Trends in Cigarette Smoking in 36 Populations From the Early 1980s to the Mid-1990s: Findings From the WHO MONICA Project

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A B S T R A C T

Objectives. This report analyzes cigarette smoking over 10 years in populations in the World Health Organization (WHO) MONICA Project (to *moni*tor trends and determinants of *ca*rdiovascular disease).

Methods. Over 300 000 randomly selected subjects aged 25 to 64 years participated in surveys conducted in geographically defined populations.

Results. For men, smoking prevalence decreased by more than 5% in 16 of the 36 study populations, remained static in most others, but increased in Beijing. Where prevalence decreased, this was largely due to higher proportions of never smokers in the younger age groups rather than to smokers quitting. Among women, smoking prevalence increased by more than 5% in 6 populations and decreased by more than 5% in 9 populations. For women, smoking tended to increase in populations with low prevalence and decrease in populations with higher prevalence; for men, the reverse pattern was observed.

Conclusions. These data illustrate the evolution of the smoking epidemic in populations and provide the basis for targeted public health interventions to support the WHO priority for tobacco control. (*Am J Public Health.* 2001;91: 206–212)

Cigarette smoking has been identified as the single most important cause of premature death in developed countries for decades and is now emerging as a major public health concern in most developing countries.[1,2] Recently, new initiatives have been launched by the World Health Organization (WHO) to intensify efforts to control the global tobacco epidemic.[3,4]

The WHO MONICA Project is a multinational study to *moni*tor the trends and determinants in *ca*rdiovascular disease.[5] It started in the early 1980s and involves collaborating centers in 21 countries. Data on smoking behavior were collected through a common protocol in all geographically defined study populations. The WHO MONICA Project therefore provides a unique opportunity to investigate in a standardized fashion the trends in cigarette smoking in a large number of populations.

This report describes the changes over 10 years in cigarette smoking in the WHO MONICA study populations. It also examines the extent to which the changes were due to initiation or cessation of smoking, whether there were differences between sexes or age groups in these trends, and whether the changes observed were related to the prevalence of smoking in the population.

Methods

The study populations of the WHO MONICA Project live predominantly in Europe, where they are widely distributed geographically and cover a range of social, economic, and political conditions. There are also a few centers in North America, Asia, and Australasia. Brief descriptions of the populations were given in a report that documented rates of coronary events.[6] Risk factor levels were monitored through independent surveys carried out at the beginning, middle (optional), and end of the study period.

The methods of sampling and the response rates for the 3 surveys of the WHO MONICA Project have been reported elsewhere.[7] The sampling frames were population based. Half (18 of 36) were population registers of all people living in the study area; others were electoral rolls (9 of 36) in populations where registration is mandatory, registers maintained by public health insurance agencies, census listings, registers of general practice patients, or household directories. Response rates ranged from 41% to 90% and were at least 70% in more than three quarters of the surveys. The survey periods are shown in Table 1; total numbers of participants in the initial and final surveys for each study population are given in Table 1 for men and Table 2 for women. Subjects were aged between 25 and 64 years at the date of examination, and they were categorized into 10-year age groups. Some centers did not include the optional age group of 25 to 34 years in their surveys.

Information on smoking was obtained by self-completed questionnaires or through interviews using standardized methods.[8,9] Two questions were used to categorize respondents as daily cigarette smokers, ex-smokers, or never smokers. The first question was "Do you smoke cigarettes now?" The response options were

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TABLE 1—Ten-Year Trends in Smoking Habits for Men: Study Populations; Survey Periods and Number of Participants in the Initial and Final Surveys; Age-Standardized Prevalence (%) and 10-Year Estimated Trends for Daily, Never, and Former Smokers Aged 35 to 64 Years

