Do Work-Site Exercise and Health Programs Work?

Roy J. Shephard, MD, PhD, DPE

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In Brief: Studies of high-profile work-site wellness programs suggest a number of important advantages for sponsoring corporations. Participants report greater wellness and enhanced productivity. Objective data suggest that programs (1) chiefly attract employees with a favorable attitude toward both work and health, (2) reduce absenteeism and employee turnover, (3) produce a small increase in productivity, and (4) reduce healthcare costs. Meta-analysis provides limited evidence of program-related changes in physical activity, aerobic fitness, and cardiac risk factors. The cumulative benefit has been estimated at $500 to $700 per worker per year, enough to cover the cost of a modest wellness program. The big challenge is to sustain long-term participation.

Work-site exercise and health programs are seen as a way to help keep employees healthy and thereby increase productivity while holding health insurance costs down. A few decades of experience with such programs and numerous studies of their effectiveness have yielded mixed results. Few, if any, programs have delivered all of the expected benefits, but many have achieved some success in proportion to the degree of employee participation.

This brief review examines critically the changes in physical activity and fitness resulting from work-site wellness programs, evaluates associated changes in health markers, comments on types of programs that appear to have succeeded, and points to future directions for work-site wellness programs.

Early Programs

Enlightened companies have sponsored sports teams and in some instances have provided sports fields at work sites through much of the present century. Management sometimes viewed such initiatives mainly as a method of building a team spirit and developing employee morale. Nevertheless, the proportion of employees who became actively involved in company sport teams was relatively small. A second option has been a brief calisthenic break. In the early 1960s, LaPorte (1) claimed that such programs reduced employee stress and enhanced physical and mental performance. The Canadian government espoused a similar plan in the mid 1970s. Fitness Canada provided taped music and written instructions, and volunteer exercise leaders were recruited on each floor of large office buildings. Sometimes fruit juice and muffins replaced the customary coffee and cigarettes, but usually only the activity component of wellness was addressed. Unfortunately, the idea that an entire work team could cease operations for 7 to 8 minutes of group exercise twice during each working day proved unrealistic in many modern industrial and business operations.

Despite these problems, the lure of enhanced productivity remained. The interest of the US and Canadian governments in the promotion of work-site fitness programs thus developed rapidly during the 1970s, and several high-profile demonstration projects were begun.

Theoretical advantages. Governments perceived several advantages in using the work site to deliver exercise and wellness programs. They saw a discreet population, established channels of communication such as company newsletters, a strong potential to recruit volunteer exercise leaders through personnel departments, and peer support for those considering wellness programs. Moreover, the introduction of specific wellness programs was seen as an important first step in the development of a healthy overall working environment (2). Areas to be addressed ranged from a wise choice of canteen foods to a smoke-free work site. Above all, no travel time was needed, so the usual excuse of the nonparticipant (lack of time) was overcome (3).

Promising results. The first results from demonstration work-site wellness projects (table 1) suggested a number of advantages to a sponsoring corporation (4,5). Objective comparisons with companies or work sites where wellness programs had not yet been introduced suggested (1) recruitment of employees with a favorable attitude toward both work and health, (2) a low rate of employee turnover among program participants, (3) a 4% to 5% increase in productivity, (4) a small reduction in absenteeism, perhaps a half a day per year, and (5) a $100 to $400 per year reduction in medical expenditures.

Table 1. Anticipated Benefits of Work-Site Fitness and Health Programs as Suggested by Early Demonstration Projects

Recruitment of premium employees with favorable attitudes toward fitness and health
Low rate of employee turnover
A small reduction in absenteeism (about a half day per worker-year)
Enhanced productivity (4%-5% gain)
Trend toward containment of healthcare costs (savings of $100 to $400 per worker-year)
Improvement in employees' sense of well-being and perception

of own productivity

Increase in various markers of fitness

Reduction in cardiac risk factors and decreased likelihood of future health problems

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Such benefits were central motivating factors for some managements. More commonly, exercise and wellness programs were introduced because of the favorable personal experience of a senior executive or a desire to offer an attractive fringe benefit. Nevertheless, the cumulative economic benefit, estimated at $500 to $700 per worker per year (5), seemed enough to cover the costs of providing and operating a modest employee wellness facility.

