Hungarian Central Statistical Office. Sample size 5476.

Additional information: (CPS): Most men smoke 16-20 cigarettes per day, most women smoke up to 15 cigs.

6 Kertai (1993)

Microcensus.

Additional information: In last grade of high school, 20%M and 24.5%F are heavy smokers.

7 Lamm *et al* (1985)

Nearly all men (99.4%) age 40-59 from 3 small villages in southern Hungary. Screening comparable to the Seven Countries Study. Sample size 1088M.

8 Masironi and Rothwell (1988)

No original source.

9 Nemeth *et al* (1994)

Study in Györ, an industrial city in NW Hungary. 65M and 55F 8th grade pupils from an elementary school, and 34M and 80F 11th grade pupils from an academically selective high school. Ages unknown. 100% response rate, but 4% rejected due to inconsistent responses.

10 Ormos *et al* (1969)

Systematic questioning of railway passengers (to provide comparison group for a study of lung cancer). Mostly in Csongrád. Sample size 777M, 1044F.

CPS estimation based on percentages of smokers smoking 1-15, 16-30, >30 cigarettes daily.

11 Scientific Association of Hungarian General Practitioners (1996)

Unpublished. Study conducted 1995-1996. Sample size 1109M, 1503F, representative of the population registered at family practices, thus under-representing younger, male and more highly qualified persons compared with the national population. A few subjects aged 13-14 have been omitted.

Note: This is the HGPS study.

12,13 WHO (1989)

Regional surveys forming part of WHO MONICA project.

	Region	Population size	Sample size	Participation rate %	Sample used[a] M	F	Date
12	Budapest	94000	1472	80	747	692	Apr82-Sep84
13	Pecs	76200	... ...		823	846	Jan82-Feb83

[a] age 25-64, all other figures relate to age 35-64.

All ages column relates to age 35-64.

Regular smokers: smoked cigarettes daily. All smokers: smoked cigarettes daily or occasionally, or 1 g pipe tobacco or 1 cigar per week.

14,15 WHO (1997)

14 Prevalence estimates, no precise statistics are available. Age and year not stated.

15 Study in 1993-4. No original source.

Additional information: In 1990, in a study of adults (age 14+), 19.4% of smokers smoked over 25 cigarettes per day.

In a 1987-90 study, around 25% of secondary and technical school students age 14-18 smoked.

16 Dindar (1991)

In a study of 8800 pregnant women in Budapest and county Vas from 1979-1983, the prevalence of smoking before pregnancy was 48% under age 20.

17 Horne (1996)

Recent survey by FACT Institute of Applied Social Scientific Research, Pecs, showed that one third of adults smoke. In contrast, Amer Nielson Research states that about 50% smoke.

The average smoker consumes 141 cigarettes a week (no original source given).

18 Pákozdi (1991)

Ranges of prevalence of smoking are given for various groups (pupils, students, recruits, doctors) but none is sex-specific. Highest is smoking among recruits age 22-25 - 78.4%.

Total number of smokers is 4 million (from population of 10.7 million)

19 Steptoe *et al* (1995)

Prevalence of smoking among university students age 18-30: 17% M, 16% F. Year not stated.

20 WHO (1993)

Quoting National Institute for Health Promotion.

In a study of pupils age 11-15 in 1990, 82% were non-smokers and 7.6% were daily smokers.

21 Zatonski (1991)

37.8% of total population smoke, almost half of all smokers are women. There is discussion of age/sex specific patterns, but no source given.

Hungary Male Percentage of smokers

frequency product source year	12	13	14	15	16	17	18	19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 - 69	70 - 74	75 - 79	80 +	all ages
64 7 UC U													56									
66 10 U U									57.1													
75 1 U U					45																	
80 4 UC U				31																		
80 8 U U									50													
82 13 UC R										64.8		46.9		56.1		40.4						48.5
82 13 A A										66.2		47.4		57.1		40.9						49.2
83 12 UC R										63.0		60.8		45.7		46.9						51.9
83 12 A A										64.1		62.3		46.8		46.9						52.9
86 2 MC R													61									
86 3 UC R				20.4																		
86 3 UC A				26.3																		
86 6 U U													47.1									
92 9 UC A		14.7			44.1																	
92 9 UC R		1.6			14.7																	
93 15 U A				23.0																		
94 5 U U													43.7									
95 11 UC U						26.6			33.3	35.3		47.4		39.4		28.3			19.2			34.0
95 11 A U						29.1			33.3	36.7		48.4		39.4		28.3			19.9			34.7
95 14 U U													40									

