

Do doctors accurately assess coronary risk in their patients? Preliminary results of the coronary health assessment study

Steven A Grover, Ilka Lowensteyn, Katja L Esrey, Yvonne Steinert, Lawrence Joseph, Michal Abrahamowicz

Abstract

Objective—To evaluate the ability of doctors in primary care to assess risk patients' risk of coronary heart disease.

Design—Questionnaire survey.

Setting—Continuing medical education meetings, Ontario and Quebec, Canada.

Subjects—Community based doctors who agreed to enrol in the coronary health assessment study.

Main outcome measure—Ratings of coronary risk factors and estimates by doctors of relative and absolute coronary risk of two hypothetical patients and the "average" 40 year old Canadian man and 70 year old Canadian woman.

Results—253 doctors answered the questionnaire. For 30 year olds the doctors rated cigarette smoking as the most important risk factor and raised serum triglyceride concentrations as the least important; for 70 year old patients they rated diabetes as the most important risk factor and raised serum triglyceride concentrations as the least important. They rated each individual risk factor as significantly less important for 70 year olds than for 30 year olds (all risk factors, $P < 0.001$). They showed a strong understanding of the relative importance of specific risk factors, and most were confident in their ability to estimate coronary risk. While doctors accurately estimated the relative risk of a specific patient (compared with the average adult) they systematically overestimated the absolute baseline risk of developing coronary disease and the risk reductions associated with specific interventions.

Conclusions—Despite guidelines on targeting patients at high risk of coronary disease accurate assessment of coronary risk remains difficult for many doctors. Additional strategies must be developed to help doctors to assess better their patients' coronary risk.

Introduction

Doctors in primary care face increasing numbers of expert guidelines on the treatment of hyperlipidaemia to prevent coronary heart disease. In North America and Europe there are numerous and often divergent recommendations on the management of hyperlipidaemia.¹⁻⁶ Despite all this information doctors remain uncertain about the clinical indications for treating the condition.⁷⁻¹¹ One source of the confusion may be specific guidelines that suggest targeting all adults for screening and substantial numbers for intervention.¹²⁻¹⁴ Another problem may be the difficulties that doctors experience when estimating the absolute risk of the "high risk patient," at whom their best efforts should be targeted.

Several recent studies have shown that doctors in primary care often dismiss consensus recommen-

dations for screening and treating hyperlipidaemia.¹⁵⁻¹⁷ McBride and colleagues surveyed primary practitioners and identified doctors' concerns that serum lipid concentrations alone are too simplistic to define risk and that further education on multifactorial risk is needed.¹⁸ To this end, DeFries and Fielding proposed individualised health risk appraisals to identify specific risk factors that place patients at increased risk of disease.¹⁹ Finally, the American Heart Association supported the use of a multifactorial coronary risk profile to identify patients who might benefit the most from modification of lipid concentrations.²⁰

We recently carried out a randomised controlled trial, the coronary health assessment study, to evaluate the effectiveness of a computerised multifactorial risk profile to help doctors to identify patients at high risk of coronary heart disease. We also evaluated doctors' abilities to assess risk at entry into the study, and we report these results here.

Methods

DESIGN

We selected urban and rural communities throughout Ontario, Canada, for recruitment of doctors on the basis of the communities having sufficient doctors. Doctors in each of the 24 selected areas were invited to attend a local evening meeting in continuing medical education; the meetings included a dinner. Two of these meetings had to be held in Montreal, Quebec, after cancellations in Ontario because of low interest among doctors.

The meetings introduced the programme for the coronary health assessment study; at each meeting a one hour lecture on coronary heart disease was presented, covering such topics as primary prevention, multifactorial risk, and the limited accuracy of current guidelines for identifying high risk patients.²¹⁻²³ The goals of the study were then defined, although the potential participants were not told about the randomised and controlled nature of the study. The doctors attending the meetings were eligible for up to six study credits in continuing medical education from McGill University, Montreal.

