Socio-economic status, risk factors and coronary heart disease

The CORIS baseline study

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Summary

The relationship of socio-economic status (SES) indicators and coronary risk factors (RFs) with coronary heart disease (CHD) prevalence was examined in 5 620 subjects aged 20 - 60 years who participated in the Coronary Risk Factor (CORIS) baseline study. Education and income (with some exceptions in males) were strongly and inversely related to hypercholesterolaemia, low high-density lipoprotein cholesterol, hypertension, smoking, overweight and prevalence of angina pectoris. In contrast, type A behaviour was positively associated with higher income and education. Females showed stronger SES-RF relationships than males.

Town-dwelling females were more likely to be smokers, and had a higher prevalence of angina pectoris and myocardial infarction. The lowest overall prevalence of RFs, angina pectoris and myocardial infarction was found in the professional and managerial categories for both males and females.

The SES indicators had little or no independent effect on CHD prevalence in multivariate logistic analyses after inclusion of the standard RFs. We conclude that these indicators relate to RFs, and through them to CHD.

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Compared with the vast number of publications on the relationship of variables such as hypercholesterolaemia, hypertension and smoking with coronary heart disease (CHD), relatively little is known about the impact of socio-economic status (SES) variables on CHD.[1] Nevertheless there are strong indications from cross-sectional and prospective studies that social class (as defined by occupation, education, income and, to a lesser extent, urban versus rural domicile) does influence the risk of CHD.[1-6] Although in industrialised countries higher social class, education and income are at present inversely related to CHD risk, this has not always been the case; in the UK, males in social classes 1 and 2 had higher CHD death rates than those of social classes 3 and 4 before 1950.[6] Since 1950 the pattern has reversed and the social inequality is still widening.[7]

The mechanisms through which SES variables influence CHD are not fully understood, although most studies have concluded that the classic biological variables explain at least part of their impact.[2-5] Hypertension and smoking appear to be more prevalent in lower SES groups,[2-5,8-11] whereas the data on hypercholesterolaemia are conflicting.[2]

Few studies have included women[6,11,12] or have investigated the relationship of more than one SES indicator with CHD and with standard risk factors (RFs),[13] and no data addressing these questions have been published for South African populations. The present study examines the interaction of income, education, domicile (farm or town) and occupation with RFs and with CHD in a rural white population.

Methods

The study population was drawn from the 1979 baseline survey of the Coronary Risk Factor Study (CORIS), which was conducted in three magisterial districts of the south-western Cape (Robertson, Riversdale and Swellendam). For the present purpose, only males and females aged 20 - 60 years (5 620 subjects) were considered in order to exclude school pupils and retired persons. The study methods have been described previously.[14] The questionnaire, completed by interview, included items on gross joint household income, education, occupation and domicile. These were used as SES indicators. Income was stratified into high (the 20% of the population with the highest income), middle and low groups (approximately 40% in each group). Education was stratified into high (1 or more years after matriculation, i.e. more than 12 years of education), middle (Standards 9 and 10; 11 - 12 years) and low (less than Standard 9; less than 11 years). Occupation was categorised into four groups for males (professional and managerial; clerical and sales; agricultural; and tradesmen, services, artisans and operators) and into three groups for females (professional and managerial; clerical and sales; and housewives). Domicile was divided into farm or town.

The prevalences (%) of each of the following RFs were stratified by SES indicator: hypercholesterolaemia ($\geqslant$ 6,5 mmol/l); low high-density lipoprotein cholesterol (HDL-C) ($<$ 1,2 mmol/l for males, $<$ 1,4 mmol/l for females); hypertension (systolic blood pressure $\geqslant$ 140 mmHg); current smoking (yes/no); type A behaviour ($\geqslant$ 55 on the Bortner scale); overweight (body mass index $\geqslant$ 30 kg/m^2). The prevalence of angina pectoris (AP) (by the London School of Hygiene questionnaire) and myocardial infarction (MI) (severe chest pain lasting half and hour or more, and/or Q waves (Minnesota code 1,1 - 1,2) on a resting ECG) were similarly

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stratified by SES indicators. All prevalences were determined in 10-year age groups and age-standardised by the direct method, using the total CORIS population as reference.

The significance of differences in prevalences was tested by the Cochran-Mantel-Haenszel chi-square statistic, which gives a stratified statistical analysis of the general association among the different SES strata, after controlling for age.[15] In view of the multiple analyses performed, $P < 0{,}05$ was regarded as marginal and $P < 0{,}01$ as significant.

The independent effect of the SES indicators income and education was assessed by entering them into multiple logistic models for confirmed AP and MI, after the standard RFs age, family history, hypertension (blood pressure $\geqslant$ 160/95 and/or on treatment), non-HDL cholesterol, HDL-C, smoking duration, body mass index, diabetes and uric acid (identified by preliminary univariate logistic regression) had been entered. The variables were defined in this manner to maximise the RF-CHD association (J. E. Rossouw *et al.* — in preparation). Thus, for this analysis a history of AP or MI was accepted only if the chest pain had been confirmed by a doctor as being that of coronary heart disease; additionally, Q waves (as above) were accepted for MI. The choice of RF variables, and their definition, was decided upon after exploration of their strength of association with confirmed AP and MI by means of odds ratios and univariate logistic regression analysis.

