

ROLE OF INDUSTRY IN PREVENTIVE CARDIOLOGY

Exercise Prescription in an Industrial Fitness Program

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INTRODUCTION

In an effort to curtail skyrocketing costs of health care, several companies have begun to develop prevention or health promotion programs. These vary from recreational programs and subsidized YMCA memberships to highly structured cardiovascular fitness programs with or without in-house medical screening facilities and associated health education programs (1-4). Objectives of such programs include reduced costs for medical care, decreased absenteeism, and increased employee enthusiasm and productivity. Clear demonstration of these benefits remains to be achieved.

The value of vigorous physical activity in either the prevention of coronary heart disease or the prolongation or survival in coronary heart disease patients is under considerable debate (5-24). While appropriate supervised exercise is probably a valuable part of any coronary heart disease (CHD) preventive program, it is unlikely to prove beneficial unless combined with a broader program of risk factor intervention and life style change. Unsupervised vigorous aerobic exercise in sedentary individuals over 40 years of age is hazardous and should not be encouraged. A good example of a large scale national prevention effort is the Operation Life-Style program of the Canadian Ministry of Health (25,26). The Operation Lifestyle Profile (27) portion of this program has been used successfully by Kimberly-Clark Corporation as a motivational tool in our new corporate Health Management Program.

The NASA study (28) showed that employees participate in such programs for many reasons including organization and leadership, exercising in general, recreational aspects, camaraderie, and health benefits. While these data are subjective, they do give us a basis for designing employee fitness programs. A subsequent report from NASA (29) has also suggested benefit from such a program, although no

conclusive affect on CHD morbidity or mortality was demonstrated. Table 1 shows several features shared in common by successful fitness programs.

KIMBERLY-CLARK HEALTH MANAGEMENT PROGRAM

Kimberly-Clark Corporation, like other companies, has invested much time, money, and other resources in the development of a comprehensive preventive or prospective medicine program entitled the Health Management Program. The program is available to the 2,000 corporate salaried employees of all levels residing in the Fox Valley area of Wisconsin (Appleton and Neenah-Menasha).

The Health Services Center includes a multiphasic screening area, an exercise facility, and an educational conference area. Screening procedures include urine and blood analysis (CBC, SMA-12 including triglycerides, HDL cholesterol, and lipoprotein phenotyping), vision and hearing testing, tonometry, chest x-ray, pulmonary function, percent body fat by skin fold thickness and body density by underwater weighing, physical examination, and treadmill testing with a computerized system by Marquette Electronics of Milwaukee with simultaneous direct measurement of VO₂ Max. by a Metabolic Measurement Cart by Beckman Instruments, Inc. of Schiller Park, Ill.

The exercise facility includes a 25-meter Olympic pool; a 100-meter suspended track; exercise equipment; a gym area for calisthenics and other aerobic exercise; 1,000 lockers (500 each, male and female); showers; two saunas; a whirlpool; and a lounge and dining area with vending machines. Our exercise facility is open from 5:00 A.M. to 9:00 P.M. Monday through Friday and 8:00 A.M. to 5:00 P.M. on Saturdays.

The Health Services Center staff includes 15 people:

- 1 Physician (Staff Vice President - Medical Affairs);
- 1 Manager of Health Services with a masters degree in exercise physiology;
- 1 Masters degree nurse-practitioner;
- 1 Coordinator of Special Health Services with a masters degree in psychology (Employee Assistance Program);
- 2 RN's;
- 3 Technicians for multiphasic screening and treadmill testing;

- 1 Masters degree level physical education specialist;
- 1 Executive secretary;
- 3 Receptionists; and
- 1 Clerk-typist

Table 2 shows an overview of our program and staff.

Programs include health screening, aerobic exercise, cardiac rehabilitation, health education, employee assistance for alcoholism and drug abuse, and individual and group risk factor intervention counseling.

A detailed discussion of treadmill testing is beyond the scope of this presentation, but key references are included in the bibliography (30-37). We employ the Bruce Protocol whenever possible. All center personnel are fully trained in cardiopulmonary resuscitation. Qualified personnel are also trained in appropriate advanced life support procedures, including defibrillation by DC counter-shock. Informed consent is strictly observed. Community internists assist the corporate medical director with physical examinations and treadmill testing. Because we expect a large number of false positive exercise tests, particularly in women (38), we are trying to determine suitable criteria for referral for thallium scanning and/or angiography in asymptomatic persons. At the present time, those suggested by Cohn (39) seem most reasonable and include:

1. ST segment depression early in the exercise test;
2. 2.0 mm of ST segment depression persisting at least one minute post-exercise (with the ST segment flat or inverted for at least 80 m sec past the J point); and
3. The presence of other risk factors.