EVALUATION BY DOCTORS AND DATA ANALYSIS

During a 15-30 minute reception before the lecture the doctors were offered light snacks and a drink. During the 10-15 minutes after the lecture and before the dinner, the doctors enrolling in the study completed a brief questionnaire that evaluated their beliefs about the prevention of coronary heart disease. Although the issues in the questionnaire had been covered in the preceding lecture, the answers to the questions were not contained in the lecture. The questionnaire included a list of 14 coronary risk factors

Division of Clinical Epidemiology, Centre for the Analysis of Cost-Effective Care, Montreal General Hospital, Montreal, Quebec, Canada H3G 1A4
Steven A Grover, director
Ilka Lowensteyn, research fellow

Katja L Esrey, research fellow

Lawrence Joseph, biochemist
Michal Abrahamowicz, biochemist

Department of Family Medicine, Sir Mortimer B Davis Jewish General Hospital, Montreal, Quebec, Canada H3T 1E2
Yvonne Steinert, psychologist

Correspondence and reprint requests to: Dr Grover.

that the doctors were asked to rate on a 10 point scale according to their importance as risk factors for developing coronary heart disease.

Presented with the cases of two hypothetical patients (a 40 year old man and a 70 year old woman) without diagnosed coronary heart disease, each participating doctor was asked to estimate each patient's absolute risk of developing coronary heart disease (angina, myocardial infarction, or coronary death) over the next eight years; the absolute amount that this risk would be reduced by if one or more risk factors were modified; and the average risk for Canadian men aged 40 or women aged 70. The doctors also had to estimate the change in life expectancy that would be associated with modification of risk factors.

The male patient had a blood pressure of 150/90 mm Hg, a body mass index of 23 kg/m², and a sedentary lifestyle, and he smoked cigarettes. He had a serum

total cholesterol concentration of 6.2 mmol/l, a high density lipoprotein cholesterol concentration of 0.8 mmol/l, a serum glucose concentration of 5.5 mmol/l, and a normal resting electrocardiogram. The female patient had a blood pressure of 180/90 mm Hg, a body mass index of 23, and a sedentary lifestyle, and she did not smoke. She had a serum total cholesterol concentration of 7.2 mmol/l, a high density lipoprotein cholesterol concentration of 1.4 mmol/l, a serum glucose concentration of 5.5 mmol/l, and a normal resting electrocardiogram.

We determined the accuracy of each doctor's estimates of absolute coronary risk and changes in life expectancy by comparing them with the estimates of the coronary heart disease prevention model (the "gold standard"). The risk ratio between the two was calculated as x_1/x_2 where x_1 is the average estimate by the doctor and x_2 the model's estimate.

TABLE I—Characteristics of 253 doctors in primary care who completed questionnaire on assessing risk factors for coronary disease. Values are numbers of doctors unless stated otherwise

| | |
|--|-----------|
| Men | 208 |
| Women | 45 |
| Mean (SD) age (years) | 48 (10) |
| Mean (SD) year of graduation | 1970 (10) |
| Medical training: | |
| General medicine | 172 |
| Board certified family medicine | 68 |
| Board certified internal medicine | 13 |
| % (SD) of practice time spent in specific settings: | |
| Office (n=143) | 85 (14) |
| Hospital (n=197) | 13 (12) |
| Community clinic (n=21) | 13 (23) |
| Academic (n=12) | 10 (20) |
| Other (n=16) | 14 (11) |
| Type of practice: | |
| Singlehanded | 152 |
| Group | 101 |
| Mean (SD) weekly % of ambulatory patients | 149 (66) |
| Mean (SD) proportion of time spent on primary prevention | 18 (14) |
| Mean (SD) level of confidence* when estimating a patient's coronary risk | 3.7 (1.8) |

*Scale of 1 to 10 (1=very confident; 10=not at all confident).

TABLE II—Mean (SD) ratings by doctors of relative importance of specific factors* for developing coronary heart disease