Hungary Female Percentage of smokers

frequency product source year	12	13	14	15	16	17	18	19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 - 69	70 - 74	75 - 79	80 +	all ages
64 7 UC U																						
66 10 U U									18.3													
75 1 U U					23																	
80 4 UC U				20																		
80 8 U U									25													
82 13 UC R										48.8		34.1		24.0		10.0						24.3
82 13 A A										51.3		36.1		24.5		11.0						25.5
83 12 UC R										43.5		46.0		30.9		26.6						35.7
83 12 A A										44.8		47.1		32.0		27.1						36.7
86 2 MC R													23									
86 3 UC R				14.1																		
86 3 UC A				20.9																		
86 6 U U													26.6									
92 9 UC A		17.7			30.4																	
92 9 UC R		2.0			5.1																	
93 15 U A				19.1																		
94 5 U U													26.6									
95 11 UC U						23.1			28.2	34.2		37.2		33.3		19.9			12.9			27.6
95 11 A U						24.3			28.2	34.8		37.8		33.3		20.1			13.1			27.9
95 14 U U													27									

U unspecified * refer to notes

Product: MC manufactured cigarettes, TC total cigarettes, UC cigarettes type unspecified, A all products

Frequency: A all smokers (including occasional), R regular or daily smokers

All ages: relevant to ages used and as given in original source

2060579178

Hungary Male Cigarettes per smoker per day

product source year	age group																					all ages
	12	13	14	15	16	17	18	19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 - 69	70 - 74	75 - 79	80 +	
66 10 UCE									20.6													
95 11 UC				9.0					14.6	17.5		20.8		20.0		16.9		17.2				18.2

Hungary Female Cigarettes per smoker per day

product source year	age group																					all ages
	12	13	14	15	16	17	18	19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 - 69	70 - 74	75 - 79	80 +	
66 10 UCE									16.4													
95 11 UC				8.7					11.2	12.3		14.7		13.8		14.3		13.1				13.3

U unspecified * refer to notes

Product: MC manufactured cigarettes, TC total cigarettes, UC cigarettes type unspecified, A all products
∈ indicates mean calculated from %s in intervals

All ages: relevant to ages used and as given in original source

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References

A1 Benjamin B. Tobacco smoking in the world. *WHO Expert Committee on Smoking Control, Geneva 23-28 October 1978*. WHO, Unpublished; 1978. 34pp.

A2,A3 Chollat-Traquet C. *Women and tobacco*. Geneva: WHO; 1992.

A4 Geizerova H, Masironi R. Cigarette smoking in children and adolescents: world review. In: Aoki M, Hisamichi S, Tominaga S, editors. *Smoking and health 1987. Proceedings of the 6th World Conference on Smoking and Health, Tokyo, 1987.* Amsterdam: Elsevier Science Publishers B.V. (Biomedical Division); 1988. International Congress Series No. 780: p. 601-5.

A5 Józan P. The main features of tobacco smoking and smoking attributable mortality in Hungary. Some results of the health behaviour survey 1994 [Abstract]. *Tubercle & Lung Dis* 1995;**76 (Suppl 2)**:104.

A6 Kertai P. *Public health priorities in Hungary by the year 2000*. Budapest: 1993.

A7 Lamm G, Csukás M, Gyárfás J, Östör E. Risk factors for coronary heart disease in rural Hungary. *Int J Epidemiol* 1985;**14**:327-9.

A8 Masironi R, Rothwell K. Tendances et effets du tabagisme dans le monde. *World Health Stat Q* 1988;**41**:228-41.

A9 Nemeth J, Swaim RC, Katona E, Oetting ER. Substance use among Hungarian students. *International Journal of the Addictions* 1994;**29**:1443-67.

A10 Ormos J, Karácsonyi G, Biliczki F, Szonyi F. Lung cancer in the Hungarian plain. *Neoplasma* 1969;**16**:667-75.

