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Coronary risk factor prevalence in a high incidence area: results from the Belfast MONICA Project

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SUMMARY

Northern Ireland remains at the top of the world mortality league for ischaemic heart disease. The Province is providing a centre for the World Health Organisation's MONICA Project. Registration of coronary heart disease events began in 1983 and the first of three population surveys took place in 1983–4. A total of 2,361 men and women aged 25–64 years was screened. Subjects were shorter and heavier than their fellow citizens in Great Britain. The estimated mean cholesterol levels in the 25–64-year-old population (5·80 mmol/l in males and 5·85 mmol/l in females) were similar to those reported from Great Britain. Although mean systolic blood pressures were lower, mild diastolic hypertension was considerably more common; cigarette smoking levels were similar. The results were consistent with those expected for an area with a high coronary heart disease mortality, with more than 80% of subjects being at increased risk in terms of the three major factors (cigarette smoking, hypertension and raised cholesterol).

Public concern about coronary heart disease has grown and recently the Department of Health and Social Services (NI) has launched a 10-year prevention programme which will primarily employ a population approach.

INTRODUCTION

Northern Ireland remains at the top of the world mortality league for ischaemic heart disease (ICD No 410–414). The age-standardised mortality rate per 100,000 (40–69 years) for 1986 was 557 in males and 169 in females.[1] The respective figures in Scotland were 542 and 180.[2] These countries now head the world mortality league as a continued decline has been reported

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from Finland.[3] Belfast and its environs form a centre for the World Health Organisation-co-ordinated MONICA (MONItoring of trends and determinants in CArdiovascular disease) Project.[4] The MONICA Project is being carried out in more than 30 centres throughout the world and will last for a decade. It is in two parts: registration of coronary heart disease events (fatal and non-fatal) will establish trends in incidence, and screening of independent samples of the population on three occasions will monitor risk-factor levels. In this way, possible changes in incidence and case fatality may be analysed in relation to risk-factor changes within communities, and across the many centres. The study area comprises the Belfast, Castlereagh, North Down and Ards Health Districts of the Eastern Health and Social Services Board area with a total population of 499,111 and a target population, aged 25 – 64 years, of 223,575.[5] Registration began on 1 January 1983 and the first survey took place from October 1983 to September 1984.

METHODS

The MONICA Project requires that at least 200 persons of each sex should be screened for risk-factor levels in each 10-year age group between 25 and 64 years. Specific assumptions are made for each of the major risk-factors concerning the magnitude of the true change which should be detectable, and the sample size was estimated to give a high power to detect these changes as statistically significant. Screening is to be carried out on three well separated occasions during the study period. Various core (essential) items are: smoking (self-reported, validated by serum thiocyanate estimation), blood pressure, serum cholesterol, height and weight. Other factors strongly recommended for inclusion are high density lipoprotein cholesterol (HDL-cholesterol) and gamma glutamyl transferase. Each centre is free to study other factors and there are several MONICA optional studies, eg nutrition, exercise, medical care, drugs and psychosocial factors.

The sampling frame selected for the survey was the Northern Ireland Central Services Agency's general practitioner lists. A stratified random sample of 5,000 subjects was chosen with eight strata defined by age group and sex. This sample size was sufficient to give almost 400 subjects per stratum assuming a response rate of 75% and an ineligibility rate of 15%. Subjects were initially contacted by letter, with an introductory questionnaire seeking preferences for times and clinics. In the event of envelopes being returned undelivered or a non-response, general practitioners' receptionists were approached and asked to check addresses and, when necessary, subjects were visited at home. Subjects were seen in community health suites of health centres throughout the area. Arranging clinics in Belfast and certain other areas was a problem as subjects were sometimes reluctant to travel out of their localities. A strict protocol was adhered to for all screening procedures. Height and weight were measured in a standardised way, and blood pressure (diastolic phase V) was taken before venipuncture using the Hawksley random zero sphygmomanometer. Two readings were obtained when the subject was sitting and relaxed for five minutes. Where appropriate, an over-sized cuff was used. Periodic checks for digit preference on the uncorrected readings were made and recorders were retrained and recertified as necessary. As well as employing internal quality control procedures, total cholesterol, HDL-cholesterol and thiocyanate estimation were subject to external quality control through the World Health Organisation reference laboratory in Prague. Centrifuging and separation took place within three hours of venipuncture.

Cholesterol was estimated using the enzymatic CHOD-PAP method[6] and precipitation for HDL-cholesterol estimation employed phosphotungstic Mg^{++} reagents.[7] Thiocyanate was measured using Butts' method. Subjects were requested not to eat a heavy meal during the few hours before the examination (semi-fasting).

