PAPERS AND ORIGINALS

Study of Coronary Risk Factors Related to Physical Activity in 15 171 Men

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Summary

Physical activity, both at work and during leisure, was assessed in 15 171 men aged 25-74 years. Heavy leisure activity was associated with lower mean serum cholesterol levels and blood pressure. In men under 60 years the same negative association was also noted between leisure activity and relative weight and cigarette smoking. Different degrees of physical activity at work were not associated with any differences in these risk factors, nor did the level of exercise at work seem to influence the negative association between leisure activity and risk factors.

Heavy leisure activity in young and middle-aged men is associated with lower levels of certain coronary risk factors and, therefore, a lower risk of coronary heart disease. The often-reported reduction in coronary morbidity and mortality with physical exercise may not be the direct effect of the exercise itself.

Introduction

Opinions are divided about the effects of physical activity on coronary heart disease (C.H.D.) in young and middle-aged men. Some epidemiological studies of occupational groups suggest that physical exercise may protect against C.H.D.,¹⁻³ while

others have failed to confirm this finding.⁴⁻⁶ High rates of coronary heart disease exist among people whose work involves heavy exercise,⁷ though Morris *et al.*⁸ have recently shown that vigorous leisure activity is accompanied by a reduced incidence of C.H.D.

The mechanism by which physical activity might influence coronary risk is not known. Several studies have shown that exercise has little or no effect in lowering blood cholesterol and sugar levels or blood pressure,^{6, 9, 10} and Mann *et al.*¹¹ found no improvement in serum lipid levels or glucose tolerance in men who adhered to a six-month programme of supervised strenuous physical activity, though their blood pressures fell. No relation between physical activity and cigarette smoking was noted by Paffenberger *et al.*¹² or Taylor *et al.*⁶

In discussing the relation between exercise and C.H.D., Taylor *et al.*¹³ suggested that leisure activity needs to be examined as well as occupational physical activity. We report here the relation between physical activity at work and during leisure time and serum cholesterol levels, blood pressure, relative body weight (% overweight), and cigarette smoking habits in 15 171 men who presented for risk-factor screening.

Subjects and Methods

During 1969-72 15 171 men, aged 25-74 years, from industry and the general population, were screened for coronary risk factors as part of the Irish Heart Foundation MEDISCAN programme.^{14, 15} At screening they were questioned on their work and leisure activity over the previous six months, and each man was categorized according to this activity. For both work and leisure three grades of activity were recorded: minimal, moderate, and heavy.

Minimal physical activity during work was recorded when the job predominantly involved sitting or standing, irrespective of the amount of arm activity. The seated executive, the standing bank cashier, and the standing bench worker or factory worker were similarly coded. Leisure activity was recorded as minimal when the man did no more than stroll leisurely twice or three times a week or play an occasional game of golf or other non-vigorous sport.

Heavy physical activity during work included farming, building, road work, and jobs involving constant leg activity. Heavy leisure activity included regular (more than three times weekly) leg exercise such as running, squash, tennis, handball, football, swimming, sailing, and heavy gardening.

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Moderate activity included all activity that could not be classified as mild or heavy. At work it included regular walking such as that undertaken by shop stewards, shop assistants, and door-to-door salesmen. Moderate leisure activity included any sport or off-work activity that fell short of being classified as heavy and yet was performed regularly three days or more a week.

Work activity was not equated with occupation. While differences between mild and heavy activity seemed clearcut, there was no clear cut-off point between moderate activity and the two extremes. When doubt existed about a man's activity he was classified as moderate, thereby accentuating the two extremes of activity.

The methods used to measure coronary risk factors have been described elsewhere.¹⁴

Statistical Methods.—We examined the simultaneous effect of independent measurements on a single dependent variable. The effects parameter technique consisted of fitting constants to the marginal frequencies of a contingency table and, by logarithm transformation of the proportions in each cell, the transformed values were subjected to analysis of variance. Tests of significance were applied to determine whether the variance was attributable to the independent measurements, either alone or in combination. The relative effect of each independent measurement was provided by the constant calculated for each measurement.

Results

The number of men in each category is shown in table I. For all categories the mean serum cholesterol levels, blood pressure, relative weight, and number of cigarettes smoked a day were calculated. For

TABLE I—Number of Men in Each Category of Physical Activity

	Work	Leisure
Minimal	7347	7557
Moderate	7113	7266
Heavy	711	348
Total	15 171	15 171

each category of work activity there was a consistent decrease in all five mean risk-factor levels with increasing leisure activity (table II). The lowest levels of the five risk factors were in the category of heavy leisure activity and minimal work activity. A one-way analysis of variance showed that the difference between the risk-factor levels in different categories of leisure activity was significant at the 1% level. Analysis by effects parameter technique¹⁶ showed no apparent additive effect of work activity. All five risk factors thus seemed to be related to leisure activity rather than work activity.