A11 Scientific Association of Hungarian General Practitioners. *Several relationships between the health status and life-style of the Hungarian population.* Unpublished; 1996.

A12,A13 WHO. *World health statistics annual. Section B: special topic, WHO MONICA Project.* Geneva: WHO; 1989.

A14,A15 World Health Organisation. *Tobacco or health: A global status report.* Geneva: WHO; 1997.

A16 Dindar A. Influence of some social and maternal factors on birth weight in Hungary. *Acta Paediatrica Hungarica* 1991;**31**:131-40.

A17 Horne B. Tax screw being tightened in Hungary. *Tobacco Journal International* 1996;(**2**):48-9.

A18 Pákozdi L. The smoking situation in Hungary. *Tobacco and youth. International conference.* Venice: ATTI; 1981. p. 349-50.

A19 Steptoe A, Wardle J, Smith H, Kopp M, Skrabski A, Vinck J, *et al.* Tobacco smoking in young adults from 21 European countries: association with attitudes and risk awareness. *Addiction* 1995;**90**:571-82.

A20 World Health Organisation. *Highlights on health in Hungary.* 1993.

A21 Zatonski W. Country reports. *World Smoking and Health* 1991;**16**:12-21.

A22 Mackay JL. The fight against tobacco in developing countries *Tubercle and Lung Disease* 1994;**75**:8-24.

Figure 1

Prevalence of cigarette smoking, by sex, birth cohort and year, derived from HGPS