Estimates of means and proportions for the 25–64-year-old population were obtained by appropriate weighting of the estimates from the separate age strata.

RESULTS

Considerable difficulty was encountered in tracing subjects because of the large shifts of population which have occurred over the years of civil disturbance. Subjects were only classified as ineligible if at least two visits to the last known address and reference to other sources failed to establish that the person was alive and living in the study area: 1,620 (32%) were so classified.

A total of 2,361 subjects were screened giving an overall response rate of 70%; non-response records were completed for 82% of the 1,019 non-responders. Response rates were higher in the older age groups. The unemployed were under-represented in the sample whereas skilled workers were over-represented.[5]

The mean height of men in the population was estimated as 172·9 (SE 0·2) cm and of women, 159·3 (SE 0·2) cm. Younger subjects were taller than older subjects and this was more marked in males. The estimated mean weight in the male population was 76·6 (SE 0·4) kg and in the female population 63·7 (SE 0·3) kg; the weights were greatest in the 45–54 year age group in both sexes. The distribution of body mass index by age and sex is shown in Table I. In both sexes, the percentage carrying excess weight (body mass index [BMI] >25 kg/m^2) increased with age. In the three younger age groups a greater proportion of males than of females bore excess weight. These differences disappeared in the older age group. Over half of the men in the sample, 53·6%, were classified as carrying excess weight compared with 44·4% of females. A large proportion of men and women in the sample claimed to take no leisure time exercise: 43·5% of the males and 47·3% of the females.

TABLE I

Distribution of body mass index (kg/m^2)

	Male				*Female*			
Age (years)	*n*	*Over-weight* %	*Obese* %	*Excess weight* %	*n*	*Over-weight* %	*Obese* %	*Excess weight* %
25–34	241	34·0	6·2	40·2	267	17·2	9·4	26·6
35–44	276	40·9	12·0	52·9	294	30·3	10·9	41·2
45–54	334	48·8	11·7	60·5	322	35·1	15·8	50·9
55–64	314	48·1	8·9	57·0	308	38·6	17·5	56·1

Overweight:- BMI $>25 <=30$ kg/m^2
Obese:- BMI >30 kg/m^2
Excess weight:- BMI >25 kg/m^2
Missing values:- 3 male, 2 female

The distribution of total serum cholesterol is shown in Table II. Although females had a lower cholesterol than males in the two younger age groups, the converse was true in the older groups. The biggest increase between age groups was seen in males from the 25 – 34 to the 35 – 44 age group and in females from the 35 – 44 to the 45 – 54 year age group. In the 55 – 64 year age group, cholesterol levels were markedly higher in females than males. Across all age groups, however, the estimated mean levels for the population were similar in the sexes: 5·80 (SE 0·03) mmol/l in males and 5·85 (SE 0·03) mmol/l in females. Taking an upper limit of 6·70 mmol/l, 21 % of males and 24 % of females in the sample were identified as having abnormal levels. Applying an upper limit of 5·20 mmol/l, as recommended by one authority,[8] identified 71 % of males and 69 % of females to be at increased risk and in the 55 – 64 year age group, 80 % of males and 91 % of females were so identified.

TABLE II

Serum total cholesterol levels (mmol / l) *

	Male					*Female*				
Age (years)	*n*	*Mean*	*SD*	*Percentile* 5th	95th	*n*	*Mean*	*SD*	*Percentile* 5th	95th
25 – 34	233	5·22	0·97	3·79	6·72	264	4·99	0·91	3·59	6·48
35 – 44	276	5·95	1·10	4·32	7·58	291	5·44	0·93	4·04	7·05
45 – 54	328	6·02	1·08	4·34	7·89	320	6·26	1·18	4·49	8·05
55 – 64	312	6·12	1·05	4·63	7·83	303	6·74	1·14	4·84	8·71

*Conversion: SI to traditional units — 1 mmol/l = 38·6 mg/100 ml (approximately)
Missing values:- 19 male, 15 female

The distribution of HDL-cholesterol in men and women is shown in Table III. The mean levels remained fairly constant across the age groups, but were considerably lower in males than in females. The estimated population means were 1·14 (SE 0·01) mmol/l and 1·40 (SE 0·01) mmol/l, respectively.

