ELSEVIER

Trends in Risk Factors for the Major "Lifestyle-related Diseases" in Geneva, Switzerland, 1993–2000

BRUNA GALOBARDES, MD, MPH, MICHAEL C. COSTANZA, PHD, MARTINE S. BERNSTEIN, MD, CÉCILE H. DELHUMEAU, MPH, AND ALFREDO MORABIA, MD, PHD

PURPOSE: Continuous monitoring of health determinants in populations is necessary to predict future disease burdens. The objective of this study was to assess the prevalences of major risk factors for lifestyle diseases for 8 years (1993 to 2000) in representative samples of the general population.
METHODS: Independent cross-sectional surveys representative of adults aged 35 to 74 years (4,228 men and 4,190 women) in Geneva, Switzerland, conducted continuously between 1993 and 2000.
RESULTS: Prevalence of hypertension decreased 15% in men and 10% in women (trend p's $<$ .0001), while overweight/obesity prevalences increased 10% in men and 8% in women (trend p's $<$ .05). The prevalences of smoking (men: 29%; women: 24%) and physical inactivity (men: 44%; women: 50%) remained high and unchanged, and the dietary unsaturated/saturated fat ratio did not change (men: 0.40; women: 0.48).
CONCLUSIONS: Because of the persistent high prevalence of risk factors, the global burden of chronic diseases is likely to grow in the next decade and beyond. Continuous monitoring provides reliable trends, beyond seasonal and sampling variations.
Ann Epidemiol 2003;13:537–540.

KEY WORDS: Surveillance, Trends, Lifestyle Diseases, Risk Factors, Monitoring.

INTRODUCTION

Mortality rates from coronary vascular disease, stroke, and colon cancer continued to decrease in the 1980s and 1990s, while those from lung cancer and chronic obstructive pulmonary disease (women), and diabetes are currently increasing in most industrialized countries. These are the leading "lifestyle-related diseases", accounting for almost 5.5 million annual deaths in developed regions (1). Future disease trends will depend on the progression of their major risk factors. It is therefore important to develop and maintain methods for evaluating risk factor trends in populations in a comprehensive but timely manner. Reports on trends usually rely upon periodic local or national surveys, repeated within intervals of years (2) (e.g., the MONICA, NHANES national surveys, and several local surveys have also provided data), with a few exceptions such as the BRFSS which collects monthly data in 49 US states. For example, Nelson et al from the BRFSS recently reported an increase in obesity in all US states, a stable or increasing trend in smoking in some states, a decline of physical inactivity and, finally, an increase in the use of cholesterol screening (3).

Our ongoing survey ("*Bus Santé*") is community-based, uses locally-developed and validated instruments to measure the main chronic disease determinants, and is conducted continuously. We therefore are able to report 8-year quarterly data (32 time points between January 1993 and December 2000) on the evolution of behavioral and biologic health determinants through the last decade.

METHODS

Our risk factor surveillance system has been collecting information uniformly throughout each year from independent random samples of adults aged 35 to 74 years, representative of the Geneva general population, since 1993. Through 2000, 4,228 men and 4,190 women have been interviewed and examined. Sampling methods, questionnaires, and examination techniques were standardized over the 8-year period and are described in detail elsewhere (4). Briefly, eligible subjects are identified from the list of all residents

From the Division of Clinical Epidemiology, Geneva University Hospital, Geneva, Switzerland (B.G., M.C.C., M.S.B., C.H.D., A.M.).
Address correspondence to: Dr. Alfredo Morabia, M.D., Ph.D., Division of Clinical Epidemiology, Geneva University Hospital, 25, Rue Micheli-du-Crest, CH-1211 Geneva 14, Switzerland. Tel.: 41-22-372-9552; Fax: 41-22-372-9565. E-mail: Alfredo.Morabia@hcuge.ch
Address reprint requests to: Alfredo Morabia, M.D., Ph.D., Division of Clinical Epidemiology, Geneva University Hospital, 25, Rue Micheli-du-Crest, CH-1211 Geneva 14, Switzerland. E-mail: alfredo.morabia@hcuge.ch
Received September 25, 2002; accepted December 6, 2002.