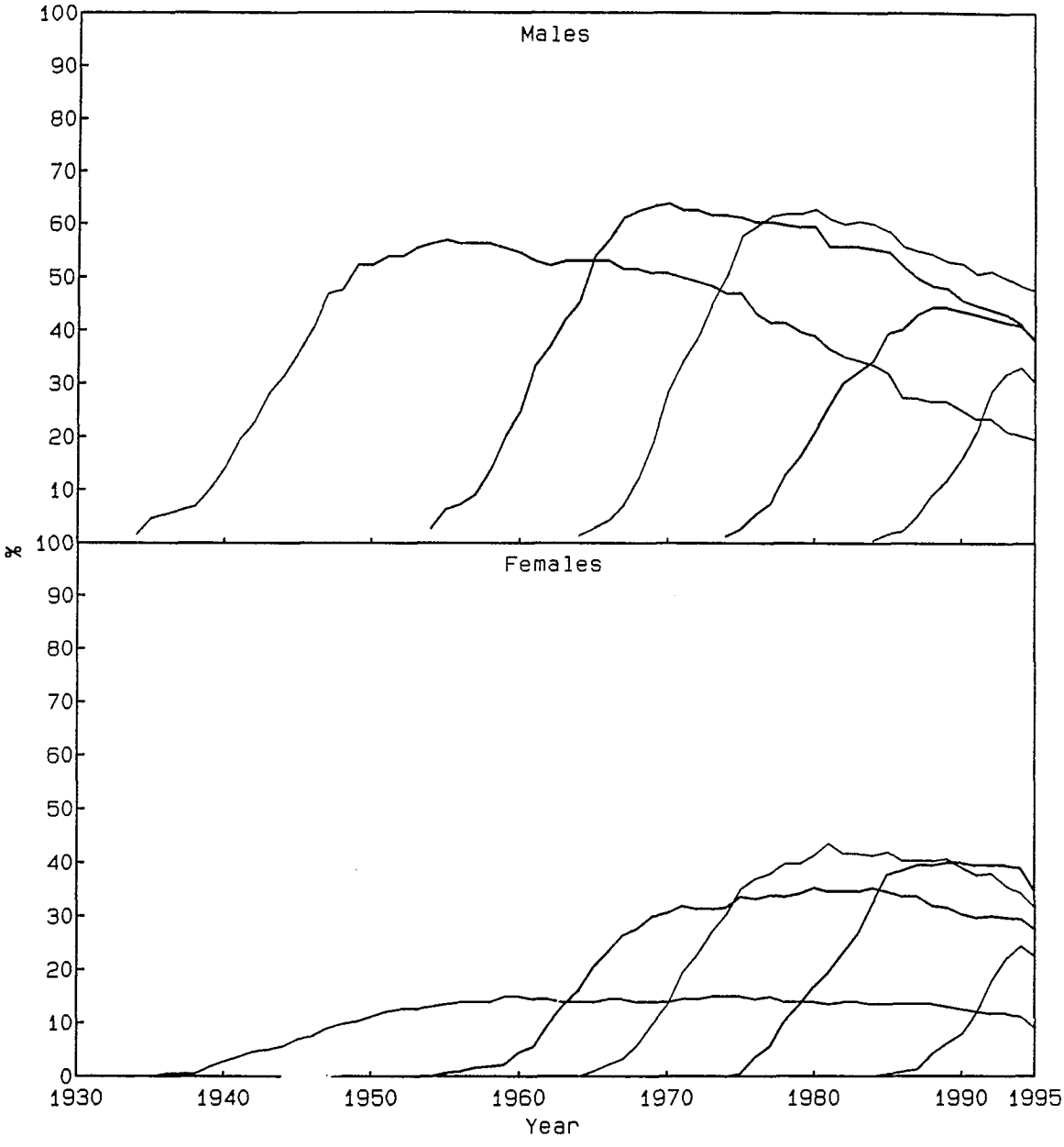

Figure 2M

Observed Lung Cancer rate,
actual and smoothed, scaled to 1980.
MALES

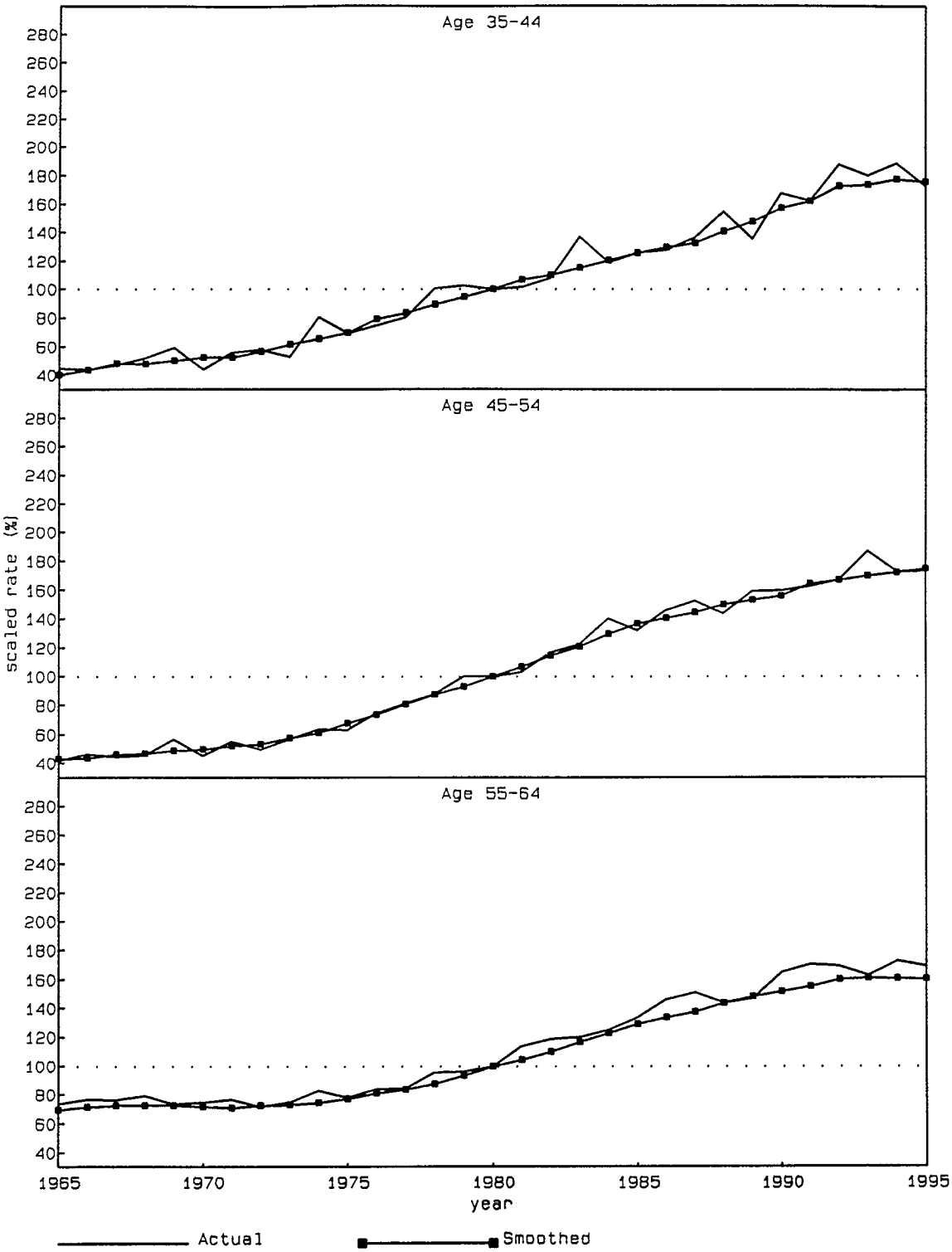

Figure 2F

