Department of Epidemiology
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Epid. 160 Principles of Epidemiology Fall Semester

Seminar Exercise

The Epidemiology of Coronary Heart Disease

In a current major cohort study of coronary heart disease an attempt is being made to determine whether a certain pattern of personality characteristics is associated with this disease. The personality pattern is characterized by excessive drive, agressiveness and ambition frequently in association with a relatively greater preoccupation with competitive activity, vocational deadlines and similar pressures. Such a complex has been designated as pattern type A. The relative absence of these attributes is called pattern type B.

In this study, 3182 men between the ages of 39 and 59 years who were found to be free of any evidence of coronary heart disease, have been followed for $4\frac{1}{2}$ years. (These men were all the employees of several industries who fulfilled these criteria, namely were between the ages of 39 and 59 and were free of coronary disease.)

At the beginning of the study, all the participants were subjected to a specially designed interview which allowed them to be characterized either as pattern type A or B. In addition, a number of other characteristics of each individual were assessed. The total group has now been followed with periodic examinations for $4\frac{1}{2}$ years, during which time 133 new cases of coronary heart disease have developed

On the basis of the data presented from this study:

1. Present a series of tables and compute the appropriate rates per 10,000 population to show which of the following factors are associated with coronary heart disease.

    a. Age
    b. Level of serum cholesterol
    c. Diastolic blood pressure
    d. Systolic blood pressure
    e. Parental history of cardiovascular disease
    f. Smoking history
    g. Exercise patterns
    h. Obesity (ponderal index)
    i. Income level
    j. Education level
    k. Personality type

2. Indicate for each of these characteristics the current status of knowledge concerning its relationship to coronary heart disease and whether the findings of this study are in general agreement with this knowledge.

TABLE I

Number of New Cases of CHD Developing During 4½ Year Follow-up in 3182 Men by Various Characteristics

Age	TOTAL POPULATION	NEW CASES
39-49	2258	63
50-59	924	70
Total	3182	133
Cholesterol		
< 219	1461	29
220-259	1058	53
260 +	~~786~~ 649	51
Unknown	14	0
Total	3182	133
Diastolic Blood Pressure		
< 94	2882	102
≥ 95	300	31
Total	3182	133
Systolic Blood Pressure		
< 119	773	20
120-159	2279	92
≥ 160	130	21
Total	3182	133
Parental History of Cardiovascular Disease		
None	2031	68
CHD	518	39
Other cardiovascular disease	633	26
Total	3182	133
Smoking History (cigarettes)		
None	1298	30
1-15	320	11
16-25	601	34
≥ 26	587	39
Unknown	376	19
Total	3182	133

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Exercise Patterns	POPULATION	NEW CASES
None	449	24
Occasional	1873	79
Regular	860	30
Total	3182	133
*Obesity (Ponderal Index)		
7.00 - 11.69	80	5
11.70 - 12.49	1136	57
12.50 - 13.29	1731	66
13.30 +	234	~~25~~ 5
Unknown	1	0
Total	3182	133
Income Level		
Under $10,000	1409	49
$10,000 - $15,000	1224	57
$15,000 +	549	27
Total	3182	133
Level of Education		
High school or less	1479	74
College or more	1703	59
Total	3182	133
Personality Type		
Type A	1602	94
Type B	1580	39
Total	3182	133

*Ponderal Index is a formula derived from height and weight ($\sqrt[3]{\frac{Ht}{Wt}}$): the lower the number the more obese the individual.

3. From Tables 2 and 3, compute the appropriate rates (per 10,000) to answer the following questions.

   a. Does personality type have the same relationship to CHD at each age level?

   b. Can the relationship of personality type to CHD be explained by an association between personality type and either of two important risk factors for CHD - cholesterol or diastolic blood pressure?

