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Incidence of ischaemic heart disease in two cohorts of Belgian clerks

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Kornitzer, M., Thilly, C. H., Vanroux, A., and Balthazar, E. (1975). *British Journal of Preventive and Social Medicine*, **29**, 91-97. **Incidence of ischaemic heart disease in two cohorts of Belgian clerks.** A study during a five-year period has been conducted on the incidence of ischaemic heart disease (IHD) among two cohorts of Belgian employees who were free of IHD at entry. As regards the final outcome these incidences differ significantly. The chief difference between the two cohorts is their systolic blood pressure. These pressure differences may be attributed to differences in the level of work pressure. The increased work pressure in Cohort I might account, through stress, for the greater incidence of sudden death or myocardial infarction.

More than 20 years ago. the Framingham study in the USA was the first study of the incidence of ischaemic heart disease (IHD) within a 'free-living' population. Since then there have been many other studies, mostly in the USA, and after some delay studies in Europe followed, notably the 'Seven Countries Study' (Keys, 1970; Keys *et al.*, 1972). In 1964 and 1965 at two banks in Brussels, two studies into the incidence of IHD and its relation to certain parameters were started (Goossens and Messin, 1966; Kornitzer, Demeester, and Goossens, 1971b; Kornitzer *et al.*, 1971a). We were unable to discover in the literature any studies that had been carried out in a single town on two cohorts of clerks using standardized data. Stout *et al.* (1964) studied two small neighbouring towns in the USA and found very different incidence rates; however, Keys (1966) challenged the results obtained. In the 'Seven Countries Study', two rural samples were studied in Italy, and although the incidence of hard events was different, this did not reach a statistically significant level (Keys, 1966). We believe it is worthwhile to report the results of this study, as the incidence of IHD differs statistically.

Material and Method

We observed two cohorts. These were men, aged between 40 and 59 at entry all of whom were bank employees—either clerks or executives. The first cohort was re-examined after five years and the second after six years. Cohort I comprised 538 subjects (or 95% of total sample) and Cohort II, 877 subjects (91% of total sample). In the follow-up examination no subject who had been free of IHD at entry was lost sight of, although some of them were not re-examined, either because they refused or had left the district. In Cohort I this represented 2·4%, and in Cohort II 5·4% of living subjects. The cause of death of all those who died during the period of study was ascertained (Table I). Table II shows the measurement techniques applied, but there were some important differences in the measurement used for blood pressure. The base-line electrocardiogram of Cohort II was coded in London, that of Cohort I by one of us (MK). There was good standardization of data between the London

TABLE I

FOLLOW-UP EXAMINATION (1970)
(POPULATION FREE OF I H D AT ENTRY)

Follow-up	Cohort I		Cohort II	
	No.	%	No.	%
Examined ..	406	93·5	700	91·6
Refused.. ..	10	2·3 (2·4)*	40	5·2 (5·4)*
Died	18	4·1	24	3·1
Total	434	100	764	100

*Percentage of survivors

TABLE II
STANDARDIZED TECHNIQUES APPLIED AT ENTRY-EXAMINATION

Cohort	Questions: Angina	Possible Infarction	Intermittent Claudication	Smoking Habits	Weight and Height	Blood Pressure
I					Stripped to the waist with shoes	Sitting, after interview Rounded down to the next even value S B P D_4 B P—D_5 B P
II					Stripped to the waist without shoes	Recumbent, after physical examination Rounded down to next 0·5 cm S B P and D_5 B P

*Formula for computing relative weight (Lorenz and Vanderwael)

Cohort	Blood Cholesterol	Electrocardiogram
I	Samples analysed in Naples*	Minnesota Code
II	Samples analysed in Naples	Minnesota Code