Results

RFs by income and education

In females, income and education were inversely associated with RFs, with the exception of type A behaviour (Tables I and II). The same was true for education in males. However, there was no consistent pattern of RFs by income in males. An interesting dichotomy was observed: overweight was more common in high-income males, but less common in the highly educated.

RFs by domicile and occupation

Domicile appeared unimportant in males (Table III), but female farm dwellers had lower prevalences of smoking, hypertension and low HDL-C levels than female town dwellers. Interestingly, type A behaviour was similar in farm and town dwellers.

Males involved in transport, services, artisan or operator occupations had the highest smoking rates but the lowest prevalence of type A behaviour (Table IV). Among females, professional or managerial workers had the lowest prevalences of hypercholesterolaemia and hypertension.

Angina and myocardial infarction

The prevalence of myocardial infarction (MI) in males was only minimally influenced by SES indicators, but in females both MI and AP were inversely associated with income and education, and their prevalence was lower in farm dwellers (Tables I - IV). AP in males was significantly less frequent in higher income and educational groups, and the professional/managerial occupation group tended to have a lower prevalence of AP and MI.

TABLE I. AGE-STANDARDISED PREVALENCES (%) OF RFs, AP AND MI BY INCOME*

	Males				Females			
	Low (N = 974)	Middle (N = 1 013)	High (N = 554)	P	Low (N = 1 373)	Middle (N = 1 003)	High (N = 503)	P
Hypercholesterolaemia	**43,0**	**46,6**	**50,7**	**0,032**	**47,4**	**46,9**	**42,1**	**0,046**
Low HDL-C	**45,6**	**43,9**	**46,6**	**0,483**	**44,6**	**37,3**	**31,4**	**0,001**
Hypertension	**35,6**	**33,2**	**36,3**	**0,517**	**37,1**	**31,8**	**32,4**	**0,009**
Smoking	**59,5**	**49,1**	**50,7**	**0,001**	**23,7**	**18,7**	**16,0**	**0,001**
Overweight	**14,2**	**15,4**	**22,2**	**0,001**	**22,5**	**15,5**	**12,1**	**0,001**
Type A behaviour	**38,5**	**46,9**	**50,8**	**0,001**	**34,3**	**43,9**	**42,9**	**0,001**
MI	**8,9**	**8,0**	**8,3**	**0,736**	**5,2**	**4,4**	**2,0**	**0,013**
AP	**7,3**	**4,2**	**3,7**	**0,002**	**7,6**	**3,8**	**2,3**	**0,001**

*See text for definition of variables.

TABLE II. AGE-STANDARDISED PREVALENCES (%) OF RFs, AP AND MI BY EDUCATION*

	Males				Females			
	Low (N = 1 077)	Middle (N = 834)	High (N = 667)	P	Low (N = 1 293)	Middle (N = 808)	High (N = 941)	P
Hypercholesterolaemia	**44,4**	**46,7**	**45,0**	**0,523**	**49,1**	**47,0**	**40,7**	**0,001**
Low HDL-C	**46,6**	**44,8**	**41,0**	**0,066**	**47,5**	**39,2**	**30,0**	**0,001**
Hypertension	**38,2**	**34,2**	**28,2**	**0,001**	**40,8**	**32,8**	**24,5**	**0,001**
Smoking	**58,8**	**53,6**	**45,9**	**0,001**	**25,7**	**19,2**	**16,0**	**0,001**
Overweight	**17,1**	**17,7**	**12,3**	**0,007**	**23,5**	**16,0**	**10,5**	**0,001**
Type A behaviour	**37,3**	**45,8**	**51,8**	**0,001**	**34,0**	**41,6**	**44,6**	**0,001**
MI	**8,5**	**9,0**	**8,0**	**0,608**	**5,5**	**3,6**	**3,4**	**0,024**
AP	**6,7**	**5,0**	**3,2**	**0,011**	**8,0**	**4,1**	**2,7**	**0,001**

*See text for definition of variables.

TABLE III. AGE-STANDARDISED PREVALENCES (%) OF RFs, AP AND MI BY DOMICILE*

	Males			Females		
	Farm (N = 1 093)	Town (N = 1 449)	P	Farm (N = 1 078)	Town (N = 1 908)	P
Hypercholesterolaemia	44,7	46,1	0,485	43,9	47,0	0,077
Low HDL-C	43,8	45,2	0,473	37,7	41,3	0,050
Hypertension	32,8	35,1	0,201	31,8	35,4	0,022
Smoking	51,4	55,0	0,068	14,8	23,7	0,001
Overweight	17,1	14,9	0,132	16,6	18,9	0,089
Type A behaviour	46,2	42,5	0,055	38,7	39,8	0,543
MI	7,3	9,3	0,090	3,1	5,2	0,010
AP	4,8	5,4	0,493	4,2	6,4	0,009

*See text for definition of variables.