Time does not permit discussion of all our risk factor intervention programs. Therefore, I will limit discussion to our exercise program and our approach to exercise prescription for the employee population.

General principles of exercise prescription--
These are shown in Table 3. Exercise prescription may be individualized or by group according to age, treadmill estimated functional capacity and VO_2 Max, the presence of risk factors or known CHD, and the presence of orthopedic abnormalities. Table 4

Table 1. Common features of successful programs

1. Strong leadership
 2. Administrative support, with personal and financial commitment
 3. Accessibility (On-site or nearby facilities)
 4. Availability (The right programs offered at the right times)
 5. Assessment (Continuing evaluation of fitness, anthropometry and performance)
 6. Recording (Techniques should be devised for monitoring the progress of participants)
 7. Group exercise. (Large-scale fitness improvement is unlikely to be accomplished exclusively by individual programs)
 8. Challenging physical programs. (Participants come to be improved, not humored)
 9. Continued motivation, stimulation and incentive
 10. Organization (Careful attention to the mechanics and details of program operation)
 11. Visibility and variety
 12. Continuity and extension (The program should work with, and not against, related company and community organizations)
 13. Fun
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Table 2. Kimberly-Clarks' health management program

An Overview

Lifestyle evaluation	Breast self-examination
Medical history and health hazard appraisal	Risk factor reduction
Multiphasic screening	Employee assistance (alcohol and drug abuse)
Physical examination	Exercise
Treadmill testing	Cardiac rehabilitation
Eating behavior modification	

Full Time Staff (14)

Staff vice president - medical affairs	Health management specialists (male and female)
Exercise physiologist	EAP coordinator
Nurse practitioner	Receptionists
RN's	Secretaries
Technicians	

Part Time Staff

Community physicians (internal medicine/ cardiology)	RN
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Other

Physician Advisory Committee - Local community

Table 3. Principles of exercise prescription

1. Determine functional capacity by graded exercise testing
 - A. Treadmill or bicycle ergometer
 - B. Rule out presence of coronary heart disease
 2. Cardiology or personal physician consultation
 3. Determine the exercise to achieve desired training effect. Type, frequency, duration, intensity
 4. Orthopedic considerations
 5. Individual targets
Heart rate, blood pressure, EKG changes, weight, endurance
 6. Education and motivation for adherence
 7. Program features
Fun, well organized, camaraderie, attainable goals
-

Table 4. Target levels for training

- I - "Normals"
 - A. O₂ uptake - 57% to 78% V_{O₂} max
 - B. Heart rate - 70% to 85% max heart rate attained
70% to 85% age predicted maximal heart rate
 - C. Systolic BP - Maximal level of 225 mm Hg
Watch for fall in systolic BP
 - II - Symptomatic Patients
 - A. O₂ uptake - 57% to 78% V_{O₂} max
 - B. Heart rate - 70% to 85% max heart rate attained
 - C. Other - EKG - PVC's
IV and A-V block
ST depression (3-4mm)
BP - abnormal response (fall > 20 mm Hg)
Signs and symptoms
-

shows normal target levels for training. It is very important to prevent "Type A" (40) employees from attempting to correct ten or more years of inactivity by two days of hyper-exertion (41)! Acute coronary fatalities are not conducive to a successful company exercise program. Exercise sessions conducted for employees with angina pectoris, previous myocardial infarction or previous coronary by-pass surgery, and others at high risk are conducted with a physician and R N in attendance and defibrillation equipment operational. A limited number of telemetry units are also available, and Holter monitoring is employed in selected persons for 12-24 hours post-exercise.

In most company fitness programs, exercise prescription will be used for apparently normal individuals with sedentary occupations, many of whom are overweight and in poor physical condition. Many will also have abused food, alcohol, and tobacco to varying degrees. The most important aspect of the program will be to achieve an alteration in lifestyle - a supervised exercise program being part of that process.

