Influence of several physical activities on serum cholesterol concentrations in young men

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SUMMARY An attempt has been made to determine the influence of several physical activities upon the serum cholesterol of 133 young adult males, who were randomly selected to participate in 10-week programs of cross-country running, golf, tennis, tumbling-gymnastics, wrestling, and weight training, and whose cholesterol values were compared with those of a control group. The findings as examined by analysis of variance suggest that different types of physical activity influence cholesterol concentrations in different degrees: subjects who participated in a vigorous and dynamic type of activity showed a significant decrease, whereas subjects who participated in a vigorous but static type of activity experienced no significant reduction during the experimental period.

KEY WORDS physical activity · dynamic · static · serum cholesterol · cross-country running · weight training · tumbling-gymnastics · wrestling · tennis · golf

During the past several years, a number of investigators have been concerned about the possible role of physical activity in retarding or preventing the development of coronary atherosclerosis, the increase in the blood cholesterol level with age, or both. The evidence for the beneficial effects of physical activity comes from epidemiological research (1–8), animal experimental research (9–12), and human experimental research (13–18). These studies have sought to establish a relationship between the serum cholesterol level and physical activity. Each investigator selected one physical activity as the experimental factor, without indicating the reason for the selection. Furthermore, some investigators found a significant relationship between physical activity and the serum cholesterol level, and others found none.

The purpose of the present investigation was to determine if the type of physical activity is a determining factor in control of serum cholesterol values.

METHOD AND EXPERIMENTAL DESIGN

The subjects were 133 male freshmen students who were randomly selected and enrolled in classes of cross-country, weight training, tumbling-gymnastics, wrestling, tennis, or golf. The control group was composed of freshmen who were not enrolled in any physical activity class. All subjects were volunteers who expressed an interest and willingness to participate in the study.

All subjects were given a dietary check sheet to record all food and liquid consumed during the 48 hr required to collect the initial and the final blood samples. When these reports were analyzed it was established that the participating subjects had not consumed grossly different amounts or kinds of food before the initial blood sampling and before the final blood sampling. Blood was drawn (10 ml) on three successive mornings with subjects in the fasting state. Serum cholesterol concentrations were determined in triplicate by the method of Abell (19). The value reported is the mean of these determinations, for which the standard methodological error was separately determined to be ± 7.66 mg/100 ml (n = 3).

The physical activities were investigated in three periods of 10 weeks each (Table 1). Each of the groups participated in the regularly scheduled activities of the program, after which the subjects were again tested in

TABLE 1 Number of Subjects in Each of the 10-Week Periods of the Application of the Physical Activities

Activity	First	Second	Third	Total
Control	7	7	6	20
Cross-country running	20	0	0	20
Golf	0	0	20	20
Tennis	0	0	20	20
Tumbling-gymnastics	7	5	5	17
Weight training	10	10	0	20
Wrestling	8	8	0	16
Total	52	30	51	133

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TABLE 2 SERUM CHOLESTEROL CHANGES RESULTING FROM PARTICIPATION IN PHYSICAL ACTIVITY FOR 10 WEEKS

Activity	n	Mean Serum Cholesterol		Average Change	Sum of the Squared Changes χ^2	Standard Deviation of the			Correlation Coefficient	
		Before Activity	After 10 Weeks of Activity			Initial Values	Final Values	Changes	Initial–Final	Initial–Change
		mg/100 ml	*mg/100 ml*	*mg/100 ml*						
Control	20	182.0	190.3	+8.25	8287	34.3	34.0	19.1	+0.84	−0.29
Cross-country running	20	180.4	160.5	−19.85	14373	32.8	28.5	18.5	+0.83	−0.50
Golf	20	181.4	179.3	−2.10	5310	14.6	21.5	16.6	+0.63	−0.06
Tennis	20	169.1	162.0	−7.05	1981	22.0	19.1	7.2	+0.95	−0.54
Tumbling-gymnastics	17	176.3	179.8	+3.53	13778	45.9	33.4	29.1	+0.77	−0.69
Weight training	20	165.5	168.4	+2.95	4927	23.8	25.2	15.8	+0.79	−0.24
Wrestling	16	189.4	191.8	+2.38	12824	38.6	34.6	29.1	+0.69	−0.51
Total	133	177.4	175.5	−1.94	61480					

TABLE 3 ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between groups	10318.81	6	1719.80	4.27
Within groups	50679.99	126	402.22	
Total	60998.80	132		

the same manner as before. The changes between the initial and the final serum cholesterol level were assumed to be the result of the physical activity (Table 2).

RESULTS

An analysis of variance was applied to the data collected. An F ratio of variance of 4.27 was found (Table 3). A ratio of 2.80 would be sufficient to establish the presence of a correlation between one or more of the physical activities and the serum cholesterol level that would be significant at the 1% level. To determine which of the activities resulted in a significant amount of change, the "t" test of differences between means was computed between the 21 combinations of groups (Table 4). A "t" value for 126 degrees of freedom of at least 2.36 would indicate a significant difference at the 1% level of confidence, whereas at least 1.28 was required for the 5% level.

Cross-country running produced serum cholesterol decreases with $t>2.36$ when compared with controls and with all other activities except tennis (t for this difference, 1.95). Tennis caused a decrease in serum cholesterol significant at the 1% level ($t = 2.41$) when compared with controls and at the 5% level when compared to weight training, tumbling-gymnastics, and wrestling. Golf produced a decrease from control values ($P<0.05$). Changes produced by the other activities were not statistically significant.

DISCUSSION

Cross-country running and tennis are phasic activities and produced decreases in serum cholesterol (proportional to an intuitive assessment of their intensity), whereas the more static activities of wrestling, weight training, and tumbling-gymnastics produced little or no detectable change.

These results may explain the discrepancies between previous studies on the influence of exercise upon serum cholesterol. Chailley, Labigrette, and Fabre-Chevalier (15) found a reduction in serum cholesterol after a program of walking and cycling; Golding (16), who also found a reduction in serum cholesterol, had his subjects exercise by running and performing the Master's Two-Step Exercise Test. On the other hand Brumbach

TABLE 4 "t" DIFFERENCES

Activities	Control	Weight training	Tumbling-gymnastics	Wrestling	Golf	Tennis
Cross-country running	4.43	3.60	3.54	3.30	2.80	1.95
Tennis	2.43	1.58	1.60	1.40	0.78	
Golf	1.63	0.79	0.87	0.66		
Wrestling	0.87	0.08	0.16			
Tumbling-gymnastics	0.71	0.09				
Weight training	0.84					

1% Level of confidence = 2.36; 5% level of confidence = 1.28.

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(14) had his subjects exercise by running and lifting weights and found no significant reduction in serum cholesterol. The results of the present study suggest that these two activities have opposite effects on the serum cholesterol.

CONCLUSIONS

The following tentative conclusions are drawn, related specifically to the healthy young men used in the study: (*a*) a regular, vigorous physical activity of 10 weeks' duration produced a significant decrease in the serum cholesterol level if the activity was of a dynamic type involving rapid interchange in the position of the arms and legs and a rapid flexing and relaxation of the muscles; (*b*) a vigorous but more static type of physical activity, in which the muscles were held in a prolonged state of contraction and had a slower rate of flexing and relaxation, failed to produce a significant reduction in the serum cholesterol level.

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