The possibility that age might be important in determining the mean levels of any of the five risk factors, independently of leisure activity, was examined. In table III mean risk-factor levels were

TABLE II—Categories of Physical Activity and Mean Risk-factor Values

Leisure Activity	Serum Cholesterol (mmol/l)	Blood Pressure (mm Hg)		Relative Weight (% Overweight)	Cigarettes per Day
		Systolic	Diastolic		
Minimal Work Activity					
Minimal ..	6.02	138.6	85.1	7.2	9.4
Moderate ..	5.87	137.3	83.2	7.0	7.2
Heavy ..	5.35	124.8	80.1	4.2	5.7
Total	5.95	135.9	84.2	6.3	8.4
Moderate Work Activity					
Minimal ..	5.93	138.4	85.0	7.0	9.8
Moderate ..	5.84	135.6	83.2	6.4	8.1
Heavy ..	5.59	127.2	80.4	5.1	7.5
Total	5.88	136.8	84.0	6.3	8.9
Heavy Work Activity					
Minimal ..	5.75	134.7	84.6	6.1	9.9
Moderate ..	5.73	134.5	84.4	5.5	9.0
Heavy ..	5.64	129.0	84.3	5.5	6.7
Total	5.72	134.5	84.4	6.5	8.7

Conversion: SI to Traditional Units—Cholesterol: 1 mmol/l $\approx$ 38.6 mg/100 ml.

related to leisure activity in three age groups—under 41, 41-59, and 60 years and over. Within each age group one-way analysis of variance showed significant differences at the 1% level for serum cholesterol and systolic and diastolic blood pressure. Significant negative associations between leisure activity and relative weight and cigarette smoking were found only in men under 60. These findings indicated that the associations between increasing leisure activity and decreasing risk-factor levels was independent of age, at least in men under 60 years.

Discussion

The mean levels of five coronary risk factors tended to decrease with increasing leisure activity, but a similar trend was not apparent for work activity. The effect was independent of age except in men of 60 years or older, in whom cigarette smoking and relative weight were unrelated to leisure activity.

It is tempting to suggest that, in the case of heavy leisure activity, exercise reduces the risk of C.H.D., but the fact that work activity shows no such relation to risk-factor levels suggests that physical activity itself is not responsible for the lower risk-factor levels. Possibly those men who are physically active during their leisure time may smoke less and eat more prudently for personality, psychological, or cultural reasons. And possibly, because of their better health, they are enabled to take more exercise. Intuitively we may postulate that the psychological factors that motivate men to perform heavy leisure

TABLE III—Categories of Leisure Activities, Age, and Mean Risk Factor Levels ($\pm$ S.D.)

Age (Years)	No. of Men	Serum Cholesterol (mmol/l)	Blood Pressure (mm Hg)		Relative Weight (% Overweight)	Cigarettes per Day
			Systolic	Diastolic		
Minimal Leisure Activity						
<41	3395	5.82 ± 1.05	131.9 ± 15.58	81.4 ± 11.92	5.8 ± 8.0	9.0 ± 12.08
41-59	3638	6.11 ± 1.02	141.1 ± 21.74	87.6 ± 13.64	7.9 ± 9.19	10.2 ± 13.14
≥ 60	524	6.01 ± 1.05	153.6 ± 24.64	91.0 ± 13.75	7.9 ± 9.22	8.6 ± 12.56
Total	7557	5.96 ± 1.04	137.8 ± 20.4	85.0 ± 13.36	6.9 ± 8.73	9.6 ± 12.65
Moderate Leisure Activity						
<41	3374	5.65 ± 1.06	129.9 ± 15.03	79.4 ± 12.54	4.7 ± 6.97	7.4 ± 10.92
41-59	3405	6.02 ± 1.01	138.2 ± 20.64	86.2 ± 13.0	6.6 ± 8.27	8.4 ± 11.75
≥ 60	487	5.96 ± 1.05	149.2 ± 24.01	90.0 ± 13.32	6.5 ± 8.18	5.9 ± 9.76
Total	7266	5.83 ± 1.05	135.1 ± 19.33	83.3 ± 13.35	5.7 ± 7.45	7.7 ± 11.26
Heavy Leisure Activity						
<41	176	5.25 ± 0.99	124.6 ± 15.0	78.5 ± 11.09	3.9 ± 6.67	7.0 ± 10.16
41-59	140	5.84 ± 0.85	128.4 ± 21.2	85.0 ± 14.12	7.9 ± 8.04	6.6 ± 10.15
≥ 60	32	5.93 ± 1.05	137.9 ± 23.45	89.0 ± 14.93	6.8 ± 7.99	3.6 ± 7.73
Total	348	5.54 ± 0.99	127.4 ± 18.9	82.1 ± 13.27	5.8 ± 7.56	6.6 ± 9.97
Grand Total	15 711	5.90 ± 1.05	136.3 ± 19.96	84.1 ± 13.37	6.3 ± 8.27	8.6 ± 11.98

