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Vigorous exercise in leisure time and the death rate: a study of male civil servants

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SUMMARY In 1968–70, 17 944 middle-aged male executive grade civil servants in Great Britain provided a record of their leisure-time activities for two sample days and they have been followed until the end of 1977. In a 20% sample (3591 men), 268 have died. Men who had reported 'vigorous exercise' (VE) during the two days suffered fewer deaths from coronary heart disease throughout the years 1968–77; there was no significant difference in mortality from other causes. VE men recorded more physical activity in general, and they saw themselves as physically more active than the rest. Total physical activity scores, however, were weakly related to coronary mortality. Men reporting vigorous exercise smoked somewhat less than other men, but the two factors were independently associated with mortality from coronary heart disease.

In 1968–70, 17 944 male executive grade civil servants aged 40–65 in six government departments provided a five-minute by five-minute record of how they had spent two unannounced sample days. The records were completed at work on Monday morning and referred to the preceding Friday (normally a working day) and Saturday (nearly always a rest day). No account was required of the hours spent at work. The executive grade of the civil service is intermediate between the administrative and clerical grades and is engaged almost entirely in office, and so sedentary (or physically very light) work. Large numbers of the men worked in London, but some of the departments participating also have substantial offices spread across England, Wales, and Scotland. The whole inquiry was conducted in close collaboration with the central personnel departments, the six departments themselves, staff associations, and the trades unions. The 17 944 men represented an 86% response of those eligible.

Previous papers (Morris *et al.*, 1973; Morris, 1978) have reported that no association could be found between various estimates of the *total physical activity* of the men in *leisure-time* and their incidence of coronary heart disease but that there was a clear association with *vigorous exercise* (VE). During the two sample days in 1968–70, VE was reported less commonly by men who developed a first clinical episode of coronary heart disease during 1968–73 than by matched controls; and VE men showed fewer major and minor ischaemic changes on the resting electrocardiogram, as well as fewer ectopic beats (Epstein *et al.*, 1976).

'Vigorous exercise' represents the most strenuous activity reported by these men. After extensive analysis of the data had failed to confirm the initial hypothesis that total physical activity of sedentary workers in leisure-time is related to coronary incidence, it was noticed that among the numerous gardening activities, 'digging' occurred only half as often among future 'cases' of coronary heart disease (CHD) as in other comparable men. Digging 'is always heavy work' (Durnin and Passmore, 1967). So we went on to identify other kinds of heavy work and other activities making similar physical demands. As the criterion of VE, we eventually adopted the standard definition of 'heavy work' in industrial physiology: work liable to require peaks of energy expenditure of 7·5 kcals per minute or more (Astrand and Rodahl, 1970). The following are examples of VE reported by our men:

FORM OF VE	*EXAMPLES*
Sport, recreations*	Swimming, tennis, hill-climbing
'Keep-fit'* Vigorous moving about*	Morning exercises, 5BX Walking at over four mph, jogging, cycling fast or uphill
Climbing upstairs	450+ daily
Heavy work†	
Gardening 'Do it yourself' Heaviest work about house and garage	Digging, tree-felling Sawing, concreting Moving heavy furniture, replacing engine of car, stacking logs.

*For at least five minutes.
†For more than half an hour.

Data and methods

Each man provided a seven-page handwritten account of the two days. Coding of the physical activities is done independently, and 'blind' of any medical information, by two clerical officers, and the few disagreements are referred to a member of the scientific staff. The process is a very time-consuming one, and hence we are reporting here on a 20% sample of the total population.

A 10% and then a 3% random sample was drawn from each department; this was supplemented by two groups of 3–4%, one comprising all the men in our study in 12 towns of England and Wales (Stitt *et al.*, 1973), and the other the 'controls' of cases of CHD first presenting in 1968–73. Together these provided the 20% sample, 3591, of the 17 944 men in the study. On admission to the study, the records of all men were 'tagged' at the National Health Service Central Register, as well as with the Civil Service Medical Advisory Service, and, when any man dies, a copy of his death certificate is received. In addition, information on all serious illness is routinely notified to us in confidence. It is thus possible to link the information on the initial personal records provided by the men themselves to subsequent service data on sickness absence, retirement, etc., and to mortality. The 268 deaths that have occurred in the 3591 men are now analysed. The findings are very similar for the 13% random sample and for the further 7%.