Population	Survey Period		n		Daily Smokers			Never Smokers			Former Smokers		
	Initial	Final	Initial	Final	Initial	Final	Trend (SE)	Initial	Final	Trend (SE)	Initial	Final	Trend (SE)
Stanford, USA	1978–1980	1989–1990	426	450	36	23	–13.7 (2.9)	29	37	8.9 (3.2)	35	40	4.7 (3.3)
Area Brianza, Italy	1986–1987	1993–1994	620	650	44	34	–12.4 (3.7)	26	34	9.0 (3.5)	28	32	5.4 (3.4)
Toulouse, France	1985–1987	1994–1996	678	609	37	24	–12.3 (2.7)	30	35	4.7 (2.8)	34	41	7.6 (2.8)
Strasbourg, France	1985–1987	1995–1997	667	536	34	23	–11.8 (2.7)	28	35	6.4 (2.7)	37	41	5.4 (2.9)
Glasgow, UK	1986	1995	504	664	52	41	–11.8 (3.2)	25	35	9.8 (3.0)	21	23	2.4 (2.7)
Newcastle, Australia	1983	1994	1214	637	34	22	–11.1 (2.0)	37	42	4.1 (2.2)	29	36	6.9 (2.1)
Auckland, New Zealand	1982	1993–1994	1018	745	29	17	–10.3 (1.9)	37	45	6.7 (2.2)	34	38	3.9 (2.1)
Perth, Australia	1983	1994	631	307	33	24	–9.1 (2.8)	36	42	6.5 (3.1)	31	34	2.3 (2.9)
Catalonia, Spain	1986–1988	1994–1996	987	1397	48	41	–8.1 (2.6)	23	23	–0.4 (2.2)	28	35	9.6 (2.4)
Warsaw, Poland	1984	1993	1297	751	59	52	–7.8 (2.5)	18	21	3.0 (2.1)	22	27	4.6 (2.1)
Czech Republic	1985	1992	948	893	44	39	–7.4 (3.2)	29	33	5.7 (3.1)	26	27	1.9 (2.9)
Göteborg, Sweden	1985–1986	1994–1996	496	638	32	26	–7.4 (3.0)	29	39	9.5 (3.2)	38	34	–2.4 (3.2)
Vaud–Fribourg, Switzerland	1984–1985	1992–1993	627	569	32	27	–7.0 (3.3)	36	37	0.7 (3.6)	30	35	6.0 (3.4)
Belfast, UK	1983–1984	1991–1992	929	812	34	29	–7.0 (2.9)	31	39	10.8 (3.0)	35	32	–3.5 (2.9)
Friuli, Italy	1986	1994	721	685	35	29	–6.9 (3.0)	29	33	5.7 (3.0)	36	38	1.7 (3.1)
Lille, France	1986–1989	1995–1996	646	571	39	33	–6.7 (3.3)	25	27	1.9 (3.0)	34	40	5.5 (3.2)
Augsburg (rural), Germany	1984–1985	1994–1995	849	819	30	24	–5.0 (2.2)	43	47	4.6 (2.5)	27	28	1.2 (2.2)
Kuopio, Finland	1982	1992	969	568	34	30	–4.2 (2.5)	30	32	1.7 (2.6)	32	33	0.8 (2.6)
Ticino, Switzerland	1985–1986	1992–1993	781	733	38	36	–3.5 (3.5)	34	35	1.4 (3.6)	26	28	2.7 (3.4)
Kaunas, Lithuania	1983–1985	1992–1993	728	611	38	35	–3.4 (2.9)	37	41	3.0 (3.0)	23	23	0.1 (2.5)
North Karelia, Finland	1982	1992	1130	504	30	27	–3.1 (2.3)	32	36	4.5 (2.6)	37	32	–3.6 (2.6)
Tarnobrzeg Voivodship, Poland	1983–1984	1992–1993	1237	620	58	54	–3.1 (2.8)	23	19	–4.6 (2.3)	19	25	7.0 (2.2)
Iceland	1983	1993–1994	338	353	27	23	–2.8 (3.3)	36	40	4.4 (3.7)	37	36	–1.3 (3.7)
Charleroi, Belgium	1985–1987	1990–1993	381	417	51	48	–2.4 (6.0)	19	20	1.1 (4.8)	31	31	0.9 (5.5)
Northern Sweden	1986	1994	641	568	23	21	–2.4 (3.1)	44	43	0.7 (3.8)	31	34	3.5 (3.5)
Moscow (control), Russia	1984–1986	1992–1995	774	557	48	47	–2.2 (3.1)	25	31	8.1 (2.9)	27	22	–4.7 (2.7)
Glostrup, Denmark	1982–1984	1991–1992	1456	607	45	44	–1.9 (2.9)	38	38	–0.4 (2.9)	17	18	2.0 (2.2)
Turku/Loimaa, Finland	1982	1992	1194	568	30	29	–1.2 (2.3)	30	32	2.0 (2.5)	37	34	–2.5 (2.6)
Ghent, Belgium	1985–1987	1990–1992	531	482	43	43	–0.8 (5.7)	26	23	–4.3 (5.0)	31	34	4.6 (5.4)
Novosibirsk (control), Russia	1985–1996	1995	588	584	61	60	–0.5 (3.0)	18	20	1.3 (2.5)	20	19	–2.0 (2.5)
Augsburg (urban), Germany	1984–1985	1994–1995	711	658	36	35	–0.3 (2.6)	33	34	1.1 (2.6)	30	29	–1.7 (2.5)
Novi Sad, Yugoslavia	1984	1994–1995	606	566	48	49	0.8 (2.9)	26	28	2.0 (2.6)	24	22	–2.1 (2.5)
Moscow (intervention), Russia	1984–1985	1992–1995	553	538	40	42	2.8 (3.5)	35	36	1.9 (3.5)	23	22	–2.7 (3.0)
Halifax, Canada	1985–1988	1995	388	259	28	32	3.0 (4.6)	30	27	–1.2 (4.6)	42	40	–4.0 (4.9)
Novosibirsk (intervention), Russia	1985	1994–1995	608	619	54	58	5.0 (3.1)	23	23	–0.7 (2.6)	22	18	–5.6 (2.5)
Beijing, China	1984–1985	1993	612	480	50	64	16.4 (3.5)	44	27	–20.6 (3.4)	5	8	3.8 (1.8)