TABLE IV. AGE-STANDARDISED PREVALENCES (%) OF RFs, AP AND MI BY OCCUPATION*

	Males				Females		
	Agriculture (N = 983)	Transport, services, artisan, operator (N = 541)	Clerical, sales (N = 296)	Professional, managerial (N = 586)	Housewife (N = 2 084)	Clerical, sales (N = 505)	Professional, managerial (N = 319)
Hypercholesterolaemia	45,3	43,8	49,6	45,5	46,4^{ab}	49,8^{a}	37,6^{b}
Low HDL-C	43,4	45,0	43,7	45,0	40,6	40,0	33,8
Hypertension	33,5	36,7	32,9	34,2	34,1^{a}	37,0^{a}	28,6^{b}
Smoking	52,7^{a}	61,3^{b}	54,6^{ab}	47,3^{a}	19,7	23,8	19,9
Overweight	19,1	18,9	13,2	10,6	18,4	16,7	11,8
Type A behaviour	43,5^{b}	36,6^{b}	48,1^{ab}	48,8^{a}	38,4	43,4	42,2
MI	8,8^{a}	9,7^{ab}	6,8^{ab}	3,5^{b}	5,0	2,6	3,9
AP	6,1^{ab}	7,2^{a}	3,6^{ab}	2,2^{b}	5,9	4,6	3,5

*Differences significant (P < 0,01) where alphabetical superscripts differ.

Independent effect of SES indicators on CHD prevalence

Multivariate logistic regression analyses did not reveal any significant additional contribution to confirmed MI or AP by education, after the standard RFs had been entered into the model. Income showed a marginal independent negative association with AP in males (P = 0,026) and with MI in females (P = 0,024).

Discussion

Education appeared to be the SES indicator with the most consistent and strongest inverse relationship to the majority of RFs and to prevalence of CHD. Other studies have found education to be inversely related to RFs[5,9,13] and to CHD prevalence.[5] In the present study the direction of the relationship of income to RFs was inconsistent, particularly in males, although it did have a significant inverse association with AP prevalence, which remained marginally significant in multivariate analyses. It is possible that income and education are not always associated, and therefore do not exert a congruent effect on RFs. This is exemplified by the finding that, among males, overweight and hypercholesterolaemia were more common in higher income groups, but this was not the case for higher education groups. In fact, education had a significantly negative association on overweight. The more highly educated groups may be more receptive to health education than those with high income but without high education.

Domicile and occupation were less strongly related to RFs than education or income. This is in contrast to the findings from North Karelia, where rural people had higher prevalences of hypercholesterolaemia and hypertension than urban dwellers.[13] However, our population could be classed as rural, whether they live on the farm or in the town. A number of cross-sectional studies have indicated that manual workers have higher RF levels than white-collar workers,[3,8,10,16] and prospectively they have higher CHD mortality.[2,3,6-10] The British Regional Heart Study found a strong inverse gradient of hypertension and smoking with social class (by occupation), but a positive gradient for serum total cholesterol in males.[2]

SES indicators were more likely to interact with RFs in females than in males, and were much more consistent in having a favourable trend with higher SES. Few studies have looked at these associations in females, but it is known that HDL-C is positively associated with education[11] and that women in employment have higher HDL-C and lower triglyceride levels than housewives.[12] It is also known that, at least since 1931, UK women in social classes 1 and 2 have had a lower CHD mortality rate than classes 4 and 5.[6] It is possible that women are more susceptible to the protective influences of SES, i.e. they respond earlier to changes in lifestyle norms that accompany a rise in SES.

Type A behaviour went against the general trend in both males and females, in that it increased with income and education and was high in professional males. It would seem that a certain amount of type A behaviour is needed to succeed in a Western society; however, it is uncertain whether this behaviour precedes achievement, or is a result of exposure to the working environment.[1]

The prevalences of MI and AP were generally congruent with RF trends (and particularly with smoking), with AP the more informative end-point. However, the impression was gained that the CHD end-points were less strongly related to SES indicators than were the RFs. This impression was borne out by multiple logistic function analyses, which showed that the SES indicators income and education made little or no further contribution to the prediction of MI or AP after the standard RFs had been entered into the model. The limited number of studies of the independent effect on social class of CHD morbidity or mortality have yielded conflicting results. Some cross-sectional, case-control and prospective studies have suggested a residual effect of SES after allowing for standard RFs,[4,5,8,17] while the most recent prospective study has failed to find an independent effect.[2] Further studies in which SES indicators are included in multivariate analyses are clearly required to resolve this question.

It would be of interest to examine the effect of SES on CHD mortality in other South African populations, since the interaction between SES, RFs and CHD may explain some of the variation in mortality rates and help provide guidelines for intervention strategies.

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