| Risk factor | 30 year old patient | 70 year old patient |
|--|---------------------|---------------------|
| Cigarette smoking | 1.5 (0.9) | 3.1 (2.0) |
| Diabetes | 1.7 (1.0) | 2.8 (1.8) |
| Left ventricular hypertrophy | 1.9 (1.3) | 3.0 (1.9) |
| Family history of premature coronary heart disease before age 60 | 1.9 (1.2) | 6.1 (2.6) |
| Diastolic blood pressure > 90 mm Hg | 2.3 (1.4) | 5.0 (2.3) |
| High density lipoprotein cholesterol < 0.9 mmol/l | 2.3 (1.3) | 5.0 (2.3) |
| Synovial blood pressure > 160 mm Hg | 1.7 (1.1) | 5.3 (2.3) |
| Total cholesterol > 6.2 mmol/l | 2.7 (1.5) | 6.2 (2.2) |
| Low density lipoprotein cholesterol > 1.4 mmol/l | 2.7 (1.5) | 6.2 (2.2) |
| High fat diet (> 30% fat) | 3.0 (1.7) | 5.2 (2.4) |
| Sedentary lifestyle | 3.5 (1.9) | 3.5 (2.4) |
| Obesity (body mass index > 27 kg/m ²) | 3.6 (1.9) | 5.6 (2.2) |
| Excess stress or tension | 3.7 (2.0) | 5.9 (2.4) |
| Triglycerides > 2.3 mmol/l | 4.4 (2.3) | 6.9 (2.2) |

*Scale of 1 to 10 (1=very important; 10=not at all important). Each individual risk factor was considered to be significantly less important (paired Student's *t* test, $P < 0.001$) in a 70 year old compared to a 30 year old.

TABLE III—Mean (SD) percentage estimates by doctors and of computer model of eight year coronary heart disease risk* in hypothetical patients

| Patient | Doctors | Computer model | Risk ratio† |
|---|-------------|----------------|-------------|
| Sedentary 40 year old male smoker with normal electrocardiogram; blood pressure 150/90 mm Hg; cholesterol 6.2 mmol/l; high density lipoprotein cholesterol 0.8 mmol/l; serum glucose 5.5 mmol/l; body mass index 23 kg/m ² | 32.2 (21.2) | 9.5 | 4.4 (2.4) |
| Average 40 year old Canadian man | 11.0 (19.0) | 3.6 | 6.7 (5.3) |
| Relative risk for 40 year old (hypothetical/average male) | 2.9 (2.0) | 2.6 | 1.0 (0.8) |
| A sedentary 70 year old female non-smoker with a normal electrocardiogram; blood pressure 180/90 mm Hg; cholesterol 7.2 mmol/l; high density lipoprotein cholesterol 1.4 mmol/l; serum glucose 5.5 mmol/l; body mass index 23 kg/m ² | 26.9 (19.5) | 11.3 | 3.0 (1.4) |
| Average 70 year old Canadian woman | 25.8 (18.4) | 11.3 | 2.3 (1.6) |
| Relative risk for 70 year old (hypothetical/average woman) | 1.2 (0.7) | 1.1 | 1.0 (0.6) |

*Includes risk of developing angina, myocardial infarction, or coronary death.
†Doctors' risk estimates divided by estimates of coronary heart disease model.

THE CORONARY HEART DISEASE PREVENTION MODEL

The previously published coronary heart disease prevention model was developed to calculate the annual probability of death from coronary heart disease and from other causes by using data from the Framingham heart study, the Canada health survey, and Canadian life tables.¹² Risk of coronary heart disease is a function of the patient's age; sex; total and high density lipoprotein cholesterol concentrations; diastolic blood pressure; whether the patient smokes; and the presence of glucose intolerance or left ventricular hypertrophy in the electrocardiogram, or both. This model has been shown to predict accurately the results of prospective randomised clinical trials by using summary data characterising the treatment and control cohorts.¹³ The average risk of Canadians of a specific age and sex was calculated with 2109 profiles based on a random sample of Canadians aged 30-74 from the Canada health survey.¹⁴

Results

In all, 445 doctors attended 24 meetings over seven months. Of these doctors, 253 (57%) agreed to participate in the study and completed the questionnaire. Table I shows the characteristics of the participating doctors. On a 10 point scale (ranging from 1 (very confident) to 10 (not at all confident)) the doctors rated their confidence in their ability to estimate a patient's risk of coronary heart disease, and 142 doctors rated their confidence as 3 or higher.

The doctors rated the relative importance of specific risk factors for developing coronary heart disease (table II). For 30 year olds the doctors rated cigarette smoking as the most important risk factor and raised serum triglyceride concentrations as the least important risk factor; for 70 year old patients they rated diabetes as the most important risk factor and raised serum triglyceride concentrations as the least important. They rated each individual risk factor as significantly less important for 70 year olds than for 30 year olds (paired Student's *t* tests, all $P < 0.001$).