360 Park Avenue South, New York, NY 10010
1047-2797/03/$–see front matter
doi:10.1016/S1047-2797(03)00055-3

published annually using a standardized procedure. Participants are reached through several mail and telephone attempts. Each study participant receives by mail a self-administered health questionnaire and a semi-quantitative food frequency questionnaire (FFQ), developed and tested in the target population (5). Response rates have ranged from 57% to 65% over the years.

On the day of their scheduled visit to the mobile unit, each participant brings these questionnaires which are checked for completion by trained interviewers, who then administer two further sections dedicated to passive and active exposures to tobacco smoke. In addition, the participants undergo a physical examination. Weight is measured dressed without shoes using a medical scale (precision, 0.5 kg), and standing height is measured using a medical gauge (precision, 1 cm). Blood pressure (BP) is measured in the sitting position using a sphygmomanometer with cuff placed on the left arm at the heart level in a temperature controlled room. Systolic and diastolic BPs are measured once and they correspond, respectively, to the first and last Korotkoff sounds. Blood pressure measures have been performed by the same technicians during the 8-year period. All procedures are reviewed and standardized across technicians on a regular basis. Total cholesterol is measured in plasma from capillary blood taken from the fingertip of non-fasting subjects. The blood analyzer is checked each morning and calibrated every three months. Quality controls are performed monthly by the Swiss Center for Quality Control in Clinical Chemistry and Hematology.

We defined hypertension as systolic BP $\geq$ 140 mmHg and/or diastolic BP $\geq$ 90mmHg and/or under hypertension treatment; overweight/obesity as body mass index (BMI) $\geq$ 25 kg/m^2; hypercholesterolemia (or high cholesterol) as cholesterol $\geq$ 6.5 mmol/liter and/or under cholesterol treatment. Ever smokers had smoked at least 100 cigarettes in their lifetime; current smokers were still smoking at some time during the year before they were interviewed. Physical inactivity was measured (1994 to 1999 only) via the question: "Do you perform, at least once a week, a physical activity that makes you sweat (e.g. walking, running, bicycling)?"

Even though the survey is performed on a continuous basis, trends were assessed, for sample size purposes, through age-adjusted prevalences or means of risk factors per *quarter* of each year of survey. General linear regression coefficients for each quarter, coded as an ordinal variable, provided the slope, i.e., the change per quarter-year. The associated (two-tailed) p-value tested the null hypothesis that the slope was 0 (no trend).

RESULTS

The mean $\pm$ SD ages (years) of survey participants were 51.7 $\pm$ 10.7 among men and 50.9 $\pm$ 10.4 among women. The prevalences of hypertension decreased 15% in men and 10% in women between 1993 and 2000 (trend p's $<$ .0001), while the prevalence of hypercholesterolemia increased 5% in men and 7% in women (trend p's $<$ .02). Overweight and obesity also increased 10% in men and 8% in women (trend p's $<$ .05) (Figures 1A, 1B).

Mean cholesterol increased by 0.008 mmol/l per quarter in women (trend $p <$ .0001), and cholesterol treatment prevalence increased 0.16% in men and 0.12% in women per quarter (trend p's $<$ .002). Systolic/diastolic BPs decreased respectively by 0.22/0.11 mmHg in men and 0.21/0.13 in women per quarter (trend p's $<$ .0001). Hypertension treatment prevalences remained stable at about 13.6% in men and 10.8% in women between 1993 and 2000 (Table 1).

Prevalences of smoking (men: 29%; women: 24%) and physical inactivity (men: 44%; women: 50%) remained high