Prescribed exercise must be both conservative and aggressive (42). It must not push a person beyond 85% of his maximal performance capability as estimated by graded exercise testing; yet, it must be adequate to produce a cardiopulmonary conditioning effect. There are four factors to consider in any exercise prescription and these are shown in Table 5, and include type, frequency, duration, and intensity of exercise.

Acceptable types of exercise for cardiorespiratory fitness are shown in Table 6 and include walking, jogging, swimming, outdoor and indoor cycling, rope jumping, and long distance running. Weight lifting and isometric exercises are not acceptable for this purpose. Contact sports in sedentary individuals are not recommended because of the high incidence of injuries. Common everyday activities such as walking, climbing stairs, and gardening should also be encouraged. Golf is relaxing, but inadequate for aerobic conditioning. Tennis requires seven hours of singles per week to produce an adequate training effect. While facilities for racketball, squash, and handball are not always available, these sports can produce an adequate training effect if participation is regular.

The frequency of exercise (Table 7) must be at least three times weekly. While daily exercise is desirable, properly regulated

Table 5. Exercise prescription

-
1. Type (aerobic)
 2. Frequency (3 times a week)
 3. Duration (20 minutes at training heart rate)
 4. Intensity (70%-85% capacity)
-

Table 6. Types of exercise

Selection of the type of exercise takes into consideration:

1. Individuals personal preference
2. Individuals time schedule and lifestyle
3. Limiting physical factors

Types of exercise recommended include:

Walking	Swimming
Jogging	Rope jumping
Cycling	Cross country skiing
Aerobic dance	

Table 7. Frequency

First 4 months

Individuals initiating an exercise program should limit exercises to 3 times per week on alternate days (Example: Monday, Wednesday, Friday)

After first 4 months

Individuals continuing an exercise program beyond 4 months can increase frequency to 5 or 6 days per week.

sessions of three times a week are suitable in achieving reasonable levels of fitness.

The duration of exercise required to achieve cardiorespiratory fitness objectives varies, but should be for a minimum of 20 minutes. An optimal session should include five or more minutes of warm up exercises to stretch and condition muscles, 15-20 minutes of aerobic exercise at the training heart rate, and five minutes for cooling down by walking or other submaximal activities. Shorter periods are often prescribed initially to develop muscle strength.

Intensity of the exercise performed is probably one of the most important items to be considered. Close attention to supervision of this factor is very important, particularly when highly competitive, "Type A", executives are involved. During the beginning phases of an exercise program, intensities of more than 75% of a person's work capacity should be avoided. The appropriate level of intensity can be determined by heart rate response, VO_2 max, or physical work performed. In our own program, we use VO_2 max, either measured directly or as estimated by treadmill time (30,43).

Table 8 shows a sample exercise prescription form. Exercise should be reduced or curtailed in the presence of active infection or injury to the extremities. Aching joints and muscles and early fatigue may be the result of excessive exertion and should be evaluated appropriately. High altitude and extremes of temperature also require modification of activity. Another note of caution is that hot showers immediately after exercise may cause syncope or frank symptoms of myocardial infarction.

Cardiorespiratory fitness level programs--

Company exercise programs designed to achieve cardiorespiratory fitness require supervision. The ideal combination is an exercise physiologist and a physician (44) but this is not always practical. In the event that supervision of exercise is not available, a program of longer duration at low intensity is advisable with slow progression to submaximal heart rates. Treadmill or bicycle ergometer exercise testing is important prior to vigorous aerobic exercise in sedentary individuals over 35 years of age.

The Committee on Exercise of the American Heart Association has published two books (30,31) of guidelines for exercise testing

Table 8. Exercise prescription form

NAME _____ Extension _____

Personal Physician _____

Age _____ Sex _____

FITNESS CATEGORY I II III SPECIAL

Type of Exercise _____

Frequency _____

Duration _____

Intensity - HR _____

 - METS _____

Retest _____ Weeks/Months

Date _____ Provider
(N.P. or M.D.) _____

Table 9. Classification of fitness level
by oxygen consumption

		<u>Male</u>	<u>Female</u>
CLASS I (Least Fit)	VO ₂ Max	31-39 ml/kg/min	VO ₂ Max 25-29 ml/kg/min
CLASS II	VO ₂ Max	40-44 ml/kg/min	VO ₂ Max 30-34 ml/kg/min
CLASS III (Most Fit)	VO ₂ Max	45 or more ml/kg/min	VO ₂ Max 35 or more ml/kg/min

and fitness training of healthy individuals and those at high risk for or with a clinical history of coronary heart disease. Anyone embarking on a program should be familiar with these. Cooper's New Aerobics (45) also contains many helpful suggestions. In addition, the Chicago Heart Association (46), Dr. Lenore Zohman (47) and Professor Astrand (48) have published concise and informative exercise guidelines for laymen. Table 9 shows the levels of fitness used for exercise prescription in our program.