TABLE II

Number of New Cases of CHD Developing During 4½ Year Follow-up in 3182 Men by Personality Type, Age and Serum Cholesterol

	Age 39 - 49				Age 50 - 59			
	Type A		Type B		Type A		Type B	
Cholesterol	Popn	CHD	Popn	CHD	Popn	CHD	Popn	CHD
Less than 219	487	9	606	5	211	9	157	6
220 - 259	354	17	379	6	183	24	142	6
260 +	228	19	195	7	134	16	92	9
Unknown	3	0	6	0	2	0	3	0
	1072	45	1186	18	530	49	394	21

TABLE III

Number of New Cases of CHD Developing During 4½ Year Follow-up in 3182 Men by Personality Type, Age and Diastolic Blood Pressure

	Age 39 - 49				Age 50 - 59			
	Type A		Type B		Type A		Type B	
Diastolic B.P.	Popn.	CHD	Popn	CHD	Popn	CHD	Popn	CHD
< 94	974	35	1104	16	455	35	349	16
95 +	98	10	82	2	75	14	45	5
	1072	45						

4. From Table 4, compute the age specific rates for CHD at various income levels.

TABLE IV

Number of New Cases of CHD Developing During 4½ Year Follow-up in 3182 Men by Age Group and Income Level

Income Level	Age 39 - 49 Population	39 - 49 Cases	50 - 59 Population	50 - 59 Cases
Under $10,000	1030	28	379	21
$10,000 - $15,000	909	27	315	30
$15,000 +	319	8	230	19

It will be noted that the gradient observed when the relationship of income to CHD for the total population was examined (Question 1(i) is no longer present for each age group comprising this total population. How can you explain this discrepancy? What conclusion can you now draw regarding the relationship of income to CHD?

5. In question 1 (j), the relationship of educational level to CHD was examined. Table 5 shows this relationship separately for each age group and personality type. How do these new analyses modify the conclusions you had previously drawn?

TABLE V

Number of New Cases of CHD Developing During 4½ Year Follow-up in 3182 Men by Age Group, Personality Type and Level of Education

Educational Level	39 - 49 Years Type A Popn	Type A CHD	Type B Popn	Type B CHD	50 - 59 Years Type A Popn	Type A CHD	Type B Popn	Type B CHD
High school or less	462	29	533	8	267	27	217	1(
College or more	610	16	653	10	263	22	177	1[illegible]

DEPARTMENT OF EPIDEMIOLOGY
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EPID 160 Principles of Epidemiology Fall Semester

Epidemiology of Coronary Heart Disease

Faculty Guide

Questions 1 and 2

(a)

Age	Rate
39-49	279
50-59	458
Total	425

Comment: Every major study has found a steep rise in incidence with age.

(b)

Cholesterol	Rate	Ratios	Other studies (using same cut off points)
219	199		5.2-7.0
220-259	501	1.6	1.7
260+	486		
Unknown	-		
Total	425		

Comment: The rise in CHD rates with increasing cholesterol levels is about the same order of magnitude as that found in other incidence studies. (The studies in which no, or a very slight relationship has been found are prevelance studies (possibilities of selective survival)).

(c) Diastolic Blood Pressure

	Rate
94	354
95	1033

Comment: Approximately the same relationship as found other incidence studies

(d) Systolic Blood Pressure

	Rate
119	259
120-159	404
160	1615

Comment: Approximately the same relationship as found in other incidence studies.

(e) Parental History of Cardiovascular Disease

	Rate
None	335
CHD	453
Other Cardiovascular Disease	411

Comment: In the comparatively few studies in which this has been examined, some degree of familial aggregation has usually been observed. Stress that this is not necessarily evidence of genetic transmission.

(f) Cigarette Smoking

	Rate
0	231
1 - 15	344
16-25	566
26+	664
(Unknown	505)

557

Comment: Relative risk (smokers to non smokers) 231:557=2.4. Other incidence studies relative risk 2.3-5.4. The presence of a relatively large number of cases and population where smoking status is unknown is troublesome. But even if all these cases (and the population) were non-smokers it would only elevate the non smoking rate to 292 - i.e. the gradient would remain.

(g)

Exercise	Rate
None	535
Occasional	422
Regular	349

Comment: In line with majority of studies although there have been a few which did not show this relationship. Problem of selection i.e., Do "sick" individuals select sedentary jobs, which have plagued prevalence studies less likely to be an explanation in this incidence study.

(h)

Obesity (Ponderal Index)	Rate
7.00 - 11.64	625
11.70 - 12.49	501
12.50 - 13.29	381
13.30+	213
Unknown	0

lower the Ponderal Index the more obese

Comment: This relationship has not been found in most of the recent epidemiological studies. Certainly most studies have not discovered a regular gradient. The possibility that low ponderal index is associated with some other risk factor has to be considered. (Possibly age, cholesterol or B.P.)