The doctors' estimates of the eight year coronary risk for the two hypothetical patients and average Canadians were higher than those predicted by the coronary heart disease model (table III). The doctors overestimated coronary risk for the hypothetical male patient and the average 40 year old Canadian man to a greater degree than they did for the hypothetical 70 year old female patient and the average 70 year old Canadian woman.

Although the doctors overestimated coronary risk, they were, on average, accurate in estimating the relative risk of the hypothetical patients compared with the age matched and sex matched Canadian averages. Indeed, for the hypothetical patients the mean relative

TABLE IV—Mean (SD) estimates by doctors and of computer model of years of life saved for specific treatments

| Treatment | 40 year old man* | | 70 year old woman† | |
|---|------------------|----------------|--------------------|----------------|
| | Doctors | Computer model | Doctors | Computer model |
| Stopping smoking | 7.5 (4.0) | 4.9 | NA | NA |
| Reducing diastolic blood pressure to 85 mm Hg | 4.5 (3.8) | 0.9 | 3.0 (2.2) | 0.5 |
| Reducing cholesterol to 5.2 mmol/l | 4.4 (3.3) | 1.2 | 1.8 (2.3) | 0.2 |
| All of the above | 11.2 (5.7) | 6.7 | 2.9 (3.2) | 0.7 |

NA=not applicable.

*Sedentary 40 year old male smoker with normal electrocardiogram with blood pressure of 150/90 mm Hg, cholesterol of 6.2 mmol/l, high density lipoprotein cholesterol of 0.8 mmol/l, serum glucose of 5.5 mmol/l, and body mass index of 23 kg/m².

†Sedentary 70 year old female non-smoker with normal electrocardiogram with blood pressure of 100/90 mm Hg, cholesterol of 7.2 mmol/l, high density lipoprotein cholesterol of 1.4 mmol/l, serum glucose of 5.5 mmol/l, and body mass index of 23 kg/m².

risk for each was exactly the same as that predicted by the coronary heart disease model.

Doctors' estimates of the long term benefits of modifying one or more specific risk factors were consistently higher than those predicted by the coronary heart disease model (table IV), including those for the benefits of stopping smoking, lowering blood pressure, and treating hyperlipidaemia.

Discussion

Our results show that experienced doctors assessing the risk of coronary disease were wrong about absolute risk but correct about relative risk. In other words, while they systematically overestimated both the baseline coronary risk of specific patients and the underlying risk of the average adult, their estimates of relative risk were, on average, accurate. This suggests that, with some recalibration and sufficient training, doctors might be able to predict relative and absolute risk quite well.

A recent meta-analysis of cholesterol lowering trials suggested that drug treatment reduces total mortality only among those at high absolute risk of coronary death.¹⁸ Despite the controversies surrounding treatment of hyperlipidaemia consensus is growing on targeting high risk patients for primary prevention.^{19,20} Doctors' abilities to assess risk, however, have not previously been evaluated. One important hurdle is the definition of a suitable "gold standard" by which doctors' skills may be judged. We have used the coronary heart disease prevention model, a mathematical model of coronary heart disease risk that is based on the Framingham heart study, and Canadian mortality data. The results from the Framingham study have been shown to be generalisable to other American prospective cohort studies, and the coronary heart disease prevention model has been validated and shown to predict the results of clinical trials to reduce coronary heart disease events through modification of risk factors.²¹ So while no generally accepted gold standard exists, we used a validated mathematical model based on what is arguably the best long term prospective cohort study of coronary risk to date.

Many of the doctors' responses were consistent with current medical thinking. Cigarette smoking and diabetes were ranked among the strongest risk factors for coronary heart disease, consistent with data from the Framingham study.²² Among the serum lipids, high density lipoprotein cholesterol was ranked as the most important risk factor for coronary heart disease, total cholesterol and low density lipoprotein cholesterol as slightly less important, and serum triglycerides as least important. These findings are also consistent with data from the Framingham study.²³

Despite the doctors' strong knowledge base on risk factors for coronary heart disease our results suggest that doctors need to improve their skills in estimating coronary risk for specific patients. This is not surprising; while a sound understanding of the relative

importance of coronary risk factors is a necessary condition for risk assessment, estimates of multifactorial risk require sophisticated calculations based on different conditional probabilities that may well be beyond the average doctor's capabilities.