Table 10 shows estimated VO_2 max values for the treadmill protocol calculated from multivariate regression equations as suggested by Bruce (30,43). Table 11 shows the calculated values for VO_2 max in one adult male tested in our program.

Table 12 shows a sample exercise prescription for a healthy adult and Tables 13-15 provide similar data for a patient with angina pectoris. Those persons who have had myocardial infarction or coronary by-pass surgery should participate in progressive exercise under proper medical supervision and preferably as part of a cardiac rehabilitation group. While post-coronary marathon runners have been reported (49-51), the majority of CHD patients should not be expected to progress to this level of activity. Essential features of a post-coronary exercise group are presented in Table 16.

CONCLUSION

Finally, I wish to mention some key and unanswered questions:

1. Does physical exercise prolong survival in coronary heart disease?
2. Does it have any effect on the atherogenic process?
3. Does it afford any protective effect against anoxia?

That physical exercise does significantly improve a subjective sense of well-being and physical work capacity has been clearly demonstrated (14,52). In addition, we hope that company preventive medicine programs will be effective in enhancing employee health, reduce absenteeism and health costs (53), and improve work performance. We all look forward to the proof of this proposition.

Table 10. Calculated VO_2 max from
Bruce protocol treadmill time

Treadmill min	VO_2 max	
	Male	Female
3	16.5	12.6
4	19.4	15.5
5	22.4	18.4
6	25.3	21.4
7	28.2	24.3
8	31.2	27.3
9	34.1	30.2
10	37.1	33.1
11	40.0	36.1
12	42.9	39.0
13	45.9	42.0
14	48.8	44.9

Table 11. Treadmill time, calculated VO_2 max, and fitness level in an adult male subject without evidence of coronary heart disease

Example: 37 year old male "normal"

Treadmill time (Bruce)	- 8 minutes
Maximal heart rate	- 186/min
Calculated VO_2 Max	- 31 ml/kg/min
Fitness category I (least fit)	

Table 12. Exercise prescription for "normal" adult male subject in fitness category I

Type:	Walk/Jog
Frequency:	3 times/week
Duration:	30 minutes
Intensity:	2 miles in 30 minutes (5 METS) progress to 2 miles in 24 minutes in 12 weeks (7 METS)

Table 13. Exercise prescription for a 52 year old female with angina pectoris

Treadmill time (Bruce) - 4 minutes (chest pain)
 Calculated VO₂ max - 15.5 ml/kg/min (4 METS)
 Maximal heart rate - 140
 Train at 60% - 9.3 ml/kg/min (2.6 METS)
 Training heart rate - 100-120 (70%-85% MHR)
 Walking 2 miles/hr
 Cycling-5 miles/hr

Table 14. Cardiac exercise format for a 52 year old female with angina pectoris

Period	METS	ml O ₂ /kg/min	Exercise
Warm-up	1.5	5.3	0.3 mile/10 min
Training	2.5	8.8	1.0 mile/30 min
Cool down	1.5	5.3	0.3 mile/10 min

Table 15. Subsequent prescriptions for a 52 year old female with angina pectoris

-
1. Same warm up and cool down
 2. Walk 1.5 miles in 24 minutes for 3 weeks
4 METS - 14 ml O₂/kg/min
 3. Walk 2.5 miles in 40 minutes for 3 weeks
4 METS - 14 ml O₂/kg/min
 4. Progress to 4 miles in 60 minutes at 15th week
5 METS - 18 ml O₂/kg/min
-

Table 16. Group program for post-myocardial infarction exercise

1. Three months post infarction.
 2. Controlled or treated
 - Hypertension
 - Arrhythmias
 - Congestive Heart Failure
 3. Three sessions per week
 4. Physician present
 5. EKG, defibrillator, emergency drugs, oxygen
 6. Exercise period
 - a. warm-up and cool-down
 - b. calisthenics
 - c. walk - jog
 - d. group activity
 - e. physician participation
-

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