Optimal programming. The optimal investment in facilities is unclear. Cost-effectiveness seems greatest for a limited facility with enthusiastic leadership (6). In small companies, a wellness facility can be shared with neighboring corporations, and much health-giving physical activity can result from simply installing showers and encouraging employees to walk or cycle to work (7,8).

The big challenge is to sustain long-term interest and enthusiasm. When a work-site wellness program is launched, a third of employees are likely to join, but even in massively supported demonstration projects, half of initial recruits become noncompliant within a few months (9,10). Attendance can be enhanced by involving senior management, adopting flexible hours, admitting family members, and providing modular programs. Modular programs offer not only physical activity, but also advice on other aspects of personal health (nutrition, weight loss, low-back problems, smoking cessation, stress, substance abuse, and so on) (11,12). However, strong, warm, and enthusiastic leadership is vital to long-term program success.

Hard evidence needed. Wellness program first became popular in the late 1970s. Initially, management was content to evaluate success on the basis of employees' awareness of the wellness program, their attitudes toward it, and markers of interest such as whether they were contemplating participation or had purchased a membership in the facility (5). However, after 20 years of operation, program directors and health service providers are being asked to provide hard evidence that employees are more active and have realized the enhanced wellness (13,14) that will yield economic benefits. Program directors may be tempted to continue promising large economic dividends to companies that initiate well-designed programs. But management is increasingly aware that fiscal benefits are unlikely unless lifestyle habits such as physical activity change and there is objective evidence that the health status of workers has been enhanced.

Difficulties in Program Evaluation

It might seem a simple matter to combine information from many reports on the benefits of employee fitness programs into a convincing meta-analysis. The basic idea of such an analysis is to pool all of the good data in the literature. Although the findings at any one work site may be statistically unconvincing, the pooling of experience is supposed to give a sufficient increase in participant numbers that any positive trends become statistically significant. Unfortunately, as discussed below, few data sets on work-site programs meet the stringent criteria that statisticians set for meta-analysis (15,16) (table 2).

Table 2. Criteria for Including Studies of Work-Site Exercise and Health Programs in Meta-Analysis

Data collected by unbiased observers
Experimental or quasi-experimental design*
Treatment involving an adequate and well-defined dose of aerobic exercise
Absence of ancillary treatments
Comparable outcome measure (eg, increase in aerobic power)
Use of a measure that allows calculation of effect size, such as standard deviation

*Exercise cannot be administered in a double-blind fashion.

Unbiased data. Data must be unbiased. However, the program director usually collects figures for participation in work-site wellness programs. His or her job may be on the line if the numbers do not look promising. Thus, there is a temptation to find excuses for neglecting data during periods when attendance is poor or obesity increases. (For example, "It's hard to get people to attend Friday programs"; "People are not really back from holiday during the first weeks of September"; or "Weight sometimes increases at Christmas, but it comes down again later.")

Experimental design. Statisticians also want a true experimental design. This implies that workers are assigned randomly between an experimental and a control group. Unfortunately, this is almost impossible to achieve in industry. Unions insist that everyone should have full access to the wellness facility. Moreover, exercise or a low-fat diet can hardly be assigned on a double-blind basis. At best, we may assign one group of employees to a program that we think will be effective, such as regular distance walking, and ask a second group to attend a lower-level program such as a single wellness counseling session, which we think will have only a minor impact on wellness.

Even then, it is difficult to avoid interaction between experimental and control subjects; merits of the two types of program are debated in the cafeteria, and intended inter-group differences in lifestyle become progressively weakened. For example, members of the low-level intervention group may hear about the benefits of exercise and decide to begin jogging on their own. If the study continues for a long period, there is also a selective attrition of participants. The experimental group retains subjects who are fit, health-conscious nonsmokers, while those who remain in the control group tend to be people with little interest in exercise or personal health (17).