The doctors in our study were not a random sample of doctors in the community. Rather, our sample represents doctors who were willing to attend an evening meeting and to participate in a continuing study aimed at improving their skills in risk assessment. None the less, our doctors show striking similarities to a random sample of Canadian primary care practitioners surveyed by Tannenbaum and colleagues¹¹: 82% (v 79%) were male; average age was 48 (v 42.4); 40% (v 33%) were in group practice; mean number of patients seen weekly was 149 (v 130); and participation rate was 57% (v 53%).

The results of our study show that doctors tend to overestimate the absolute benefits of reducing risk factors over both the short term (eight year risk) and the long term (life expectancy). This tendency may be particularly important if such implicit estimates form the basis of their risk-benefit assessments when they decide how aggressively to treat individual patients. The doctors in the study said that they were confident about their abilities to evaluate risk of coronary heart disease. This confidence, when communicated to individual patients, could be misleading if doctors' risk estimates are systematically too high.

Recent health economic analyses have suggested that prevention of coronary heart disease may be cost effective compared with other medical interventions, particularly when high risk patients are targeted.²⁴ Given the high prevalence of many of the modifiable coronary risk factors in our communities, including smoking, hyperlipidaemia, hypertension, and sedentary lifestyle, there is the potential to reduce substantially or to delay the development of coronary disease among adults.²⁵

Our increasingly constrained health care budgets, however, demand that we accurately identify not only who is at increased risk but also the absolute magnitude of this risk and the potential to reduce it.²⁶ The results of this study suggest that, while doctors may be knowledgeable and confident about the primary prevention of coronary heart disease, better skills in risk assessment will be necessary if we are to ensure that their evaluations of patients are right, both relatively and absolutely.

Key messages

- Despite many guidelines on treatment of hyperlipidaemia to prevent coronary heart disease doctors are uncertain about the clinical indications for treating the condition
- This study shows that doctors in primary care accurately assess the relative risk of coronary disease in individual patients
- They systematically overestimate, however, the absolute risk of coronary disease in individual patients
- Doctors in primary care also overestimate the absolute benefits of modification of coronary risk factors including lowering lipid concentration, control of blood pressure, and stopping smoking
- Additional strategies must be found to improve the skills in risk assessment among doctors in primary care to support their clinical decision making in individual patients

SAG, LJ, and MA are supported by the Fonds de la recherche en santé de Québec (a health research foundation).

This study was primarily supported by a grant-in-aid from Merck Frost Canada and was monitored by a scientific advisory committee whose members included Dr David Sackett (chairman), Mr Yale Drazin, Dr Jacques Genest Jr, Dr Brian Gore, Dr Peter McLeod, and Dr Andres Peurasovics. The authors thank Dr Andreas Laupacis for his helpful comments on earlier drafts of this manuscript. The authors acknowledge the substantial efforts of the marketing and sales divisions at Merck Frost Canada in helping to recruit doctors to the study. We wish to thank specifically Christopher Tan, Dilip Patel, Brian Erhardt, and the coordinators for the meetings in continuing medical education, including Andrea Arnott, Sean Burke, Warren Douglas, Glenn Dow, Jude D'Souza, Eric Frenno, Doug Fullford, Christian Gagnon, Celeste Heyerichs, Kirsten Horlick, Andre Lemery, Harvey Lyman, Phil McCarthy, Fawn McLaughlin-Elder, Lynn McLeod, Ric McRae, Lori Osborne, Ute Repple, Christine Sporer, Rob Steininger, and Michael Wacziarg.

We also thank Peter Wolter of Healthcare Marketing Resources for his coordination of the credits in continuing medical education and invaluable help throughout the study and Ms Nadine Bouchard for typing the manuscript.

SAG is a partner in Arcadie Health Assessment Associates, which holds the copyright to the computer risk assessment model described in this study; LJ and MA received remuneration for the development of the model.