Observed Lung Cancer rate,
actual and smoothed, scaled to 1980.
FEMALES

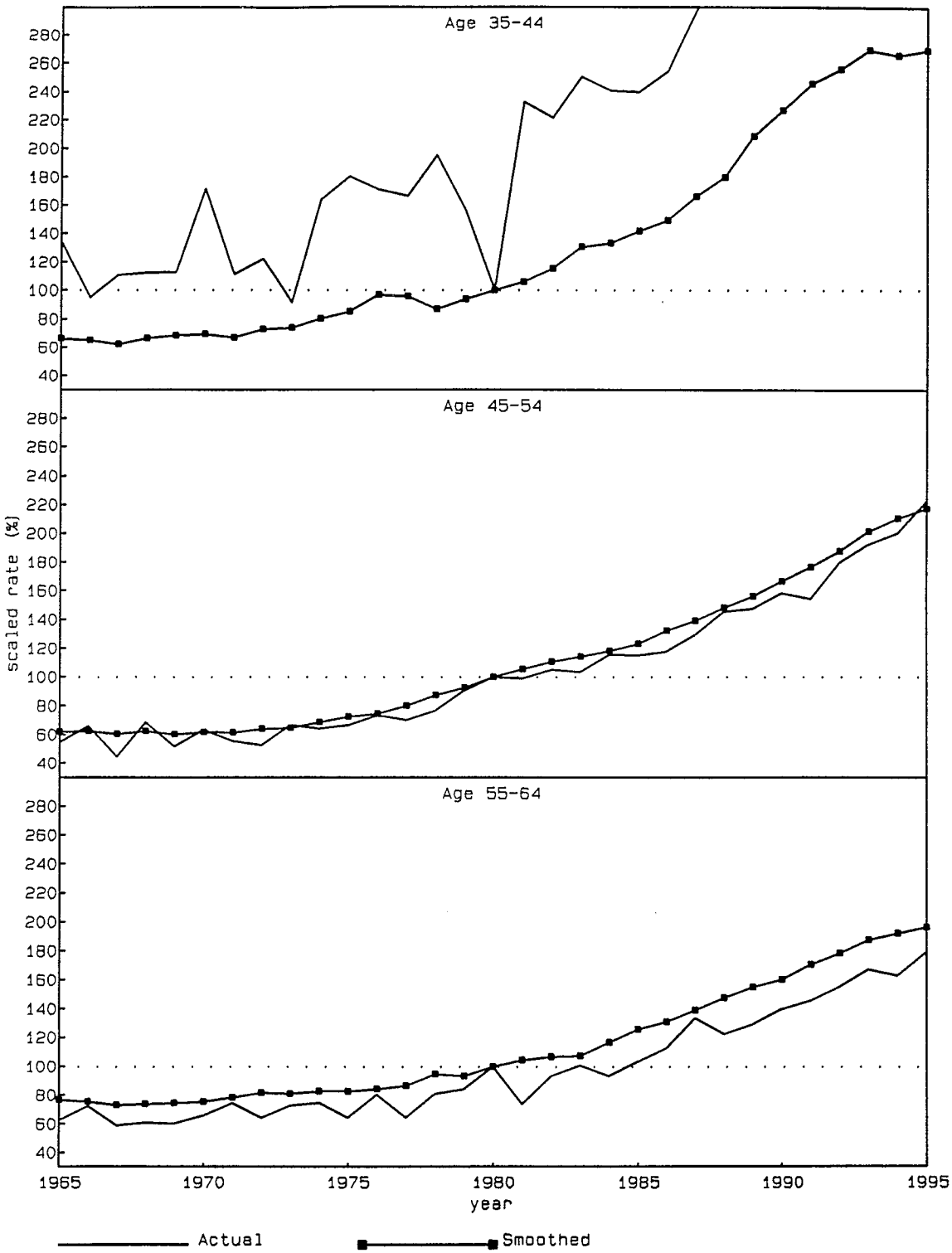

Figure 3M

Comparison of observed Lung Cancer trends with trends predicted by the aggregate method