Quasi-experimental approach. Because of difficulties in implementing a true experimental design, many investigators adopt a "quasi-experimental" approach. Here, the experimental treatment is applied at one work site, and the control treatment is introduced at a second work site with similar demographics, end-product, and management philosophy (18,19). It is very difficult to match work sites closely enough in terms of demographics, end product, or corporate philosophy. For example, we wanted to compare two large postal sorting depots in the greater Toronto area. The suburban depot was staffed by long-established Anglo-Saxon Canadians, whereas the urban depot was staffed by recent Chinese immigrants who had different attitudes about their work and health. Moreover, for ethical reasons, it is usually necessary to promise an equivalent wellness program at the control site after 1 or 2 years, and anticipation of this program further weakens the contrast between control and experimental samples. Finally, the control site lacks a program director. Unless an external agency such as a university is involved in the study, it may be difficult to collect data at the control site.

Uncontrolled observations. The great majority of reports on work-site wellness initiatives are based simply on the response to uncontrolled programs (16). Typically, they describe the changes seen over the first 3 or 6 months of a wellness program. Such data have little interest for statisticians. They point ominously to the Hawthorne effect, first described at the Western Electric Plant in Hawthorne, Illinois. Here, a dramatic jump in productivity followed the installation of new lighting, and there was much self-congratulation. Unfortunately, the new lighting was removed 6 months later to check the extent of benefits, and this second change in the working environment led to an even larger jump in productivity. It was then realized that workers were responding not to the intensity of illumination, but rather to a perception of management interest in their welfare.

In such reports, Hawthorne effects from a perception of management interest in employee welfare may influence not only productivity, but also absenteeism, employee turnover, and such lifestyle choices as cigarette smoking, alcohol consumption, and substance abuse.

Even a gain in fitness does not clearly demonstrate program success without a control group. When 1,000 employees are tested, direct treadmill measurements of maximal oxygen intake are not usually possible. Instead, investigators measure the heart rate during a submaximal cycle ergometer test or the distance covered in 12 minutes of walking and jogging (15,16). A decrease in heart rate at any given cycle ergometer setting could reflect not only an increase in aerobic fitness, but also habituation, reduced anxiety, and increased mechanical efficiency. There could also be a seasonal change in physical activity and fitness (20). Thus, it becomes very difficult to be certain whether any change in predicted aerobic power is program-related without a parallel control sample.

Other requirements of meta-analysis. Several other criteria must usually be met before data are included in a meta-analysis (21-23). A study must be well-designed and competently administered. Experimental and control subjects must either be assigned randomly or well matched. The applied treatment must be of the intended type and magnitude, and the outcome measure should not differ between studies. Particular difficulty arises in matching work-site wellness interventions. Options within a modular program differ from one company to another, and it may not be clear which options have been adopted by the typical participant. One exerciser may also attend weight loss classes, and another may combine exercise with attendance at a smoking cessation module. Sometimes it is possible to rank studies in terms of their quality. If there is indeed a true program effect, we expect to find the largest response in the best-designed experiments.

To facilitate data pooling, findings are expressed as effect sizes, such as the program-related increment in maximal oxygen intake, divided by the standard deviation of this response. It is thus necessary to reject studies that fail to indicate either the standard deviation or some similar measure of the inter-individual variance in program response (23).

A Meta-Analysis of Physical-Activity Impacts

One recent meta-analysis (15) looked at the changes in activity habits and/or measured fitness test scores that resulted from various work-site wellness programs. The method of analysis followed the usual principles of meta-analysis. An exhaustive literature search from January 1972 through August 1997 used as key words *work-site, corporate, fitness, exercise, adherence, physical activity, intervention, health education,* and *behavior modification.* Publications were sought from January 1972 through August of 1997 using the English language databases Medline, Psychinfo, Current Contents, and Biosis. One important Canadian resource, Sport Discus, was overlooked. However, the computer-generated information was supplemented by reference lists drawn from the articles retrieved, and additional information was provided by expert colleagues.

Criteria for inclusion of a study were (1) a dependent variable that measured the individual's physical activity or provided a surrogate measure such as aerobic fitness, (2) a work-site intervention designed to enhance physical activity or aerobic fitness as the independent variable, and (3) quantification of changes in the dependent variable in a manner that allowed effect size to be calculated, whether from percentages, graphs, t-tests, chi square, or F ratios.