Results

Table 1 classifies all the deaths in three main categories. The cause of death accepted is invariably that given on the certificate. Deaths from CHD in the 777 men reporting vigorous exercise (1·0%) were notably less common than in the other 2814 men (4·3%). Differences for cancer are not significant.

Table 1 *Vigorous exercise (VE) and mortality in 3591* male executive grade civil servants*

*Activity record 1968–70** (n)*	*Dying 1968–77: per cent*			
	Coronary heart disease	*Cancer*	*Other causes*	*All causes*
Reported VE (777)	1·0%† (8)	1·3%‡ (10)	1·9% (15)	4·2%† (33)
No report VE (2814)	4·3%† (121)	2·3%‡ (64)	1·8% (50)	8·4%† (235)

*20 per cent sample of 17 944 men, aged 40–65 at date of activity record.
**Sample Friday and Saturday.
†$P<0.001$.
‡NS.
Including a few early notifications in 1978.

Table 2 analyses the coronary mortality into deaths (a) in first and subsequent clinical episodes; (b) early and later deaths; and (c) by age. The findings are quite homogeneous.

TOTAL PHYSICAL ACTIVITY IN LEISURE-TIME

All activities were scored in units of five minutes (anything less being disregarded), and on a rising scale:

Grade	*Activities*	*Points per five minutes*
I	Sedentary	1
II	Very light	2
III	Light	3
IV	Moderate	4
VE	Keep-fit	5
	Heavy work	6
	Sports	7

Thus 10 minutes of I, for example, sitting and reading, rates 2 points; of II, pottering, standing in a queue, or kitchen chores, 4 points; of III, shopping, hoeing and weeding, 6 points; and of IV, for example, painting, carpentry, lawn mowing, 8 points. The sum of all points represents the 'total activity score' of the man for the two days.

Table 3, as expected, shows that the mean activity score in a 10% sample (1770) of the total population was greater among those reporting VE (737/628 and 733/600). More interestingly, excluding the vigorous exercise itself, the VE men were as active as the rest (612/628 and 604/600). In both age groups there was a tendency for the VE men to record *less* sedentary and very light 'activities' (grades I and II), and *more* light and moderate work (grades III and IV); the biggest difference relates to sitting, grade I, for which the VE men aged 55–65 recorded 22 points less (223/245), and, as each point represents 5 minutes, 110 minutes less, in the two days.

Table 2 *Vigorous exercise (VE) and mortality from coronary heart disease in 3591 male executive grade civil servants*

Activity record 1968–70 (n)	*Dying from coronary heart disease: per cent* (a) *Clinical attack** first	later	(b) *Interval from activity record*** first 3 years	next 3 years	later	40–54 (n)	Dying	(c) *Age**** 55–65 (n)	Dying	*Total 40–65 Dying*
Reported VE (777)	0·8% (6)	0·3% (2)	0·4% (3)	0·4% (3)	0·3% (2)	(597)	1·0%† (6)	(180)	1·1%‡ (2)	1·0% (8)
No report VE (2814)	2·8% (79)	1·5% (42)	1·0% (28)	1·6% (45)	1·7% (48)	(2072)	3·3%† (69)	(742)	7·0%‡ (52)	4·3% (121)

*Assessed from man's personal history as reported, together with health record in civil service.
**No. of years from completion of activity record to clinical attack.
***At date of activity record.
†$P<0.01$
‡$P<0.01$

Table 3 *Activity scores of male executive grade civil servants for sample Friday and Saturday: means in ten per cent sample of men*

Activity grade*	*Mean activity scores* Age 40–54 *Reported VE* (n=277)	*No report VE* (n=1027)	Age 55–65 *Reported VE* (n=87)	*No report VE* (n=379)
I	220 (44)	234 (42)	223 (45)	245 (41)
II	154 (64)	169 (66)	144 (76)	149 (64)
III	159 (89)	153 (85)	161 (86)	153 (82)
IV	79 (109)	73 (108)	77 (100)	53 (103)
VE	124 (138)	—	129 (184)	—
Total activity score	737 (146)	628 (101)	733 (150)	600 (96)
TAS excluding VE	612 (120)	628 (101)	604 (113)	600 (96)

*See text.
(SDs in brackets)

The findings are similar when analysed for the two age groups combined (40–65) both for the Friday and Saturday separately, and together: the mean total activity score for the two days was 736 in the VE men and 621 in the others; and, excluding VE itself, 610 and 621.