*(Laboratory of Professor Fidanza)

team and the Brussels coder (Kornitzer *et al.*, 1971b). The relative weight was not affected by the differences in method. The follow-up examination was carried out by the same team for the two banks. We define as 'free of ischaemic heart disease at entry' all the subjects presenting neither $I_{1\text{-}2\text{-}3}$ (Q-wave items), $IV_{1\text{-}2\text{-}3}$ (S-T items), nor $V_{1\text{-}2\text{-}3}$ (T-wave items) Minnesota code on their electrocardiograms, nor exercise angina in the standardized questionnaire. In the follow-up results, we define under category 'hard events' all the subjects who died from IHD or who showed a I_1 or I_2 Minnesota code on their electrocardiograms (that is, probable occurrence of an infarction between the first and the second examination). A 'soft event' is defined by the presence of exercise angina in the standardized questionnaire, or $IV_{1\text{-}2\text{-}3}$ or $V_{1\text{-}2\text{-}3}$ Minnesota code on the electrocardiograms.

RESULTS

Table III shows that the ratio of coronary to total mortality varies greatly between the two cohorts.

Table IV shows five-year incidence rates for 'hard' and 'soft' events in subjects who were free of IHD at entry in each group. A significant difference is noted for the occurrence of hard events and for hard + soft events. We thus have two groups of male clerks, working in the same town, whose incidence of IHD is markedly different, especially as regards 'hard' events. This has led us to search for differences between the two cohorts at their entry to the study.

TABLE III
MORTALITY IN BOTH COHORTS*

Mortality		Cohort I No.	Cohort I %	Cohort II No.	Cohort II %
Total	1	34	100	38	100
Observed coronary	2	17	50	13	34·2
Ratio 2:1		0·50		0·34	

*Not only subjects free of I H D at entry but *total* cohorts.

INITIAL PREVALENCE RATES

For IHD for Minnesota code these are $I_{1\text{-}2}$ 3·5% for Cohort I and 1·9% for Cohort II; for angina, the rates are 6·2% and 4·7% respectively. As regards the presence of pathological Q waves, the difference is practically double. However, the prevalence of IHD among those who refused the screening examination is not known, (5% and 9% respectively in each cohort).

TABLE IV

NEW I H D EVENTS (5-YEAR INCIDENCE, ABSOLUTE NUMBERS, AND AGE-ADJUSTED RATES)

Event	40–44		45–49		50–54		55–59		Total		χ^2
	Cohort I (N=172)	Cohort II (N=222)	Cohort I (N=52)	Cohort II (N=147)	Cohort I (N=89)	Cohort II (N=216)	Cohort I (N=121)	Cohort II (N=178)	Cohort I (N=434) age adjusted rate ‰	Cohort II (N=763) age adjusted rate ‰	
Hard	5	3	1	3	3	4	12	7	45·5	21·6	P<0·01
Soft	2	3	1	6	3	5	8	7	31·6	26·6	P>0·05
Hard+Soft	7	6	2	9	6	9	20	14	77·1	48·4	P<0·01

PRE-EMPLOYMENT MEDICAL EXAMINATION

This took place between 1925 and 1945; it was not strict, and did not include an electrocardiogram.

RISK FACTORS IN THE TWO COHORTS

Overweight was determined by relative weight, and the 'ideal weight' was determined using the formula of Lorenz and Vanderwael*. There was no statistically significant difference between the two samples as regards the percentage of subjects with a relative weight of 120% or more and as regards the mean (Table V).

*Ideal weight (kg) (I W) = 50+3/4 (height (cm) − 150)
Relative weight = Observed weight x 100/I W

For cholesterol there was a slight but significant difference, the mean being 245 mg/dl for Cohort I and 239 mg/dl for Cohort II (Table V). On the other hand, there is no significant difference between the two cohorts as regards the prevalence of hypercholesterolaemia equal to or exceeding 260 mg/dl (Fig. 1). The prevalence of cigarette smoking was similar in both cohorts (Fig. 1). A large and significant number of subjects in Cohort I showed systolic blood pressure >160 mmHg, and also diastolic blood pressure >100 mmHg). The mean SBP and D_5BP values likewise differed significantly (Table V and Fig. 1). This might have been partly