- 1 Summary of the second report of the national cholesterol education program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult treatment Panel II). *JAMA* 1993;269:1015-33.
- 2 Canadian consensus conference on cholesterol: final report. *Can Med Assoc J* 1988;139(suppl):1-4.
- 3 Naylor CD, Bassett A, Frank JW, Richels MM. Asymptomatic hypercholesterolemia: a clinical policy review. *J Clin Epidemiol* 1990;43:1021-117.
- 4 Canadian Task Force on the Periodic Health Examination. Periodic health examinations 1993 update: 2. Lowering the blood total cholesterol level to prevent coronary heart disease. *Can Med Assoc J* 1993;148:921-38.
- 5 British Cardiac Society Working Group on Coronary Heart Disease Prevention. *Lancet* 1987;3317.
- 6 Study Group of the European Atherosclerosis Society. Strategies for the prevention of coronary heart disease: a policy statement of the European Atherosclerosis Society. *Stat Med* 1987;6:77-88.
- 7 Mason RV, Peterson RW. Physicians' perceptions of their role in cardiovascular risk reduction. *Prev Med* 1989;18:45-58.
- 8 Laupacis A, Sackett DL, Roberts RS. Therapeutic practices of Canadian internists. *Can Med Assoc J* 1990;142:329-33.
- 9 Scheraga JS, Levin CE, Clancy C, Kinsman MS, Radney MH, Kaplan JP. Internists' practices in health promotion and disease prevention: a survey. *Ann Intern Med* 1991;114:46-53.
- 10 Lindsay NR, Hasselback PD, Quinley GC, Corber SJ. Attitudes and practices of primary care physicians in the management of elevated serum cholesterol levels. *Can Med Assoc J* 1989;141:33-8.

- 11 Tammerboom TN, Scarpello JS, Bellows RN, Rosenbery ER, Joseph L. Early detection and treatment of hyperlipidemia: physician practices in Canada. *Can Med Assoc J* 1990;143:875-81.
- 12 Grover SA, Coupez L, Fothery R, Simes S. Screening for hypercholesterolemia among Canadians: how much will it cost? *Can Med Assoc J* 1991;144:1611-8.
- 13 Wilson PWF, Christianson JC, Anderson KM, Kannel WB. Impact of assumed guidelines for cholesterol risk factor screening: The Framingham offspring study. *JAMA* 1989;262:41-4.
- 14 McBride PE, Plone MB, Underhills O. Hypercholesterolemia: the current education needs of physicians. *Am Heart J* 1992;123:817-14.
- 15 DeFronzo GH, Fabbius JR. Health risk assessment and the clinical practice of preventive medicine. In: Goldstein RB, Lawrence KS (eds). *Preventing disease beyond the classroom*. New York: Springer Verlag, 1990:460-6.
- 16 Anderson KM, Wilson PWF, Odell PM, Kannel WB. An updated coronary risk profile: a statement for health professionals. *Circulation* 1991;83:356-82.
- 17 Grover SA, Palmer C, Coupez L. Serum lipid screening to identify high risk individuals for coronary disease: the results of the lipid research clinics prevention cohort. *Arch Intern Med* 1994;154:679-84.
- 18 Grover SA. Modifying serum lipids to prevent coronary heart disease: do we have a consensus? *Canadian Drugs Ther* 1993;7:761-5.
- 19 Grover SA, Abrahamson M, Joseph L, Brewer C, Coupez L, Simes S. The benefits of treating hyperlipidemia to prevent coronary heart disease: reanalysis of outcomes at 6% expectancy and mortality. *JAMA* 1992;267:818-22.
- 20 Health and Welfare Canada. *The health of Canadians: report of the Canada health survey*. Ottawa, Ontario: Statistics Canada, 1981. (Catalogue No 82-538)
- 21 Smith GD, Song F, Sheldon TA. Cholesterol lowering and mortality: The importance of considering vascular level of risk. *BMJ* 1993;306:1361-7.
- 22 Oliver MF. Doubts about preventing coronary heart disease: multiple interventions in middle aged men may do more harm than good. *BMJ* 1992;304:393-4.
- 23 Ope LH. Cholesterol reduction in primary prevention of coronary artery disease. *Cardiovasc Drugs Ther* 1993;7:779-84.
- 24 Oliver MF. Lowering cholesterol for prevention of coronary heart disease—prevention and prognosis. *Cardiovasc Drugs Ther* 1993;7:785-8.
- 25 Leshem PE, Sartin PD, Kleinman JC, Overberg AL, Ingel'f-Morris L, Kannel WB, et al. Re-evaluation of the Framingham risk model for coronary heart disease mortality: a comparison with the national cohort study. *J Chron Dis* 1987;40:775-84.
- 26 Kannel WB, Castelli WP, Gordon T. Cholesterol in the prediction of atherosclerotic disease. New perspectives based on the Framingham study. *Ann Intern Med* 1971;76:25-39.
- 27 Kannel WB, Blomberg JM. Cutting into cholesterol. Cost-effective alternatives for treating hypercholesterolemia. *JAMA* 1988;259:2219-51.
- 28 Omer G, Epstein AM. Cost-effectiveness of antihyperlipidemic therapy in the prevention of coronary heart disease. The case of cholestyramine. *JAMA* 1987;258:3281-7.
- 29 Weissenborn MC, Simon WB. Cost-effectiveness of interventions to prevent or treat coronary heart disease. *Ann Rev Public Health* 1985;6:41-63.
- 30 Goldstein L, Weinstein MC, Goldstein PA, Williams LW. Cost-effectiveness of HMG-CoA reductase inhibition for primary and secondary prevention of coronary heart disease. *JAMA* 1991;265:1143-51.
- 31 Tierce J, Weinstein MC, Williams LW, Torrance ANA, Goldstein L. Expected gains at life expectancy from raising coronary heart disease risk factor modification. *Circulation* 1991;83:1184-201.
- 32 Grover SA, Grey-Davall K, Joseph L, Abrahamson M, Coupez L. Life expectancy following dietary modification or treating cholesterol. Estimating the benefits of a prudent lifestyle. *Arch Intern Med* 1994;154:1697-704.
- 33 Goldstein L, Gordon DJ, Rifkind BM, Hulley SB, Betsy AS, Goodman DS, et al. Cost and health implications of cholesterol lowering. *Circulation* 1992;85:1960-4.
- 34 Duruyvan MG. The problem with cholesterol: no light at the end of the tunnel? *BMJ* 1993;306:1355-6.