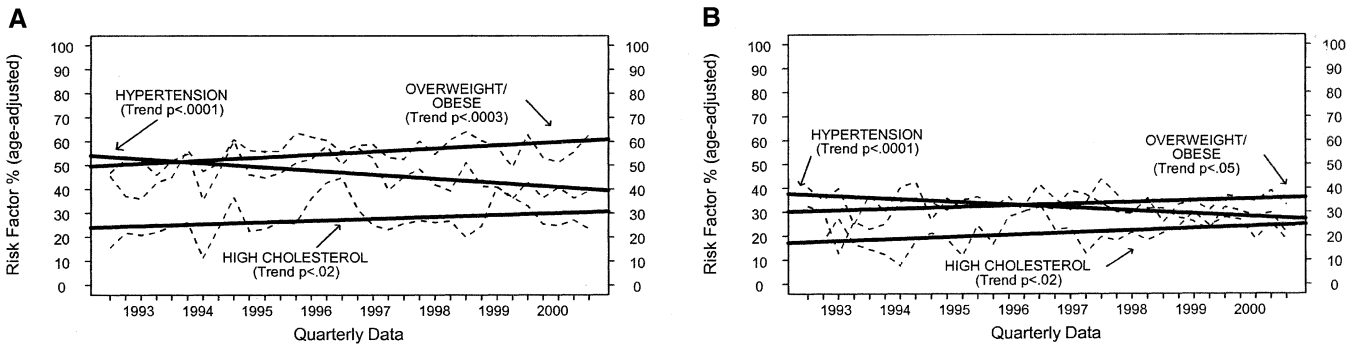

FIGURE 1. 1993–2000 trends in biological risk factors, Geneva, Switzerland. Overweight/Obese: BMI $\geq$ 25 kg/m^2 ; Hypertension: systolic Bp $\geq$ 140 mm Hg and/or diastolic Bp $\geq$ 90 mm Hg and/or under hypertension treatment; High cholesterol: serum cholesterol $\geq$ 6.5 mmol/l and/or under cholesterol treatment. 1A: Men; 1B: Women.

TABLE 1. Trends in risk factors. Geneva, Switzerland, 1993–2000

	Men			Women		
Risk factor	1993[b]	Slope[c]	p[c]	1993[b]	Slope[c]	p[c]
Cholesterol (mmol/l)	5.49	0.002	.23	5.45	0.008	<.0001
% Hypercholesterolemia[d]	15.6	0.2	<.02	18.1	0.23	<.002
% Cholesterol treatment	5.3	0.16	<.0006	3.2	0.12	<.002
Systolic BP[a] (mmHg)	130.3	−0.22	<.0001	126.9	−0.21	<.0001
Diastolic BP[a] (mmHg)	82.6	−0.11	<.0001	79.5	−0.13	<.0001
% Moderate BP[a] (only)[d]	22.4	−0.26	<.0008	19.8	−0.27	<.0001
% Severe BP[a] (only)[d]	24.5	−0.17	<.02	20.5	−0.05	.41
% Hypertension treatment	13.6	0.02	.78	10.8	0.08	.15

[a]BP: blood pressure.
[b]Age-adjusted mean, 1st quarter of 1993.
[c]Slope = rate of (age-adjusted) linear change in risk factor per quarter-year (annual change = 4 × slope); p = 2-tailed p-value for F-test of H_0: slope = 0.
[d]Hypercholesterolemia: serum cholesterol ≥ 6.5 mmol/liter and/or under cholesterol treatment; Moderate BP (only); systolic BP 140mmHg–159.9mmHg and/or diastolic BP 90mmHg–94.9 mmHg and/or under hypertension treatment; severe BP (only): systolic BP ≥ 160mmHg and/or diastolic BP ≥ 95mmHg and/or under hypertension treatment.

and unchanged, and the dietary unsaturated/saturated fat ratio did not change (men: 0.40; women: 0.48) (Figures 2A, 2B).

DISCUSSION

The indisputable decline in hypertension is encouraging. Downward trends are clear in both genders and are not associated with concurrent increases in treatment coverage. This positive evolution may be due to dietary changes, but our survey does not measure salt intakes. Overweight and obesity are steadily rising in Geneva and in other middle-aged populations (3, 6). Contrary to what has been observed in MONICA (7), hypercholesterolemia increased consistently with the trends in obesity and in physical inactivity. Current cigarette smoking plateaued during the nineties in both genders. It cannot be ruled out that smoking prevalence may rise again in the future if preventive efforts are not maintained.