TABLE V

MEAN AND STANDARD DEVIATION OF RISK-FACTORS FOR MEN AGED 40-59 AND FREE OF I H D AT ENTRY

Risk Factor	Cohort I (N=434)	Cohort II (N=764)	*t* test	P
Age	49·4± 6·3	49·8± 5·7		
Blood pressure (mm Hg)				
Systolic	133·2±22·6	129·2±30·2	2·59	<0·01
Diastolic	87·8±11·4	80·5±10·6	10·9	<0·001
Blood cholesterol (mg/dl)	245·5±46·5	239·8±35·5	2·08	<0·05
Relative weight percentage	109·2±13·7	109·5±12·5	0·02	>0·05

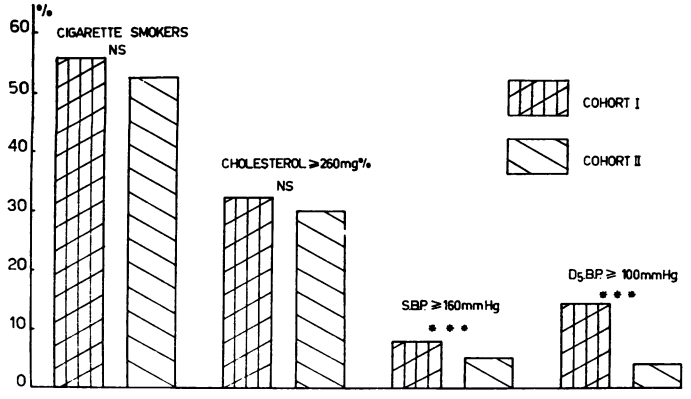

FIG. 1. 40 to 59 year-old men free of ischaemic heart disease at entry.
Prevalence of some risk factors:
S B P=systolic blood pressure
D_5 B P=diastolic blood pressure (disappearance of Korotkow sounds)
N S=Not significant (P>0·05)
***=P<0·001

due to lack of standardization, as at the first examination blood pressure was not taken by the same team nor in an identical way. However, at the follow-up examination, blood pressure was taken by the same doctors and in a standardized way for both cohorts; and again, significant differences were found between the two cohorts (Table VI). The prevalences (adjusted for age)

TABLE VI

MEAN AND STANDARD DEVIATION OF BLOOD PRESSURE AT FOLLOW-UP EXAMINATION FOR MEN AGED 40–59 AND FREE OF I H D AT ENTRY

Blood Pressure	Cohort I	Cohort II	*t* test	P
Systolic ..	143·6±22·1	139·6±30·6	2·41	<0·01
Diastolic	90·3±12·2	86·8±12·5	4·50	<0·001

of systolic blood pressure >160 mmHg are 22% for Cohort I and 16% for Cohort II (P<0·05) and similarly the age-adjusted prevalences of diastolic blood pressure>100 mmHg are 22·5% for Cohort I and 14% for Cohort II (P<0·01). Among the major risk factors, blood pressure seemed to present the most striking difference between the two cohorts.

Systolic blood pressure is one of the entry characteristics (with age, serum cholesterol, smoking habit, and body-mass index) of the multiple logistic function (MLF) which ranks every subject free of IHD at entry according to a relative risk or probability (between 0 and 1) of having a 'hard' coronary event in the next five years of follow-up.

The analysis coefficients of the MLF obtained from data in the USA were applied, in our study, to all subjects who were free of IHD at entry and of whom all the necessary variables were known. The probabilities are not normally distributed and required a logarithmic transformation. The mean log-probabilities (absolute values) are 4·35 for Cohort I and 4·53 for Cohort II (P<0·001) showing that the mean five-year probability of a 'hard' event is higher in Cohort I (0·0185) than in Cohort II (0·0148), mainly because of higher systolic blood pressures.

SOME SOCIO-ECONOMIC DATA

INCOME The ratio of mean income is 1.2/1 in favour of Cohort I.