TABLE III

HDL cholesterol levels (mmol / l) *

	Male					*Female*				
Age (years)	*n*	*Mean*	*SD*	*Percentile* 5th	95th	*n*	*Mean*	*SD*	*Percentile* 5th	95th
25 – 34	231	1·16	0·26	0·79	1·67	257	1·39	0·31	0·88	1·91
35 – 44	270	1·14	0·28	0·75	1·63	285	1·38	0·31	0·87	1·94
45 – 54	321	1·12	0·28	0·75	1·60	313	1·44	0·39	0·90	2·20
55 – 64	304	1·13	0·29	0·73	1·69	295	1·40	0·34	0·87	2·02

*Conversion: SI to traditional units — 1 mmol/l = 38·6 mg/100 ml (approximately)
Missing values:- 42 male, 43 female

The distribution of current cigarette smoking by age and sex is given in Table IV. Just over a third of men and women in the sample were cigarette smokers, even if only occasional. The estimated proportions of cigarette smokers in the 25–64-year-old male and female population were 35·8% (SE 1·4) and 36·3% (SE 1·4), respectively. A further 13·2% of males in the sample were cigar smokers and of these 70% had been cigarette smokers in the past. A higher proportion of females in the sample had never smoked cigarettes: 45·3% as opposed to 29·2% of males; and a higher proportion of males were ex-smokers: 35·4% as opposed to 18·6% of females. Male smokers smoked on average 18·8 cigarettes per day and female smokers 15·8. Only 16·0% of male smokers in the sample used low-tar-content cigarettes as opposed to 32·5% of female smokers. There were a further 131 individuals who denied smoking (5·5% of all subjects) but had a serum thiocyanate level > 50 mmol/l, of whom 37 (1·6% of all subjects) had a level in excess of 70 mmol/l.

TABLE IV

Cigarette smoking

	Male				*Female*			
Age (years)	*n*	*Current %*	*Ex- %*	*Never %*	*n*	*Current %*	*Ex- %*	*Never %*
25–34	241	36·9	23·7	39·4	268	39·9	20·6	39·6
35–44	277	39·0	27·8	33·2	295	35·9	17·0	47·1
45–54	336	33·0	39·3	27·7	322	33·2	18·6	48·1
55–64	314	33·8	46·8	19·4	308	36·0	18·5	45·5

Tables V and VI show the distribution of systolic and diastolic blood pressures. Although females had lower systolic blood pressure than males in the younger age groups, by middle age this difference had almost disappeared: this held to a lesser extent for diastolic blood pressure. The estimated mean systolic and diastolic blood pressures in the male population were 133·1 (SE 0·5) mmHg and 82·0 (SE 0·3) mmHg, respectively. For the female population, the corresponding figures were 128·6 (SE 0·5) mmHg and 77·5 (SE 0·3) mmHg. Applying cut-off

TABLE V

Systolic blood pressure (mmHg)

	Male					*Female*				
Age (years)	*n*	*Mean*	*SD*	*Percentile 5th*	*95th*	*n*	*Mean*	*SD*	*Percentile 5th*	*95th*
25–34	240	126·6	12·8	106·5	147·0	268	114·5	12·7	94·0	134·7
35–44	277	127·2	15·5	104·0	153·0	294	120·9	14·9	100·0	145·0
45–54	336	135·0	21·0	106·5	171·5	322	134·4	21·7	104·0	173·0
55–64	314	145·5	22·6	111·5	187·0	307	144·9	23·7	108·5	184·5

Missing values:- 1 male, 2 female

TABLE VI

Diastolic blood pressure (mmHg)

	Male					*Female*				
Age (years)	*n*	*Mean*	*SD*	*Percentile* 5th	95th	*n*	*Mean*	*SD*	*Percentile* 5th	95th
25–34	240	77·4	10·6	59·5	94·0	268	70·9	9·5	54·7	87·5
35–44	277	81·8	11·7	63·5	102·0	294	75·1	10·3	61·0	94·0
45–54	336	85·0	12·3	65·7	106·0	322	81·8	11·7	64·5	104·0
55–64	314	84·7	12·3	67·0	105·0	307	82·6	12·0	65·5	102·0

Missing values:- 1 male, 2 female

points of systolic $\geq$ 140 mmHg and diastolic $\geq$ 90 mmHg identified 213 (18·2%) males and 141 (11·8%) females in the sample as having abnormal blood pressure. Of these, 33 males (15·5%) and 37 females (26·2%) were on antihypertensive drugs. A further 33 males and 56 females were on antihypertensive drugs and were normotensive.

Taking risk factors in combination (cholesterol $\geq$ 5·2 mmol/l, cigarette smoking, systolic blood pressure $\geq$ 140 mmHg and diastolic $\geq$ 90 mmHg, or controlled on antihypertensives), 82·5% of men and 80·6% of women in the sample had at least one factor present; 39·4% of men and 37·0% of women had two or more factors.