Note. Populations are listed in ascending order of trend in daily smoking.

"Yes, daily," "No," and "Occasionally (<1 cigarette a day)." If the person answered "No" to this question, the next question was asked: "Did you ever smoke cigarettes in the past?" Response options were "Yes, daily in the past" and "No." The prevalence of daily cigarette smoking was calculated as the proportion of respondents to the first question who answered "Yes, daily." The prevalence of former smoking was calculated as the proportion of those who answered "Yes, daily in the past" to the second question among those who answered "Yes, daily" or "No" to the first question. The prevalence of never smoking was calculated as the proportion of those who answered "No" to the second question among those who answered "Yes, daily" or "No" the first question. Occasional smokers were excluded from the denominator for never smokers and former smokers because they were not asked about past smoking in the initial survey. The prevalence of occasional smoking, which ranged from 0% to 8%, was less than 5% for most populations. Smoking pipes or cigars was not included in the present analysis. The quality of the data on smoking has been centrally assessed,[10] and if data failed to meet the criteria the population was excluded from the analysis.

We estimated changes over 10 years in the prevalence of daily cigarette smoking by fitting a simple linear regression model separately for each sex and 10-year age group in each population, using data from all 3 surveys (if available). Smoking was the dependent variable and time from January 1, 1988, was the explanatory variable (this date was chosen because it approximates the middle of the study period). The model was

$$y=a+b(t-1988)/10+e,$$

where y has 2 possible values, 100 for a person who smokes daily and 0 otherwise. With this coding, the average of y at any time is the prevalence of daily smoking (as a percentage) and the trend is easily interpreted. The date of ex-

TABLE 2—Ten-Year Trends in Smoking Habits for Women: Study Populations; Number of Participants in the Initial and Final Surveys; Age-Standardized Prevalence (%) and 10-Year Estimated Trends for Daily, Never, and Former Smokers Aged 35 to 64 Years