MALES

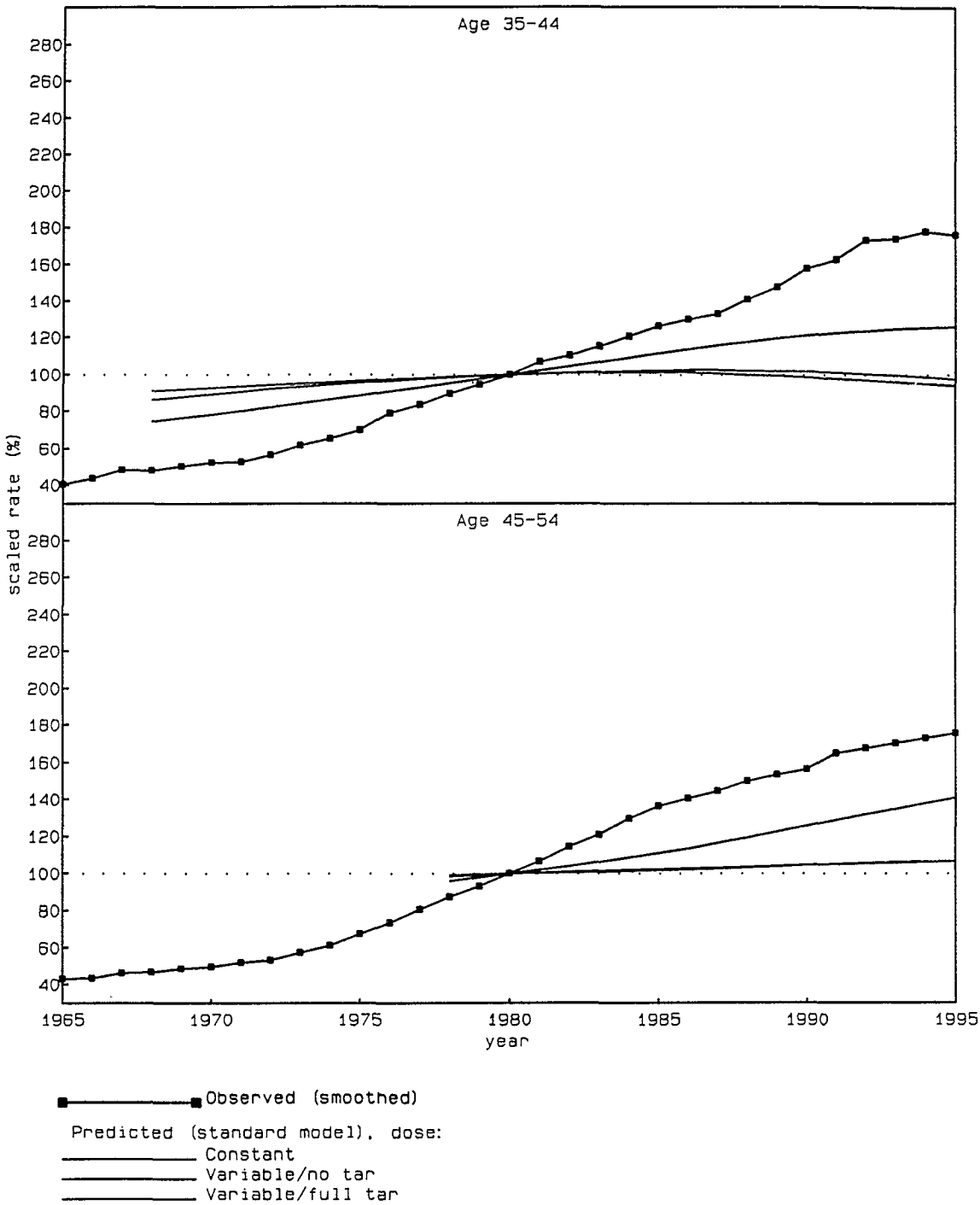

Figure 3F

Comparison of observed Lung Cancer trends with trends predicted by the aggregate method
FEMALES