DISCUSSION

The response rate achieved in the present study was 70% compared with 74% in the Medical Research Council trial of treatment of mild hypertension[9] and 78% in the British Regional Heart Study.[10] The latter studies, however, were based on selected general practices.

Both male and female subjects were shorter than their counterparts in Great Britain:[11] males on average were 0·5cm and females 1·3cm shorter. The difference was most marked in the younger age groups, possibly suggesting a difference in the rate of nutritional change between the two populations. Our subjects were also heavier: males on average by 1·6kg and females by 0·7kg. The differences were greatest in the middle (35–54) age groups. The body mass indices, which are largely uncorrelated with height,[12] revealed that 53·6% of males carried excess weight as opposed to 44·9% in Great Britain. In females the respective figures were 44·4% and 35·5%. In comparison with Great Britain, the higher proportion of subjects with excess weight was most striking in the 35–54 year olds. Increased weight contributes to coronary heart disease and this may affect serum cholesterol levels and blood pressure. Obesity has been reported to be associated with an increased production of low density lipoproteins.[13]

The mean total cholesterol level of 6·10 mmol/l for males aged 40–59 in our study was similar to that in the British Regional Heart Study (6·30 mmol/l).[14] There were differences in the biochemical methodology, and the Regional Heart Study samples were taken non-fasting, as opposed to semi-fasting in our study. Moreover, the British Regional Heart Study included northern regions in which the incidence of coronary heart disease is similar to our own. In the 40–59 year

age group in the British Risk Factor Prevalence Study, a mean of 6·0 mmol/l was found.[15] The latter study, using cut-off points of >6·5, >5·7 and >5·2 mmol/l, identified 23%, 45% and 63%, respectively, of the sample aged 25–59 years as exceeding these limits. The respective proportions in the present study were 24%, 51% and 67%. It is likely that the estimates made by Lewis and his colleagues[15] for achieving a satisfactory fall in cholesterol levels are relevant in the context of our population. The mean serum cholesterol levels reported from North Karelia in 1982 in the age group 30–59 were 6·3 mmol/l for men and 6·2 mmol/l for women.[16] In the same age group in our sample, mean values of 5·92 and 5·87 mmol/l were found for men and women, respectively.

Although the role of HDL-cholesterol as a major independent risk factor has been disputed,[17] many studies testify to its importance as a predictor of coronary heart disease.[18] The mean level in 40–59-year-old males in the present study was 1·12 mmol/l, similar to that found in the British Regional Heart Study (1·15 mmol/l).[14] The methodology in that study, however, has been criticised.[18] Furthermore, the delays in preparation of samples incurred in that study by sending to a central laboratory may have affected the precipitability. In subjects aged over 50 years in the present study, the levels were similar to those found in Framingham.[19]

The proportion of males who smoked was comparable with that reported in other local surveys, but in females it was higher.[20] The proportion of females in Northern Ireland aged 16 years and over smoking cigarettes in 1984 was estimated as only 29%. It is possible that female smoking is more an urban phenomenon in Northern Ireland. However, there was evidence from the thiocyanate estimations that smoking was under-reported. The prevalence of cigarette smoking was similar to Great Britain (1982: males 38%, females 33%).[21] In North Karelia in 1982, 38% of males aged 25–59 years were cigarette smokers[16] as compared with 36% in the present study.

The mean systolic blood pressures in 40–59-year-old males were markedly lower than in the British Regional Heart Study:[10] 134·6 versus 145·3 mmHg — the difference was greatest in younger males. Conversely, the mean diastolic blood pressure was higher in our study: 84·0 versus 82·2 mmHg. The Medical Research Council's trial of treatment of mild hypertension[9] identified 9% of 35–64-year-old men and women as having diastolic pressures of 90–109 mmHg (with a systolic pressure of below 200 mmHg). In our sample 20% of those aged 35–64 years fulfilled these criteria: 25% of men and 15% of women. Diastolic blood pressure has been shown to be a better predictor than systolic, at least in younger Norwegian men.[22] The relationship between coronary heart disease risk and diastolic blood pressure has lately been reaffirmed.[23] The 'cross-over' phenomenon usually observed in cross-sectional studies, that above 50 years there are more hypertensive females than males, was not seen in this study although a trend in that direction was observed. Johannson et al have suggested that this phenomenon is an artefact caused by selective mortality in hypertensive males.[24]

Concern about Northern Ireland's position in terms of coronary heart disease has stimulated action. In 1984 the Northern Ireland Coronary Prevention Group published its strategy for the primary prevention of coronary heart disease.[25] The recent launch of the 'Change of Heart' Programme[26] by the Department of Health and Social Services is appropriate as more than 80% of the population have been shown to have at least one risk factor present.

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