Because long-term trends in risk factors for chronic conditions involve subtle and complex multifactorial effects, a thorough understanding thereof requires long-term commitments to surveillance efforts that might not provide immediate payback. Nonetheless, surveillance and monitoring of risk factors is a critical first step in the primary prevention and control of a chronic condition. Given the long latency period between the effects of most behavioral habits (diet, smoking, physical inactivity, alcohol consumption, etc.) and/or of biological measures (blood pressure, cholesterol, etc.) on chronic diseases, adverse consequences of changes in trend patterns can be foreseen and prevented if they are reported in a comprehensive yet timely manner (2). The results of continuous monitoring of changes in risk factor prevalences and measurements such as those reported here yield quarterly fluctuations (similar to those of financial stocks) because of seasonal and sampling variations. However, over long periods of time, trends appear clearly and can be interpreted with more confidence than if they were based on smaller numbers of time points spaced at longer intervals. Such surveys are more easily conducted at the local level, given that the difficulties and costs of most national surveys imply that they can be administered only

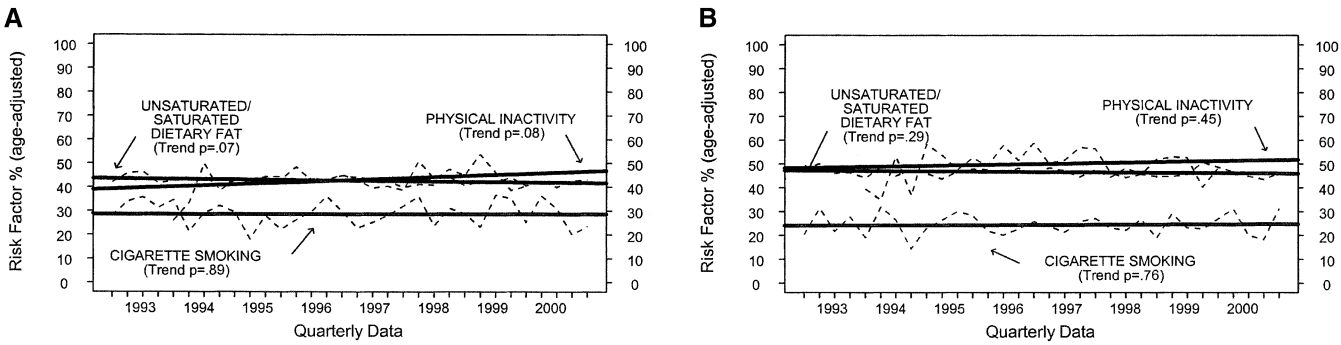

FIGURE 2. 1993–2000 trends in behavioral risk factors, Geneva, Switzerland. Physical inactivity assessed (1994–1999 only) via the question: "Do you perform, at least once a week, a physical activity that makes you sweat (for example: walking, running, cycling)?" 2A: Men; 2B: Women.

at relatively long intervals. There is a need to develop methods to compare locally- vs. nationally-based surveillance systems to maximize the benefit of these two complementary sources of information.

This study was funded by the Swiss National Fund for Scientific Research (Grants No 32-31.326.91, 32-37986.93, 32-46142-95, 32-47219.96, 32-49847.96, 3200-054097.98, 32-57104.99). We thank Christoph E. Minder for comments on an earlier draft of this manuscript.

REFERENCES

1. Murray JL, Lopez AD. Global Burden of Disease and Injury Series. World Health Organization; 1996.
2. Morabia A. Worldwide surveillance of risk factors to promote global health. Am J Public Health. 2000;90:22–24.
3. Nelson DE, Bland S, Powell-Griner E, Klein R, Wells HE, Hogelin G, et al. State trends in health risk factors and receipt of clinical preventive services among US adults during the 1990s. JAMA. 2002;287:2659–2667.
4. Morabia A, Bernstein M, Heritier S, Ylli A. Community-based surveillance of cardiovascular risk factors in Geneva: methods, resulting distributions, and comparisons with other populations. Prev Med. 1997;26:311–319.
5. Morabia A, Bernstein M, Kumanyika S, Sorenson A, Mabiala I, Prodolliet B, et al. Development and validation of a semi-quantitative food questionnaire based on a population survey. Soz Praventivmed. 1994;39:345–369.
6. Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS, Koplan JP. The continuing epidemics of obesity and diabetes in the United States. JAMA. 2001;286:1195–1200.
7. Evans A, Tolonen H, Hense HW, Ferrario M, Sans S, Kuulasmaa K. Trends in coronary risk factors in the WHO MONICA project. Int J Epidemiol. 2001;30(Suppl 1):S35–S40.