(i)

Income Level	Rate
under $10,000	348
$10,000 - $15,000	466
$15,000 +	492

Comment: This is contrary to the results of most other U. S. studies in which either no relationship to income level or slightly higher rates in the lower income groups is found. Again the possibility of some other correlated variable has to be considered. (In this instance as will be seen later in this exercise the "contaminating" variable is age)

(j)

Level of Education	Rate
High school or less	500
College or more	346

Comment: This is in line with Hinkle's work (also in industry) in which he interpreted a low educational level as an indicator of lack of preparedness for the demands of the industrial millieu.

(k)

Personality Type	Rate
Type A	587
Type B	247

Comment: This is an area of major controversy at the moment: According to Freedman and Roseman, those studies which have failed to confirm their results have used inappropriate methods to assess personality types A and B. The most convincing evidence of this relationship in the hands of investigators other than Freedman and Roseman comes from the study of Keith, Lown and Stare (Psychosomatic Medicine 27, 1965, 424) who in the text deny finding this relationship but whose tables clearly show that (in younger ages especially) they have found such a relationship.

Question 3

(a) CHD rates by age and personality type

Personality Type	39-49	50-59
A	420	925
B	152	533

Comment: Relative risk of personality type A at younger ages 420:152=2.8
At older ages: 925:533=1.8

(b) CHD rates by Age, Personality type and serum cholesterol

	Age 39-49		Age 50-59		All Ages	
Cholesterol	Type A	Type B	Type A	Type B	Type A	Type B
<220	185	83	427	382	257	144
220-259	480	158	1311	423	763	230
260+	833	359	1194	978	966	557
Unknown	0	0	0	0		

Comment: The risk of CHD is greater for Type A at all levels of cholesterol. (This is true in both age groups)

CHD rates by age, personality type and Diastolic B.P.

	Age 39-49		Age 50-59		All Ages	
Diastolic BP	Type A	Type B	Type A	Type B	Type A	Type B
<94	359	145	769	458	489	220
95+	1020	244	1867	1111	1387	551

Comment: The risk of CHD is greater for Type A at all levels of diastolic B.P. (This is true in both age groups)

Question 4

CHD rates by age and Income level

	Age		
Income Level	39-49	50-59	All Ages
$10,000	272	554	348
$10,000 - $15,000	297	952	466
$15,000 +	251	826	492

The gradient observed for "all ages" (particularly the rise from the 2nd to the 3rd income level) must be a function of the large proportion of older men (with the higher rate due to their age) in the upper income level. Putting this in other words the vast bulk of younger men (i.e. low risk because of age) are in the lower income groups. The rates for these groups are thus depressed largely because they are young not because they are low income. The most reasonable conclusion would be that there is no relationship between income and CHD.

in older ages not in the younger -

Question 5

(It should be noted that the students have not been explicitly instructed to compute rates here. Obviously no conclusions can be drawn until they have suggested that a check be made of the number who have attempted an answer without computing rates)

CHD rates by age, personality type and educational level

	39-49 Years ——>		50-59 Years		All Ages	
	Type A	Type B	Type A	Type B	Type A	Type B
High School or less	628	150	1011	461	768	240
College or more	262	153	837	621	438	253

It will be noted that a low education level only increases the risk of CHD for Type A personality. There is no association between education and CHD in the Type B individuals. To the degree that low education in these industrial groups indicates a relative lack of preparedness for the demands and expectations of their job, this then appears only to be an important source of strain in those individuals who have the drive and ambition characteristic of Type A.

INTERVIEW RATINGS IN THREE DIAGNOSTIC GROUPS

Group	Interview ratings: Pattern A 1	Pattern A 2	Pattern B 3	Pattern B 4	Total
Coronary	5	31	28	12	76
Ulcer	5	10	28	8	51
Control	3	17	29	13	62
Total	13	58	85	33	189

$y^2 = 8.72$; $p = .10$.