activity may also cause them to adopt other means of maintaining good health.

We recognize that the assessment of physical activity in this study was subjective, but we made a special attempt to distinguish those men performing minimum and heavy activity. Our findings suggest that if habitual heavy leisure activity is associated with reduced morbidity from coronary heart disease, as reported by Morris *et al.*,⁸ the mechanism may be through an associated lower level of coronary risk factors. Further study is required to determine possible social, biological, or psychological differences that may exist among young and middle-aged men who enjoy different levels of physical activity during their leisure time.

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Thalassaemia, Iron, and Pregnancy

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Summary

Haematological values of 35 pregnant women with β -thalassaemia trait were followed during pregnancy. The discriminant function, calculated from haematological indices, was of no value in diagnosing β -thalassaemia trait during pregnancy. Initially patients were given iron supplements only if the serum iron and total iron binding capacity levels indicated iron deficiency, but bone marrow biopsies performed in the first 22 patients at 32 weeks indicated deficient iron stores. These patients were therefore given iron irrespective of their serum iron level. All subsequent patients with β -thalassaemia were also put on iron routinely at booking. Retrospectively the patients were divided into two groups. Patients in group 1 (18 patients) had received iron for less than 12 weeks, and their haemoglobin levels fell significantly during pregnancy ($P < 0.001$). Haemoglobin levels in 16 patients who had received iron for more than 12 weeks (group 2), however, did not fall significantly during pregnancy ($P < 0.6$). It is suggested (contrary to common practice) that patients with β -thalassaemia trait should be given iron supplements during pregnancy. Serum folate and vitamin B₁₂ levels did not change significantly in these patients and there was no increase in the incidence of maternal or fetal complications.

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Introduction

Patients suffering from β -thalassaemia trait have only mild, if any, anaemia. But at times of stress, especially pregnancy, they may develop moderate to severe anaemia. Generally doctors have been reluctant to prescribe iron supplements in pregnancy, though iron deficiency does occur in this condition.^{1,2} During a study of the haematological values of 35 pregnant women with β -thalassaemia trait we found that at 32 weeks of pregnancy, when bone marrow biopsies were performed in 22 women, 21 women were iron deficient; iron stores were absent and the sideroblast count was less than 10%. Because of this finding all subsequent patients suffering from β -thalassaemia trait were given iron supplements from the time of booking. Retrospectively we examined the effect of adequate iron supplementation on the haemoglobin level.³

Patients and Methods

Thirty-five patients were studied. All came from a "high-risk" group of Middle-eastern or Mediterranean origin. β -Thalassaemia trait was diagnosed by the investigations described below.

Methods.—Routine haematological methods used were those described by Dacie and Lewis.³ The haemoglobin A₂ level was quantified according to the method of Marengo-Rowe.⁴ Levels above 3.5 were considered diagnostic of β -thalassaemia trait. Haemoglobin F was quantified by alkaline denaturation.⁵ Haematological indices were measured at fortnightly intervals on a Coulter Model S counter. The discriminant function (= mean cell volume—red blood count—(haemoglobin $\times$ 5)—3.4) of England and Fraser⁶ used to distinguish β -thalassaemia trait from iron deficiency was calculated at antenatal booking, at the 30th week, and in the first week post partum. Serum iron and total iron binding capacity (T.I.B.C.) were measured each month. Goldberg and Schwartz⁷ have reported increased folate demands in women with β -thalassaemia trait during pregnancy, so serum folate and vitamin B₁₂ levels were also measured each month. Bone marrow biopsies were carried out at the 32nd week of pregnancy. The aspirations were studied for evidence of megaloblastic erythropoiesis, and cell morphology and reticulo-endothelial iron stores and erythron iron were assessed independently by two people.

Results

In 35 women with the β -thalassaemia trait mean values at first antenatal presentation were haemoglobin 10.9 g/dl, mean cell volume