Population	n		Daily Smokers			Never Smokers			Former Smokers		
	Initial	Final	Initial	Final	Trend (SE)	Initial	Final	Trend (SE)	Initial	Final	Trend (SE)
Stanford, USA	516	566	34	19	–14.9 (2.6)	48	53	5.3 (3.0)	18	28	9.7 (2.6)
Belfast, UK	925	789	33	25	–10.6 (2.8)	51	56	6.6 (3.1)	16	19	4.2 (2.3)
Auckland, New Zealand	568	727	25	14	–9.2 (1.9)	50	57	6.9 (2.5)	25	28	2.6 (2.2)
Glasgow, UK	480	720	50	41	–9.1 (3.2)	38	38	0.2 (3.2)	11	20	9.2 (2.4)
Iceland	349	342	40	31	–8.2 (3.6)	41	39	–2.6 (3.7)	17	29	11.4 (3.1)
Beijing, China	635	643	16	9	–7.9 (2.1)	82	89	7.3 (2.2)	1	2	0.7 (0.9)
Perth, Australia	661	302	22	13	–7.2 (2.5)	62	64	0.5 (3.0)	16	24	6.7 (2.4)
Newcastle, Australia	1240	688	24	17	–7.1 (1.8)	66	58	–6.4 (2.1)	11	25	13.3 (1.6)
Göteborg, Sweden	524	745	34	29	–5.6 (2.6)	43	44	0.8 (2.9)	22	26	4.6 (2.5)
Friuli, Italy	737	689	25	22	–3.7 (2.7)	64	58	–7.6 (3.1)	10	19	11.9 (2.2)
Halifax, Canada	373	268	27	25	–0.9 (4.3)	46	41	–6.3 (4.8)	27	33	5.7 (4.4)
Strasbourg, France	714	543	15	15	0.2 (2.1)	78	66	–10.9 (2.6)	8	19	10.8 (1.9)
Warsaw, Poland	1327	763	34	34	0.2 (2.4)	55	49	–6.3 (2.5)	10	16	5.7 (1.7)
Glostrup, Denmark	1361	611	44	45	0.5 (2.9)	44	39	–4.2 (3.0)	12	15	3.5 (2.0)
Kaunas, Lithuania	735	628	4	4	0.8 (1.2)	94	92	–1.8 (1.5)	3	3	0.9 (0.9)
Turku/Loimaa, Finland	1270	627	17	19	1.5 (1.8)	73	63	–10.1 (2.3)	9	16	7.0 (1.7)
Moscow (control), Russia	641	527	12	14	2.1 (2.6)	82	78	–6.3 (3.1)	5	9	4.7 (1.9)
Moscow (intervention), Russia	622	858	13	14	2.1 (1.8)	81	80	–3.1 (2.2)	5	6	1.6 (1.3)
Northern Sweden	611	595	26	28	2.5 (3.2)	56	45	–13.5 (3.6)	17	26	10.9 (2.9)
Kuopio, Finland	983	609	10	13	2.9 (1.7)	82	70	–11.3 (2.2)	7	14	6.8 (1.7)
Novosibirsk (control), Russia	590	591	4	6	2.9 (1.3)	94	91	–3.7 (1.7)	3	3	0.6 (1.1)
Ticino, Switzerland	769	770	24	26	3.0 (3.2)	66	60	–8.5 (3.6)	9	13	5.4 (2.3)
Czech Republic	990	946	21	23	3.1 (2.7)	71	69	–3.4 (3.0)	8	7	–0.8 (1.7)
North Karelia, Finland	1212	595	9	12	3.2 (1.5)	84	74	–10.3 (2.1)	7	12	5.7 (1.6)
Augsburg (rural), Germany	854	872	12	16	3.8 (1.7)	78	71	–7.0 (2.2)	10	13	3.1 (1.6)
Toulouse, France	645	566	17	22	4.1 (2.5)	71	55	–16.5 (2.9)	11	23	12.2 (2.3)
Novi Sad, Yugoslavia	576	601	26	30	4.1 (2.6)	66	61	–6.1 (2.8)	6	8	2.5 (1.4)
Lille, France	544	578	13	17	4.2 (2.8)	80	67	–15.4 (3.4)	6	16	12.0 (2.5)
Vaud–Fribourg, Switzerland	570	578	21	25	4.6 (3.0)	67	58	–10.0 (3.6)	11	15	5.5 (2.6)
Area Brianza, Italy	648	666	20	23	4.9 (2.9)	76	66	–12.9 (3.2)	4	11	8.7 (2.0)
Ghent, Belgium	496	515	25	27	5.6 (5.3)	64	59	–12.3 (53.8)	11	14	6.3 (4.1)
Novosibirsk (intervention), Russia	659	654	3	8	5.8 (1.3)	94	91	–3.8 (1.6)	3	1	–2.2 (1.0)
Augsburg (urban), Germany	677	669	18	25	7.0 (2.3)	71	57	–14.6 (2.6)	10	18	7.5 (1.9)
Charleroi, Belgium	434	449	24	29	9.6 (5.0)	66	55	–17.6 (5.4)	11	16	8.0 (3.7)
Catalonia, Spain	993	1211	7	15	10.3 (1.7)	90	77	–15.9 (2.0)	3	7	5.5 (1.3)
Tarnobrzeg Voivodship, Poland	1441	696	11	21	11.7 (1.8)	87	71	–18.0 (2.0)	3	8	5.8 (1.1)

Note. Populations are listed in ascending order of trend in daily smoking.

amination is represented by t (in years with fractions); a is the estimated prevalence of smoking at the beginning of 1988, b is the average change in prevalence over a decade, and e is the error term in the regression model. Ten-year trends in never smoking and former smoking were calculated similarly. Linear models were appropriate for most populations. Where the trends appeared to be nonlinear, this nonlinearity could not be adequately estimated from 3 surveys, so a linear model was still used, resulting in a relatively large standard error for b.

We calculated age-standardized changes in daily, never, and former smoking for the age range 35 to 64 years from the estimates of average changes for the 10-year age groups by direct standardization, using the world standard population weights of 12/31, 11/31, and 8/31 for the age groups 35 to 44, 45 to 54, and 55 to 64 years, respectively.[11] Age-standardized prevalences at the initial and final surveys were calculated analogously.

To examine the relationship between magnitude of change and prevalence of smoking, we calculated correlation coefficients between the estimates of a and b for all populations, taking into account the standard errors of the estimates.[12] Bias-corrected, accelerated bootstrap confidence intervals for the correlation coefficients were also obtained.