INTERVIEW RATINGS IN
CORONARY AND NONCORONARY GROUPS

Group	Interview ratings: Pattern A	Pattern B	Total
Age 35-44 Years*			
Coronary	15	8	23
Noncoronary	14	34	48
Total	29	42	71
Age 45-49 Years‡			
Coronary	9	15	24
Noncoronary	11	23	34
Total	20	38	58

*$x^2 = 6.93$; $p = .01$.
‡$x^2 = .016$; $p = .90$.

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To the Editor:

In their recent article "Coronary Heart Disease and Behavior Patterns" (Psychosom Med 27:424, 1965) Drs. R. A. Keith, B. Lown, and F. J. Stare imply that there is no general association between coronary heart disease and the Type A Behavior Pattern described by Drs. Friedman and Rosenman of the Mount Zion Medical Center, San Francisco. Drs. Keith, Lown, and Stare attribute the discrepancy between their findings and the previous studies of the San Francisco group as due to deficiencies in the latter's research design.

It is interesting to note that despite their pointed criticism of the San Francisco group, these authors proceed to draw erroneous conclusions from their own data, and that their study, in fact, tends to substantiate the relationship originally reported by Friedman and Rosenman. Keith, Lown, and Stare seem to rest their judgment as to the validity of the association of behavior pattern with clinical coronary heart disease on the distribution of behavior types in the coronary group only, saying with reference to Table 5:

"The presence of this pattern was thus found in less than half of the sample of coronary patients. According to the hypothesis under study, there should have been a bunching at the "1" end of the scale, but the distribution of ratings is quite symmetrical. Indeed, more coronary patients were assigned the extreme B pattern than were given the extreme A side.

"For the ulcer and control patients, 29 and 32% respectively were judged to have Behavior Pattern A." (p. 428)

The appropriate question is not "What is the distribution of ratings among coronary patients?" Rather, one should ask: "How does the distribution of ratings for the coronaries compare with the distribution of ratings for controls?" The authors indirectly get around to calculating some of the appropriate percentages, and their use of chi square is correct, but it is disappointing that they fail to report directly the logically appropriate comparisons.

One of their later comments reinforces the impression that the authors have failed to grasp the basic epidemiological and statistical premises of the issue at hand. They state: "The utility of this finding (that Behavior Pattern A distinguished coronaries from controls) is doubtful, however, since it is the noncoronary group which is related to Pattern B; the coronary group is nearly equally divided between Patterns A and B." (p.428). The essential issue again is the proportion of coronary cases having the associated characteristic relative to the proportion of noncoronaries having that characteristic. In most epidemiologic studies the majority of coronary patients have not had prior hypertension, and most hypertensives do not develop clinically manifest coronary disease within the usual scope of longitudinal studies. Yet few investigators would claim on these grounds that hypertension is not associated with coronary disease. The same

epidemiologic principles apply to Behavior Type in the Keith, Lown, Stare data.

The authors' presentation continues (p. 428): "In the age group 45-49 years, however, a reverse association is evident (Table 7) . . ." Correct precentaging of Table 7, however, shows the coronary group to have aslightly greater (though statistically non-significant) proportion of Type A men than does the noncoronary group. Misleading subsequent commentary to the contrary, the assertion of "reverse association" is categorically wrong. This error is reiterated in the discussion section (p. 431). In addition, it will be noted that the total of patients on the age-specific tables does not summate to the total patient group described in Tables 1, 2, and 5. This is apparently due to the omission of the 29 men ages 50-55. By subtraction it is found that in this age group, as well as in the two age groups reported directly, the coronary group contains a higher percentage of men with Behavior Type A than does the combined control group. The association is noticeably weaker among men over age 45, as the authors correctly note.

In summary, from a study which, according to the authors, employed a far more rigorous methodology and study design than heretofore used to examine this question, Drs. Keith, Lown, and Stare report tabulated data which support the relationship between coronary heart disease and the behavior pattern previously described by Drs. Friedman and Rosenman. In all age groups in this study, the coronary cases were more often of Behavior Type A than were the noncoronaries. The present study and earlier ones by the San Francisco group are of the "case study" or retrospective type. As such they make an essential but necessarily limited contribution. More complete understanding of the degree to which Behavior Type A may possibly contribute to elevated risk of coronary heart disease awaits the results of prospective, longitudinal epidemiologic studies.

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