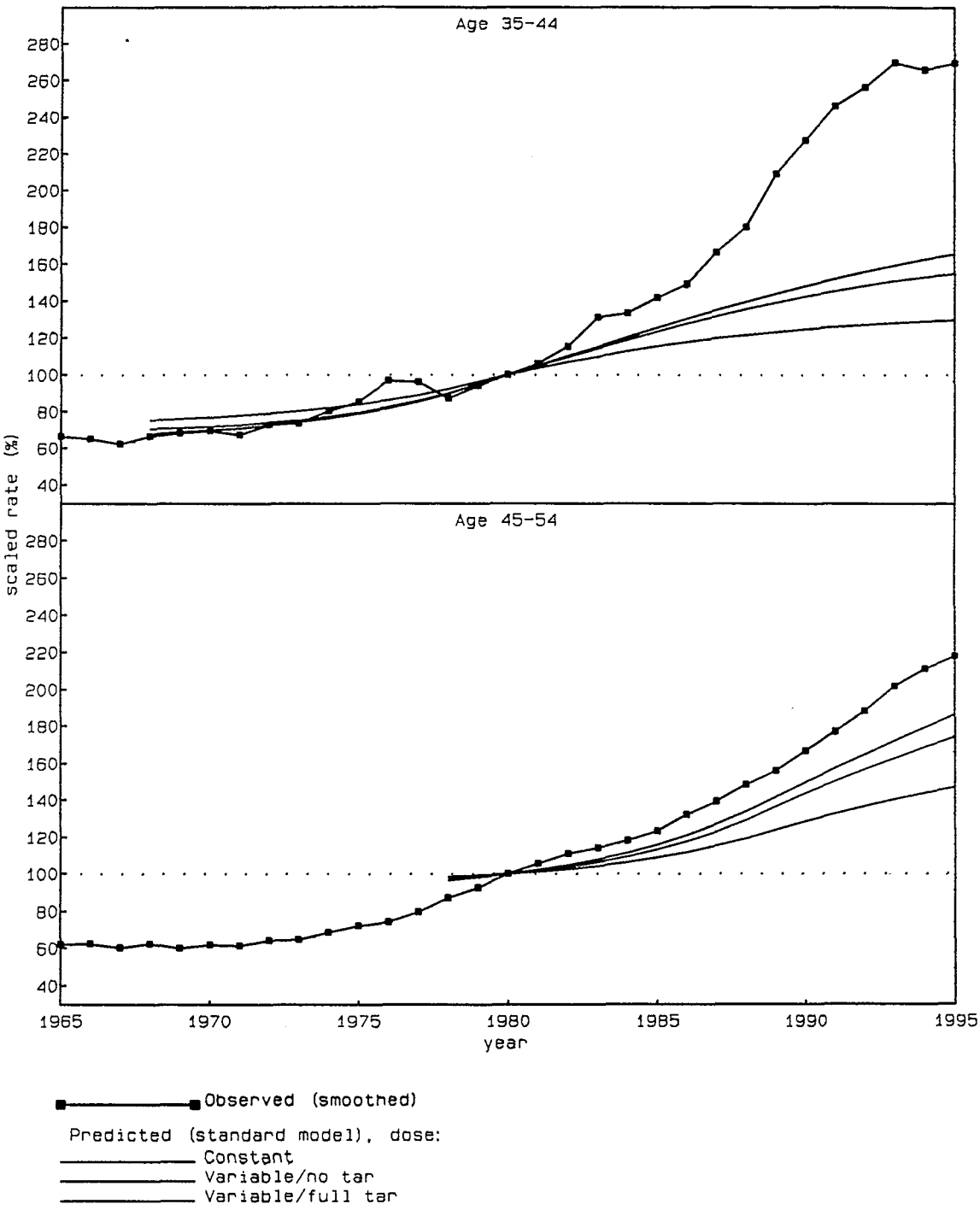

Figure 4M

Comparison of observed Lung Cancer trends with trends predicted by the individual or aggregate methods
MALES