(Accepted 3 February 1995)

ANY QUESTIONS

Does newspaper pose a health hazard? It used to be believed to be carcinogenic, and it certainly blackens hands, clothes, and furnishings.

Newspaper printing ink usually consists of black pigment dispersed in a liquid vehicle such as water, oil, or solvent and additives, such as hardening agents. Producers of ink, workers in newspaper printing rooms, readers of newspapers, and workers in deinking units producing recycled paper are all potentially exposed by the skin route, but some could inhale ink mists or aerosols or ingest substances by hand to mouth contact.

A recent nested case-control study of lung cancer among newspaper printers from Manchester (110 cases during 1946 to 1986 and 316 matched controls) gave an odds ratio of 1.73 (95% confidence interval 0.94 to 3.17) for the subgroup with 30 years' exposure compared with the subgroup with less than 20 years' exposure and a mortality ratio standardised to the local area population of 1.22 (98 to 148) for the whole group. If we extrapolate these findings to newspaper readers this exposure seems unlikely to pose a relevant risk. But some new clues regarding the potential of exposure to newspaper ink among readers of newspapers might be expected from the

follow up of a surprising study of 1-4 year old children.¹ Their increased faecal vanadium content could not be explained by consumption of food, water, medicine, or soil. The authors hypothesised that inks and prints of children's books may contribute to an increased uptake of vanadium but did not discuss the mechanism of absorption.

Clinical as well as epidemiological evidence emphasises the risk of allergic and irritant contact dermatitis in handlers of ink and newspaper.² No data are available about the risk for newspaper readers, but it is not unreasonable to assume that exposure to newspaper ink poses a hazard for people who have been previously sensitised.—TANIA FLESH-MULLOIS, lecturer, department of epidemiology and public health, Newcastle upon Tyne, and PETER BLAIN, professor, department of environmental and occupational medicine, Newcastle upon Tyne

- 1 Leon DA, Thomas P, Hurching S. Lung cancer among newspaper printers exposed to and away: a study of trade union members in Manchester, England. *Occupational and Environmental Medicine* 1994;51:87-94.
- 2 Calabrese EJ, Sanner EJ. High levels of exposure to vanadium in children aged 1-4. *J Environ Sci Health A Environmental Sciences and Engineering* 1993;28:2359-71.
- 3 Nethercott JR. Dermatitis in the printing industry. *Dermatol Clin* 1988;6:61-4.