Effect of Health Maintenance Programs on Los Angeles City Firefighters

R. James Barnard, Ph.D., and Donald F. Anthony

In an attempt to reduce the incidence of cardiovascular disease and the number of on-duty injuries, the Los Angeles City Fire Department instituted a mandatory physical fitness program in the fall of 1971 for all its members (approximately 3,250). To enter the program at Level 1, a member had to meet the following medical criteria: (1) have received a periodic medical examination within the preceding year; (2) be not more than 20% over maximum recommended weight; (3) have blood pressure not in excess of 150/95; (4) not be on restricted or rehabilitative status; (5) abide by any medical restrictions set forth in a medical report; and (6) not be under current treatment or observation for cardiac abnormalities.

Of the approximately 3,250 members of the fire department, 394 did not meet these criteria. Further medical examination was given to these individuals, including 30 who were given near-maximal stress test ECGs. All but seven individuals were eventually cleared for at least partial inclusion in the fitness program.

The progressive exercise program was designed for implementation in three, six-month stages, starting at a low level of activity. The program was instituted as a mandatory part of the daily routine of each on-duty firefighter (chief through rookie firefighter). Initially, the program was presented to all 84 command-level personnel (chief officers) at a two-day symposium during which they were instructed on how to administer the Kasch Step Test and to properly perform the individual exercises. These officers, in turn, took the program to the stations under their command and were assigned responsibility for implementing the program.

The program is conducted first thing each morning (8:00 a.m.), as this was found to be the least busy time (both routine and emergency). The exercises are done in gym suits and shoes, with the regular firefighting turnout gear readily available for emergency response. The program is of approximately 45 minutes' duration and consists of flexibility and warm-up exercises, cardiovascular exercises, muscle-conditioning exercises, and a cool-down period. In most cases the program is conducted within the fire station, although where a park or school is available, the program may be conducted at that location with radio or visual contact with the station or apparatus.

A physical fitness manual entitled “Good Health Through Physical Fitness,” which describes the program, including instructions on administration of the Kasch Step Test and each exercise, was published and distributed to each work location. In addition, a 30-minute, 16-mm film describing the program was developed to help motivate the firefighters and to assure that they received proper exercise instructions. Large posters displaying sequences and repetitions were also furnished to each fire station.

In 1972 cholesterol measurements were added to the periodic medical examination and a weight control and nutrition clinic was established. All individuals who were more than 15 pounds overweight and all individuals with serum cholesterol levels over 250 mg/dl were referred to the clinic. Firefighters through 39 years of age have a medical examination every two years; those 40 years and over are examined annually.

Methods

In order to evaluate the effectiveness of these programs, a random sample of 300 periodic medical examinations was evaluated to determine changes in cholesterol, blood pressure and body weight. Because the cholesterol analyses had been done at different laboratories over the years and different physicians conducted the medical examinations, a sample (N = 258) of Los Angeles city police officers’ medical examinations was also evaluated to determine whether or not any changes might be due to changes in laboratory procedures or medical personnel. The random sample of firefighters was divided into three age categories: less than 40 years, 40 through 49 years, and 50 years and older. Data were analyzed using the t-test for matched pairs.

The Kasch fitness scores were obtained from the entire department at the start of the program in 1971, then again in 1973, 1975 and 1978. Since only mean values were recorded in department files, it was impossible to do a statistical analysis on these data.

Results

Kasch Fitness Scores. — Fig 1 gives the data for the Kasch fitness scores and shows that the fitness level of the firefighters increased. In 1971, 38.6% of the members had fitness scores which were in the poor (Kasch score 108 through 118) or very poor category (Kasch score 119 or
Fig 1. — Kasch fitness scores (one-minute recovery heart rate) for the entire Los Angeles city fire department.

Blood Pressure. — The health maintenance programs had no significant effect on systolic blood pressure in any of the age groups (Fig 2). The programs did, however, produce a significant reduction in diastolic blood pressure in all three age groups (Fig 3). Data obtained from the police officers showed no significant difference in systolic (123.9 ± 0.8 vs. 121.4 ± 0.7 mmHg) or diastolic (79.7 ± 0.5 vs. 78.7 ± 0.6 mmHg) for the pre- and post-test periods.

Cholesterol. — Fig 4 shows that serum cholesterol levels were significantly reduced in all three age groups. In the sample of police officers, pre- and post-test, cholesterol values were 221.4 ± 2.7 and 220.9 ± 2.8 mg/dl, respectively, indicating that the significant differences observed in the firefighters were not due to changes in laboratory procedures.