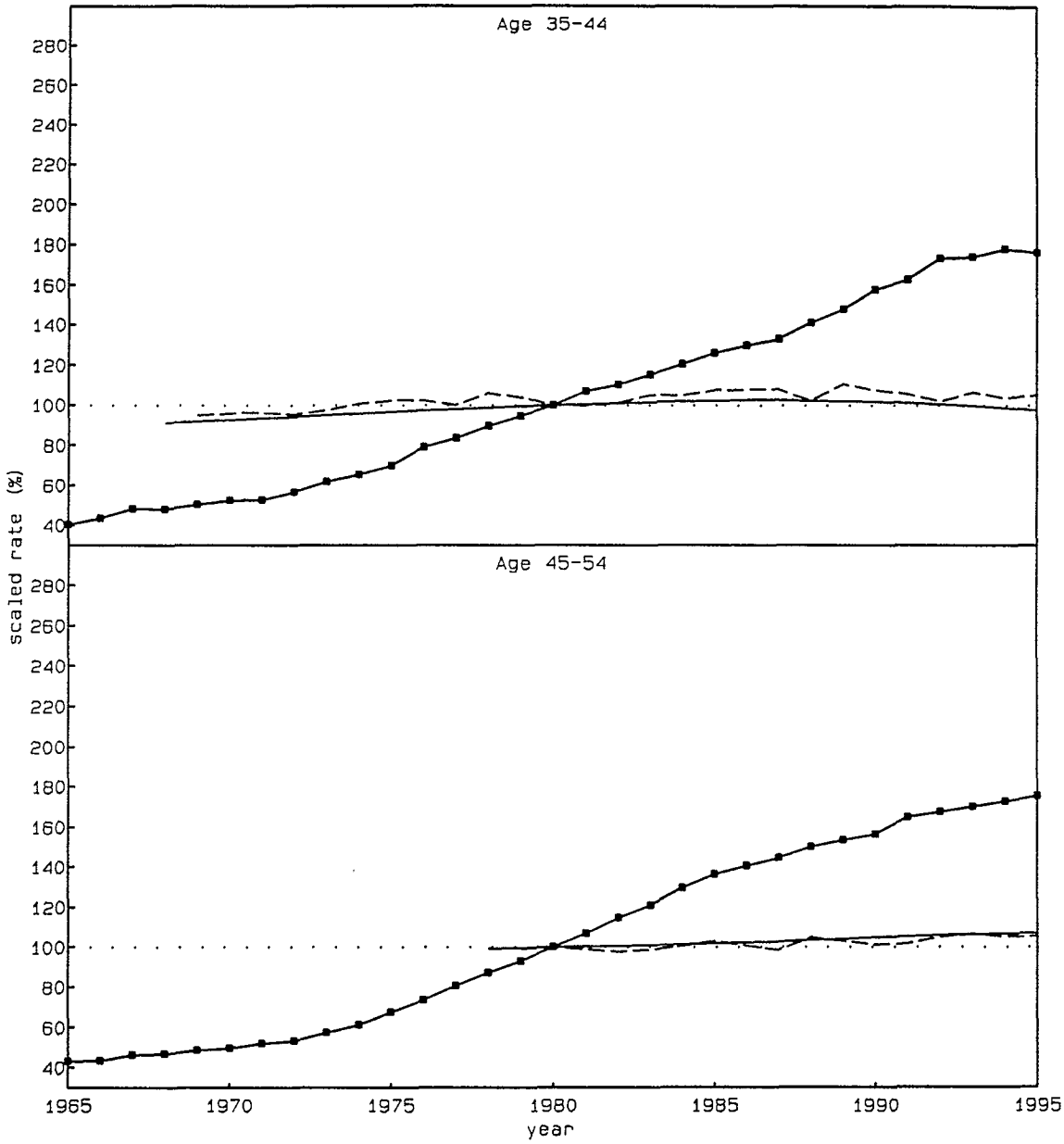

Figure 4F

Comparison of observed Lung Cancer trends with trends predicted by the individual or aggregate methods
FEMALES