THE MEN'S SELF-PERCEPTIONS

Not surprisingly, VE men saw themselves as more active than the rest. The following question was asked in the initial survey:

'On most Saturdays or Sundays the average man in your age group spends one hour at each of the following activities: walking, gardening, household chores, and 'do-it-yourself' projects. Compared to such a man how physically active do you consider yourself? (1) Very active, (2) Fairly active, (3) Average, (4) Fairly inactive, and (5) Very inactive. (Tick one category only, please)'.

Table 4 shows that 34% of the men in each age group reporting vigorous exercise perceived themselves as 'very active', by comparison with 24% and 26% respectively of the remainder; on the other hand, only 3% said that they were fairly or very inactive against 7% of those not reporting VE.

More interestingly, in both groups of men their self-assessment paralleled their actual activity scores (765/736 and 647/627, etc.) (Table 5); and at each level, the VE men recorded higher total activity scores (765/647, etc.), delightfully complementing Borg's observation (1974) that people can judge the levels of exertion that they reach.

SMOKING

Standard information on smoking was obtained in the initial survey, and Table 6 shows expected results for mortality.

VE AND CIGARETTE-SMOKING

Table 7 is an analysis of the two factors. Trends are in the expected direction, although small: men reporting vigorous exercise included more who had never smoked (18·8/15·9% and 18·9/12·4%), and fewer cigarette smokers (for example, 38·2% at 40–54 years of age compared with 41·7%); VE men who did smoke cigarettes smoked fewer.

Table 8, however, shows two independent 'effects'. Men reporting VE suffered less coronary mortality whether they smoked cigarettes or not; and cigarette smokers suffered greater mortality irrespective of whether or not they had reported VE.

Discussion

A first instalment only of the mortality study has now been reported but several points can be made. There is no evidence that the higher death rate from CHD of the men who did not report 'vigorous exercise' is due to disability or to impaired effort-tolerance already present. Table 2(b) shows just as much 'effect' in the last three years of observation as in the first three years. In 1976 the men completed a second questionnaire, and when the results are analysed we shall know to what extent VE reported in the first inquiry has continued subsequently. It would appear that the 'effect' will be mostly on coronary mortality, or even restricted to this—

Table 4 *Self-assessment of their habitual level of physical activity by male executive grade civil servants; report of VE*

	Self-assessment, per cent					
Vigorous exercise	*Very active*	*Fairly active*	*Average*	*Fairly inactive*	*Very inactive*	*Total*
Age 40–54						
Reported VE	34% (94)	47% (131)	16% (44)	3% (7)	0% (–)	100% (276)
No report VE	24% (246)	43% (436)	26% (266)	6% (65)	1% (7)	100% (1020)
Age 55–65						
Reported VE	34% (30)	43% (37)	20% (17)	3% (3)	0% (–)	100% (87)
No report VE	26% (96)	40% (149)	28% (106)	5% (19)	2% (6)	100% (376)

(Nos. in brackets)
Inadequate records for 11 men.

Table 5 *Self-assessment of habitual physical activity by male executive grade civil servants and their total activity scores (TAS) in two sample days: ages 40–65*

	Self-assessment					
Vigorous exercise	*Very active*	*Fairly active*	*Average*	*Fairly inactive*	*Very inactive*	*Total*
Reported VE, *n*	124	168	61	10	—	363
Mean TAS (SD)	765 (148)	736 (152)	690 (123)	670 (92)	—	737 (147)
No report VE, *n*	342	585	372	84	13	1396
Mean TAS (SD)	647 (107)	627 (92)	603 (100)	559 (84)	514 (72)	620 (100)

Table 6 *Cigarette smoking and mortality in 3591 male executive grade civil servants*