AGE OF RETIREMENT In the bank employing Cohort II the policy is to retire employees at the age of 60, without substantial loss of rights to retirement pension; but in the bank employing Cohort I, 65 is the normal age for retirement. Fig. 2 shows the cumulative yearly percentage of retirements for the two cohorts in subjects free of IHD at entry; there is a clear difference.

DISTRIBUTION BETWEEN EXECUTIVES AND CLERKS The proportion of executives is greater in Cohort I. The executives in both cohorts have a higher incidence of IHD but the differences between the cohorts are independent of age and proportion of executives (Table VII).

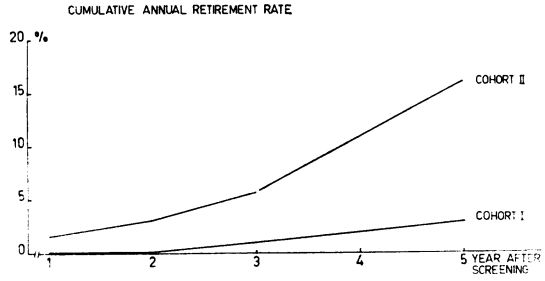

FIG. 2. High retirement rate in Cohort II as compared with Cohort I

TABLE VII

I H D EVENTS/1000/5 YEARS (AGE ADJUSTED)

Group	Cohort I				Cohort II				Test χ^2		
	No.	Hard	Soft	Total	No.	Hard	Soft	Total			
Clerks	318	36·8	25·9	62·7	629	20·1	24·1	44·2	*	NS	NS
Executives ..	116	87·1	63·0	150·1	134	28·0	34·3	62·3	***	**	***
Total* ..	434	47·3	33·6	80·9	763	21·7	26·3	48·1	**	NS	**

*Adjusted for difference in percentage of executives

*=P<0·05
**=P<0·01
***=P<0·001

Discussion

Many studies have shown the high prevalence of coronary atherosclerotic lesions in middle-aged men in industrialized countries (McGill *et al.*, 1968; Tejada *et al.*, 1968). A certain number of these subjects will present a major coronary event. Prospective epidemiological studies have made it possible to identify a certain number of 'risk factors' predisposing the occurrence of such an event. The main risk factors are age, sex, blood cholesterol, blood pressure, and smoking habits. However, Epstein (1965) when reviewing the various USA surveys, noted very different rates of incidence of IHD. On the other hand, in the 'Seven Countries Study', Keys *et al.*, (1972) applied the multiple logistic function established from American samples to Europeans and found a higher theoretical probability of new coronary events than the number of cases actually observed. Although at present the MLF is the best way of classifying subjects according to their relative risk, it nevertheless does not enable one to pinpoint those individuals who will undergo a major coronary event, within a given class of risk (Wilhelmsen, Wedel, and Tibblin, 1973). It should be admitted that, in the countries where coronary atherosclerosis is very prevalent, the sudden occurrence of a major event (infarction or sudden death) in men depends not only on the presence of the major risk factors but also on some other as yet unidentified factors. In our study, it is essentially the blood pressure which differentiates the two cohorts. These pressure differences cannot in our case be accounted for on ethnic, geographical, or social grounds (Stamler and Stamler, 1962; Maddocks, 1961; McDonough, Garrison, and Hamres, 1964; Morton, 1970). Various psychological stresses can influence arterial pressure (Geiger and Scotch, 1963; Gutmann and Benson, 1971; Stieglitz, 1930; Cruz-Coke, 1960; Weiss, 1942; Ostfeld and Lebovits, 1960; Brod *et al.*, 1959). It is possible that in our case what Kiritz and Moos (1964) termed 'work pressure' may have caused the observed differences in blood pressure, through stress. The difference in job-stress, might equally explain the difference in the incidence of hard coronary events. The presence of acute or chronic psychological tension before a major coronary event has been reported by some authors (Weiss *et al.*, 1957; Dreyfuss, 1959). An argument that indirectly supports this hypothesis lies in the retirement age, 60 years for Cohort II and 65 years for Cohort I subjects. In our study, the early retirement for Cohort II essentially affects the subjects who were aged between 55 and 59 at entry. For this age group the ratio of Cohort I : Cohort II of hard, soft, and total events is respectively 2.6, 1.5, and 1.8, there are thus very distinct differences in the incidence of IHD. The overall excess mortality in Cohort I might derive from differential retirement of sick members in Cohort II. But this explanation could not account for IHD mortality and morbidity for subjects free of IHD at entry and for whom follow-up was complete even if death or morbidity occurred after retirement. Lastly, certain data concerning the organization inside the two banks indicate different approaches to the work. These data cannot be quantified and their influence on job-stress is unknown.