Results

There were 36 populations for which at least the initial and final surveys were carried out and data of acceptable quality were available for the analysis. In 4 populations for men and 5 for women, the middle survey was not carried out. In 11 populations, the age group 25 to 34 years was not included. There were 121 288 participants in the initial survey, 93 535 in the middle survey, and 99 919 in the final survey.

Table 1 gives the survey periods, number of respondents, and age-standardized prevalence of daily smoking, never smoking, and former smoking in the initial and final surveys and the estimated trends for men aged 35 to 64 years in each population. The trends are summarized as changes in percentage points over 10 years. Most of the populations had a decreasing overall trend in the prevalence of daily cigarette smoking, with 16 (44%) of the 36 populations showing a decrease of more than 5 percentage points. The declines in daily smoking were generally due to increases in never smoking and, to a lesser extent, to increases in former smoking. In the Czech Republic, Göteborg, Glasgow, and Belfast, however, the decline was entirely due to increasing trends in never smoking. In other populations (e.g., Toulouse, Newcastle, Catalonia, Vaud–Fribourg, and Lille), the decreasing trends in

daily smoking seemed to be due more to cessation of smoking, with smaller or no changes in the prevalence of never smoking. The prevalence of smoking increased in Beijing among all age groups of men.

Among women, 9 (25%) of the 36 populations had a decreasing overall trend in the prevalence of daily cigarette smoking of more than 5 percentage points and 6 (17%) had an increasing trend of more than 5 percentage points (Table 2). In many of the populations with little change in the prevalence of daily smoking, there were large increases in the prevalence of former smoking that were counterbalanced by decreases in the prevalence of never smoking (e.g., Friuli, Halifax, Strasbourg, Warsaw, Turku–Loimaa, Northern Sweden, Kuopio Province, Ticino, North Karelia, Toulouse, Lille, Vaud–Fribourg, and Area Brianza). Among populations with declines in daily smoking, the change was solely due to an increase in cessation of smoking in Glasgow, Iceland, Perth, Newcastle, and Göteborg, whereas in Beijing it was due to an increasing proportion of never smokers. The populations with increasing trends in daily smoking had, in general, large decreases in the proportion of never smokers, indicating that younger generations with a higher prevalence of smoking entered the age range 35 to 64 years during the 10-year study period. Many of these populations also had increases in the proportion of former smokers.

The prevalence of daily smoking declined for both men and women in a number of populations (e.g., Stanford, Glasgow, Belfast, Perth, Newcastle, Auckland, and Göteborg). Other populations showed a decreasing trend among men but an increasing trend among women (e.g., Catalonia, Area Brianza, Toulouse, Vaud–Fribourg, Lille, and Czech Republic). A few populations had an increasing trend among both men and women (Novosibirsk intervention, Moscow intervention). Beijing was the only population with an increasing trend among men but a decreasing trend among women.

Figure 1 shows the trends in daily smoking plotted against the estimated mean prevalence in 1988 for 4 age groups. Except for the youngest age group, smoking prevalence declined with increasing age for both sexes, with progressively more points below the horizontal line. In all age groups, the points for women tended to lie to the left of those for men, indicating lower estimated prevalence in 1988. Among men, the correlation between the prevalence and the trend in daily cigarette smoking was consistently positive: for 25 to 34 years, $r=0.48$, 95% confidence interval (CI)=0.02, 0.73; for 35 to 44 years, $r=0.32$, 95% CI=0.01, 0.58; for 45 to 54 years, $r=0.22$, 95% CI=–0.10, 0.49; for 55 to 64 years, $r=0.34$, 95% CI=–0.05, 0.61. This is best explained by a wave of smoking moving through the male population. Smoking prevalence was still increasing in many high-prevalence populations that had not yet reached the crest of the wave, but prevalence continued to fall in those in which the peak had passed and prevalence was already lower.

Among women, the correlation was negative mainly owing to increases in smoking in populations with low prevalence and decreases in populations with higher prevalence: for 25 to 34 years, $r=-0.54$, 95% CI=–0.72, 0.04; for 35 to 44 years, $r=-0.31$, 95% CI=–0.61, 0.00; for 45 to 54 years, $r=-0.44$, 95% CI=–0.62, –0.22; for 55 to 64 years, $r=0.10$, 95% CI=–0.48, 0.46. Here, the wave of smoking had been slower to arrive and had not reached the same height as for men. Thus, female populations with only a midrange prevalence of smoking, by male standards, tended to show a fall, while those with low initial levels of smoking showed a rise.

Figure 2 shows the trends in former smoking plotted against the trends in never smoking.