	Dying 1968–77: per cent			
Smoking record 1968–70 (n)	*Coronary heart disease*	*Cancer**	*Other** causes*	*All causes*
Non-smoker (2133)	2·8% (59)	1·8% (38)	1·4% (30)	6·0% (127)
Cigarette smoker (1454)	4·8% (70)	2·5% (36)	2·4% (35)	9·7% (141)

Men aged 40–65 at date of smoking record; record incomplete for four men.
*Mortality from lung cancer was 0·4% in non-smokers and 0·6% in cigarette smokers; 18 deaths in all.
**Including 'other vascular' disease, 0·7% in non-smokers and 1·2% in cigarette smokers; NS.

indicating perhaps a local protective action. The incidence rates—of first clinical attack—are of course crucial in testing an aetiological hypothesis; the figures here are clear: first column of Table 2(a). The next column suggests that vigorous exercise is protective against coronary recurrence as well, or, rather, against death in 'later' than first attack. This observation raises another set of questions which are now being examined. There is a suggestion also in the present data that 'total activity' scores are weakly related to coronary deaths both in first and in later attacks, though again not to deaths from other causes. Excluding the men who reported vigorous exercise, and relating the coronary deaths of Table 2 to the numbers in the 10% sample, the age-standardised rate of men in the low third of the distribution for TAS was 5%; for men in the middle third 4·2%; and in the high third 3·1%. In later middle age high levels of habitual activity, falling short of the peaks of VE, could be sufficient to produce and maintain some training effect such as occurs with it (Gyntelberg, 1974). This aspect also is being reviewed, as is the further possibility that low levels of physical activity may themselves be harmful. Paffenbarger and Hale (1975), too, have found that a threshold of considerable activity was necessary for protection against coronary mortality.

What kind of men report VE? Looking ahead to health education, this is a crucial question, and several points have emerged. There is some evidence of 'health consciousness'—VE men smoked less, but not much, indeed surprisingly little, less than the rest of the men. There was only a small difference between the amounts of VE reported by the men in the older age group and those in the younger. More interestingly, there is clear evidence that VE men were more active in general than the others, and the figures on sitting are complementary. In practice the question remains: how can habitually sedentary adults be persuaded to mend their ways—as young people, many of them will have been physically more active—and will they then benefit in terms of coronary incidence as well as in the many physiological, psychological, and social modalities that can be assured? Plainly, there will be

Table 7 *Vigorous exercise (VE) and smoking behaviour in 3591 male executive grade civil servants: numbers and percentages*

*VE**	*Smoking**						
	Never smoked	*Ex-smoker*	*Pipe/cigar only*	*Cigarettes per day* 1–10	11–20	21+	*Total*
Age 40–54*							
Reported VE	18·8% (112)	27·6% (165)	15·4% (92)	12·9% (77)	18·8% (112)	6·5% (39)	100% (597)
No report VE**	15·9% (329)	28·0% (580)	14·3% (296)	11·9% (247)	21·2% (439)	8·6% (179)	100% (2070)
Age 55–65							
Reported VE	18·9% (34)	29·4% (53)	17·2% (31)	12·8% (23)	16·1% (29)	5·6% (10)	100% (180)
No report VE**	12·4% (92)	30·5% (226)	16·6% (123)	9·7% (72)	22·0% (163)	8·6% (64)	100% (740)

*At initial survey 1968–70.
**χ^3, 40–65 = 14·46; $P < 0·025$; NS in separate age groups.
Information inadequate for four men.

Table 8 *Vigorous exercise, cigarette smoking, and mortality from coronary heart disease in 3591 male executive grade civil servants*

	Dying 1968–77: per cent					
	*Age** 40–54		*Age 55–65*		*Total*	
*Activity record** (*n*)	*Non-smoker** (1574)	*Cigarette smoker** (1093)	*Non-smoker* (559)	*Cigarette smoker* (361)	*Non-smoker* (2133)	*Cigarette smoker* (1454)
Reported VE (777)	0·8% (3)	1·3% (3)	0·8% (1)	1·6% (1)	0·8% (4)	1·4% (4)
No report VE (2814)	2·3% (28)	4·7% (41)	6·1% (27)	8·4% (25)	3·3% (55)	5·7% (66)

*At initial survey, 1968–70.

plenty of experiments of opportunity to study in the years ahead even if planned experiments are too difficult to mount (Morris, 1975).

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