Body Weight. — Fig 5 shows the body weight data for the various age groups. There were no significant differences between the age groups, and the health programs had no significant effect on body weight. Data obtained from the police officers showed a slight but significant (p < 0.05), increase in body weight (180.9 ± 1.9 vs. 183.7 ± 1.2 pounds).

Although the health maintenance programs had no effect on body weight in the random sample, approximately 10% of the firefighters were referred to the weight control and nutrition clinic each year. Most of these individuals were able to lose excessive body weight as required by fire department regulations.

Discussion

Firefighting is a strenuous occupation requiring, at times, work at near-maximal heart rates for prolonged periods in hot and often polluted environments. The protective equipment used by firefighters (turnout uniforms and breathing apparatus) weighs about 22 kg and places added stress on the body. In addition, much of the equipment used in firefighting, i.e., ladders (33.2 kg), hoses (25 kg), ventilating equipment (25.4 kg), are heavy and place maximum demands on strength and endurance of firefighters. Turnout clothing causes excessive body heat buildup and adds to the physical demands of the job.

When the physical fitness program was started in 1971, the mean Kasch fitness score (101) was in the below-average category, with 38.6% of the firefighters in the poor and very poor categories. In 1978 the mean Kasch fitness score (127) was in the above-average category, with 12.7% of the firefighters in the poor and very poor categories.
score (91.4) was in the average category, with only 9.0% in the poor and very poor categories. These results demonstrate that the fitness program has been effective in improving the fitness level of firefighters. A major decrease in resting heart rate has been observed, which is further evidence that physical fitness levels have increased.

Injuries commonly occur when individuals become fatigued. The increased fitness level of the firefighters should result in an increase in endurance and decreased susceptibility to fatigue during firefighting. Prior to the initiation of the fitness program, the number of injuries occurring on duty (IOD) had been steadily increasing. This increase continued into the second year of the fitness program. Part of the increase in the number of injuries was due directly to injuries which occurred (or were aggravated) in the fitness program.

During the past five years, the number of IOD injuries has decreased. Although factors other than the fitness program may have been important in reducing the number of injuries, it is felt that the fitness program played a major role.

According to Borhani, there is no specific blood pressure level below which an individual is immune to the development of clinical atherosclerotic heart disease. One must assume that any program which reduces blood averaging 90-114 mm Hg effect on body weight for the individuals in the random from coronary heart disease and other causes decrease in mortality and morbidity. 

Thus, the significant reduction in diastolic blood pressure in this population is felt to play a significant role in reducing the future incidence of atherosclerotic heart disease.

As with blood pressure, epidemiologic studies have confirmed a strong, positive relationship between serum cholesterol level and the incidence of atherosclerotic heart disease. It is felt that the reduction in cholesterol, in addition to the reduction in blood pressure, will have an accumulative effect in reducing future incidence of atherosclerotic heart disease in Los Angeles city firefighters. Studies have demonstrated a decrease in mortality from coronary heart disease following reductions in serum cholesterol.

The health maintenance programs had no significant effect on body weight for the individuals in the random sample. However, approximately 10% of the firefighters have attended the overweight clinic (for overweight and cholesterol control), and most of them have shown significant reductions in body weight. There was no significant difference in body weight between the youngest and oldest groups, showing that, unlike most Americans, the firefighters were not gaining weight as they aged.

The fact that no significant differences were observed in blood pressure or cholesterol in the sample of police officers supports the interpretation that the changes observed in the firefighters were due to the health maintenance programs and not to changes in laboratory procedures or medical personnel.

In conclusion, the Los Angeles city fire department has demonstrated that health maintenance programs can be used to increase the fitness level and reduce risk factors associated with atherosclerotic heart disease. These physiological adaptations appear to be reducing the number of firefighters injured on duty and, one hopes, will reduce the high incidence of cardiovascular disease.

References
8. Borhani NO: Epidemiology of Coronary Heart Disease in Exercise in Cardiovascular Health and Disease, E. A. Amsterdam, J. H. Wilmore, and A. N. DiMaria, (Eds.) New York, N.Y.: Yorke Medical Books, 1977, p. 188
10. Veterans' Administration Cooperative Study Group on Antihypertensive Agents: Results in patients with diastolic blood pressures averaging 90-114 mm Hg. JAMA 213:1143, 1970