Cohort I is a private bank with a typically commercial function. Since 1965 there have been large changes in the management policy, and the old conception of an 'established bank' changed into a dynamic enterprise. Moreover, management jobs were given to the most dynamic people, and consequently, many people may have felt certain frustrations and had problems of adaptation. Last but not least, retirement age is 65 years.

Cohort II is represented by a 'state' bank which is essentially a savings-bank, and its commercial function started to develop only after 1970. The work is more monotonous, and generally entails few responsibilities. Few basic changes took place between 1965 and 1970, and there would have been little struggle for promotion. There are no rigid regulations for retirement, which is permitted at 60 years. Fig. 3 shows the possible aetio-pathogenic process in the sudden occurrence of a coronary event from the condition of psychological tension caused by job-stress. On a basis of coronary atherosclerosis the occurrence of coronary thrombosis, sudden death, or a lethal arrhythmia might be explained in this way.

Although the hypothesis of differences in job-stress was not raised at the outset of the study, and the base-line examination data are insufficient to allow the advancing of this hypothesis with certainty, it ought in our opinion to be taken into consideration. The pressure of work would have affected mainly the executives and older subjects of Cohort I. We are now testing this hypothesis in current studies by means of psychological questionnaires, interviews and, in some cases, by assessing the urinary catecholamines.

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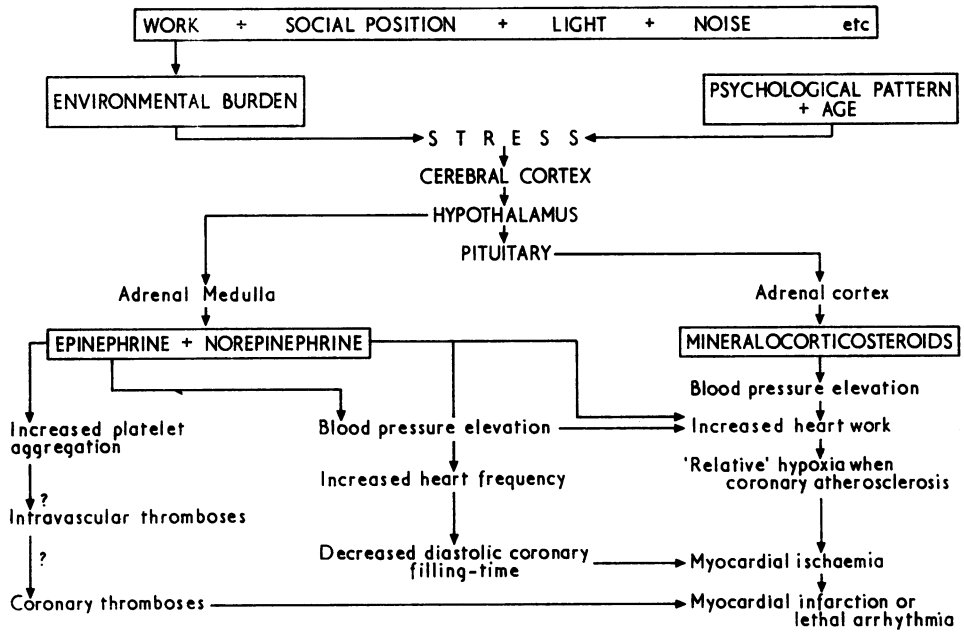

FIG. 3. Possible aetio-pathogenic process in the occurrence of a coronary event during a condition of stress.

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