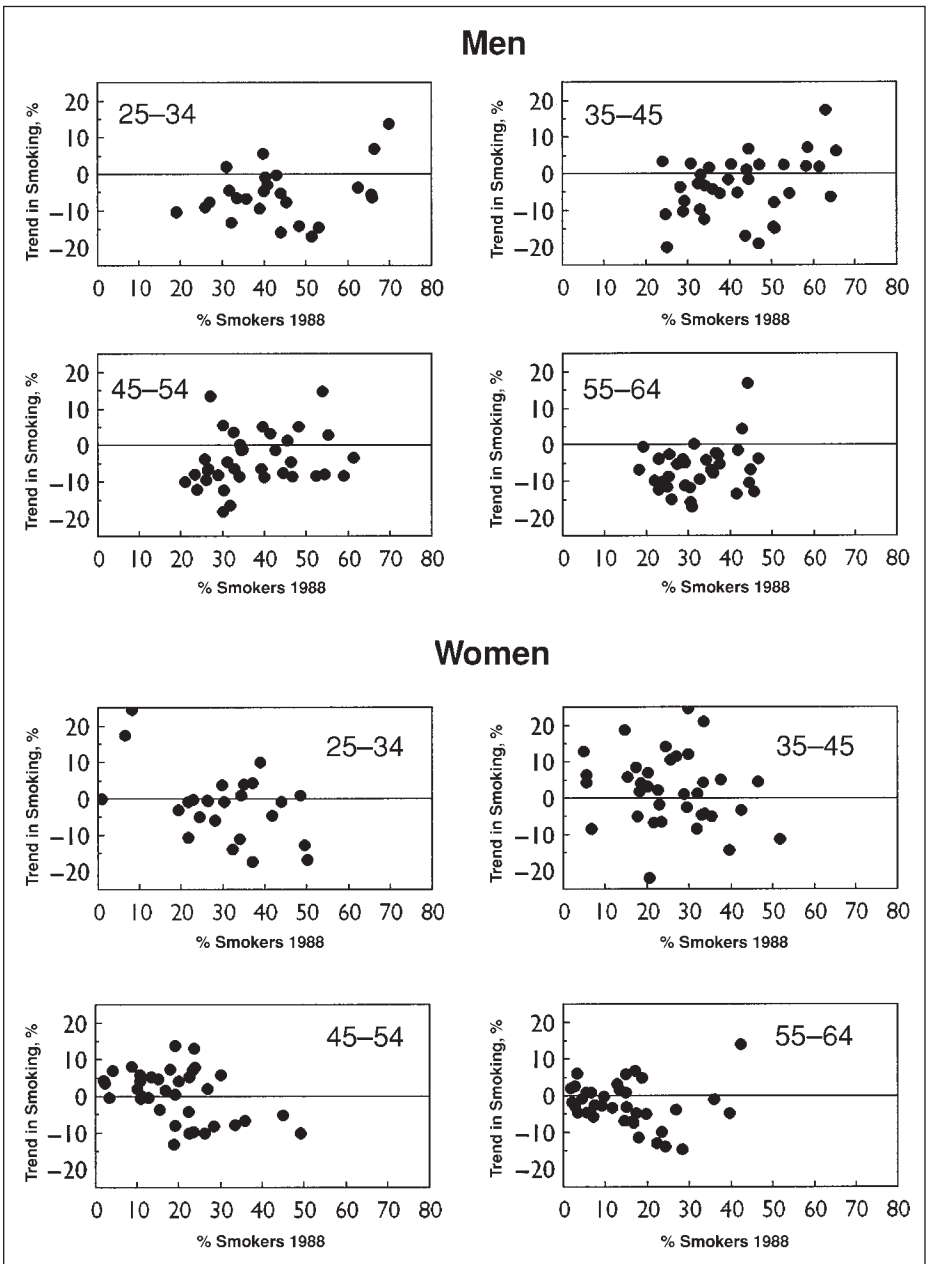

FIGURE 1—Estimated 10-year trend in the prevalence of daily cigarette smoking by 10-year age group plotted against estimated prevalence of daily cigarette smoking in 1988.

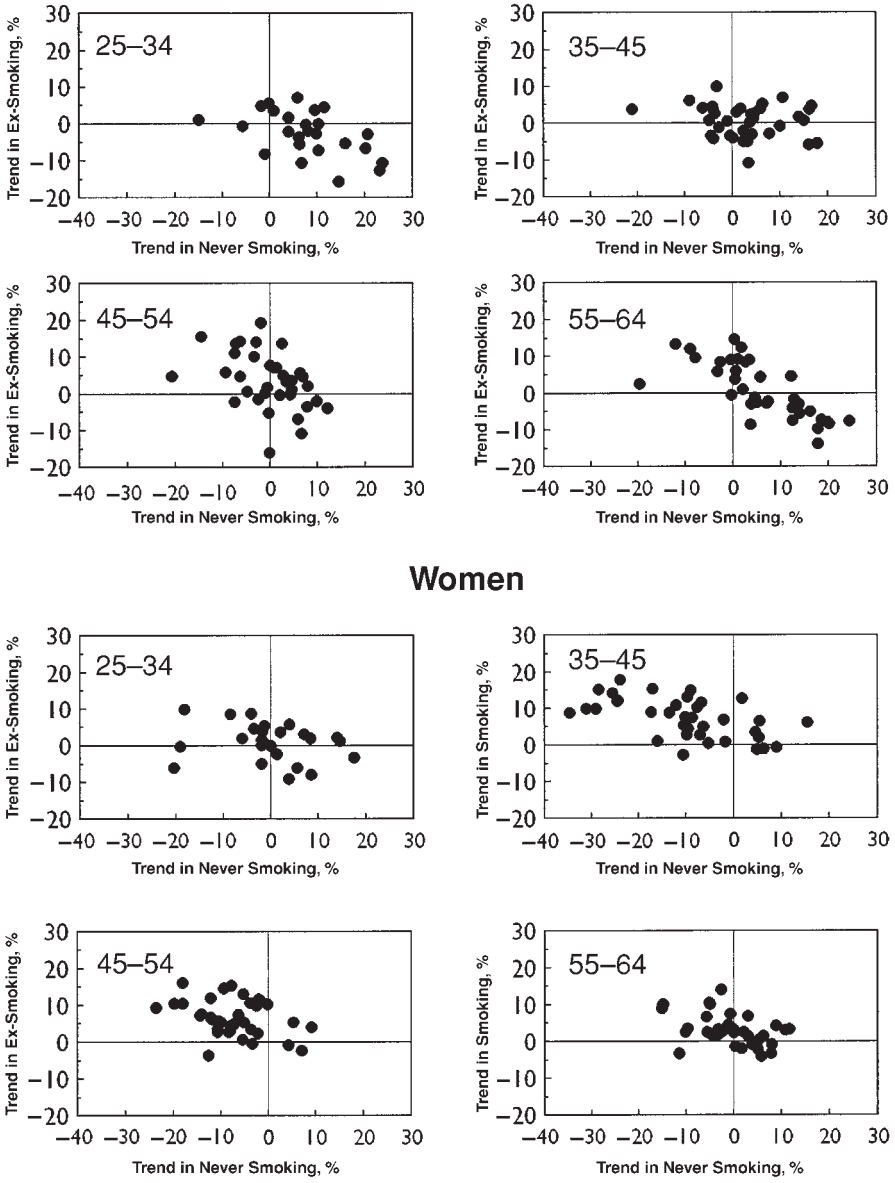

FIGURE 2—Estimated 10-year trend in the prevalence of former smoking by 10-year age group plotted against estimated 10-year trend in the prevalence of never smoking.

For men in the youngest age group, the decline in prevalence was mainly due to higher proportions of never smokers entering the age group. In general, for other age groups, the points for men tended to be above the horizontal line and to the right, indicating, respectively, that cessation and increasing proportions of never smokers both contributed to the reduction in smoking. In contrast, for women the points tended to cluster more to the left (adoption of smoking) and above the horizontal line (cessation of smoking) so that changes varied more between populations.

Discussion

We found declining trends in the prevalence of daily cigarette smoking among men in most of the 36 study populations of the WHO MONICA Project during the 10-year study period, with the patterns of prevalence at the end of that time corresponding well with national data published elsewhere.[13] Only men in Beijing showed a significantly increasing trend in smoking. For women, more than half the populations showed little change in the prevalence of smoking, 25% of them showed a decreasing trend, and 17% showed an increasing trend of more than 5 percentage points. The decrease was largest in populations in Australia, the United States, New Zealand, and the United Kingdom for both men and women. The public in these countries has been reminded constantly of the dangers of smoking by extensive coverage of issues related to tobacco in the news media. This reflects a comprehensive approach to smoking control[14] that has included increases in taxes on tobacco, a steady extension of smoke-free policies, paid mass media campaigns, advocacy by prominent antismoking groups, legal actions against tobacco companies, and increasingly stringent restrictions on the promotion and sale of tobacco products. Decreases among men but not women occurred in most southern European populations and in some eastern European populations. The biggest increases in the prevalence of daily cigarette smoking among women occurred in populations in which the prevalence was relatively low (e.g., Poland, Spain, and Russia). The results reported here tend to confirm and strengthen the 5-year trends published earlier[9] and allow much more detailed analysis of the dynamics of the smoking epidemic.

Changes in the prevalence of cigarette smoking in a population are the result of 2 processes: initiation of smoking among those who have not previously smoked and cessation by those who were smokers. Because cigarette smoking starts during adolescence in most countries,[15] the trends in the age range 35 to 64 years reflect smoking cessation and differences in the prevalence of smoking in birth cohorts that enter the age range over time (i.e., earlier initiation patterns). It is therefore useful to know to what extent changes in the prevalence of smoking are due to initiation or cessation of smoking or to a combination of both, because these require different public health strategies.

The decrease observed among men appeared to be largely due to higher prevalence of never smoking in the younger age groups rather than to smokers quitting. Among women, in many of the populations (e.g., in Italy, France, Switzerland, Finland, and Sweden) there was little overall change in the prevalence of cigarette smoking but large changes in the prevalence of both never smoking and former smoking. In these populations, increasing proportions of smokers in the younger age groups counterbalanced the increasing proportions of former smokers in the older groups. The public health measures in these populations should be directed at discouraging the young from starting to smoke.

Lopez et al.[16] proposed a descriptive model of the dynamics of the epidemic of cigarette smoking in developed countries, based on 4 stages. At stage I, the prevalence of smoking among both men and women is low but male prevalence is rising rapidly. At stage II, the prevalence of smoking among men continues

to rise rapidly, reaching a peak of 50% to 80%, and the prevalence of former smoking is low; smoking prevalence among women lags behind that of men but is increasing rapidly. At stage III, the prevalence among men begins to decline and the proportion of former smokers, especially in the older age groups, starts to rise. The prevalence among women reaches a plateau. Antismoking activities are adopted, and smoking changes from being socially acceptable to unacceptable behavior. At stage IV, the prevalence of smoking for both sexes is around 30% and continues to decline, but only slowly. Public opinion demands smoke-free personal environments and worksites.

The MONICA populations can be identified with the stages of this model. For example, the prevalence in some of the populations in eastern and central Europe (Novosibirsk, Moscow, Tarnobrzeg Voivodship, Novi Sad) was high for men, with little or no decline, and low but slowly increasing for women. These populations appear to be at stage II. Beijing also seems to be at stage II, although the trend for women is not following that for men. Most of the populations in southern Europe (France, Italy, and Spain) and some of the populations in central Europe (Czech Republic) had a high but rapidly decreasing prevalence for men but not for women, typical of stage III. In Australia, the United States, New Zealand, and the United Kingdom, the prevalence was at similar levels and decreasing both for men and women, typical of stage IV. Some populations do not, however, fit the model very well. For example, there was a relatively high prevalence (more than 40%) of daily cigarette smoking among both men and women in Glostrup, with little sign of a decline. This demonstrates that the prevalence of smoking cannot be expected to decline automatically; rather, it will require major public health efforts.

Although the WHO MONICA Project collected data in a standardized way across many different populations, it is still possible that participants did not report their smoking behavior truthfully (only in a minority of populations were the self-reported results validated by biochemical methods). With antismoking attitudes growing in many populations, participants may have tended to underreport smoking. This could partly explain the declines in daily smoking. Another limitation of the study is that it covers only trends in cigarette smoking and not those in use of other forms of tobacco, such as cigars, cigarillos, pipes, cheroots, or oral snuff.

In many countries, tobacco control activities have been successful and the prevalence of cigarette smoking is declining. In a global economy, other populations, including men in China and in some countries in eastern and central Europe and women in many populations, have an increasing prevalence of smoking as a result of powerful socioeconomic forces. Urgent countermeasures are needed. There is growing knowledge about the effectiveness of different intervention methods, both in general and in specific population subgroups.[17–22] These need to be vigorously implemented and their impact monitored through continuing surveillance programs. Reducing the prevalence of smoking must be a high priority for public health in all countries to control the epidemic of smoking-related diseases. □

Contributors

A. Evans and S. P. Fortmann were involved at all stages of the smoking component of the WHO MONICA Project, from the definitions of the survey items through assessment of data quality to the conceptualization and writing of the paper. R. W. Parsons prepared the first draft and conducted the initial data analyses. A. Molarius undertook the subsequent revisions. K. Kuulasmaa supervised the assessment of data quality and the statistical analyses, which were performed by V. Moltchanov. K. Jamrozik and J. Tuomilehto contributed to the conceptualization of the study, the writing of the paper, and the interpretation of the data. S. Sans and P. Puska contributed to the conceptualization and interpretation. A. J. Dobson was the team leader for the study, contributing to the conceptualization and writing.

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