The literature search identified 72 studies (table 3), but 7 were redundant publications, and another 25 did not use controls. Two other studies were excluded because they reported outcome and follow-up data separately. Effects derived from unstandardized measures of muscular strength or endurance (for example, grip strength, number of sit-ups, number of push-ups, and the performance of job-related skills) were also excluded if the data did not allow an estimation of measurement errors arising from practice of the task, changes in subject motivation, or observer bias. Another 12 studies did not provide enough information to calculate effect sizes. Finally, the meta-analysts were left with 26 acceptable reports, yielding 45 effects, based on a sample of some 8,800 workers.

Table 3. Results of Meta-Analysis of Studies of Work-Site Exercise and Health Programs (15)

Study Selection

72 studies identified
46 studies rejected; 7 were redundant, 25 lacked controls, 2 reported outcome and follow-up separately, and 12 did not allow calculation of effect size
Net yield: 26 studies involving 8,800 workers and reporting 45 effects

Major Findings

Physical activity or fitness increased by 0.11 standard deviations (SD) (95% confidence interval -0.2 to +0.4 SD)
Benefit larger for fitness than for physical activity
Gains smallest in corporate settings with use of health-education/risk-appraisal approach
Gains largest in public agencies or university settings with incentives for participation
Only 10% of studies reported an effect greater than 0.40 SD

Compiled from Dishman et al (15).

Findings were weighted by the size of the individual samples and were combined after making a z-transformation of effect sizes to allow for the nonlinear distribution of percentage changes in performance and fitness. The final z ratio showed a mean effect of 0.11 SD, with 95% confidence limits ranging from -0.2 to +0.4 SD. This is equivalent to increasing the success rate from the chance expectation (an improvement of physical activity in 50% of subjects and a worsening in the remaining 50%) to an increase in 56% and a worsening in 44%, a benefit that remains far from significant despite the use of 8,800 subjects. Slight heterogeneity within the sample may merit future investigation. Effects seemed larger in studies that used a non-randomized quasi-experimental design, or provided incentives to enhance the primary intervention.

Effects were weakest in studies that used a randomized experimental design, relied on a health-education/risk appraisal intervention, or were conducted within a major corporation rather than a university or public agency. However, a multiple regression equation found no significant impact from randomized vs nonrandomized design, type of intervention (health education and risk appraisal vs exercise prescription, behavior modification, or combined treatment), incentives vs no incentives, and public-sector vs private-sector work-site. The effect size was also unrelated to the duration of the intervention or to the average age of the participants. The only significant effect was for outcome, with measurements of fitness yielding a larger effect of 0.47 SD than estimates of habitual physical activity; this may be because fitness can be measured more precisely than physical activity. Fewer than 10% of studies reported an effect greater than 0.40 SD; this response is equivalent to an improvement from a chance response of 50% to an actual increase of habitual activity in 70% of workers.

Response in high-profile projects. It is particularly interesting to look at details of high-profile demonstration studies. In the United States, the best-known demonstration project has been that conducted at Johnson & Johnson (18). There, a quasi-experimental design compared gains in cycle-ergometer-test predictions of aerobic fitness for employees at test and control work-sites. The sample was large and the study well designed. Experimental work-sites showed a 10% increase in fitness score over 2 years. Unfortunately, a fair part of this apparent response was due to habituation and test learning; the advantage over control work-sites was a smaller 5.9%, and in the subgroup of employees most likely to benefit from an increase of fitness, those older than 45, the net effect decreased to 2.8%. Likewise, in the Canada Life Assurance study (19), some participants developed gains in aerobic fitness as large as 20%, but this benefit was confined to a minority of workers who became regular and enthusiastic program participants.

Thus from more than 20 years of work-site fitness and wellness programming, it appears that even in the ideal circumstances of a well-funded demonstration project, the average employee shows little change in habitual physical activity or aerobic fitness. Reasons for this failure are not hard to understand. The workers who are recruited to work-site wellness programs are a health-conscious minority. Many, previously active in community fitness programs (9), enter the work-site program with little potential to enhance their wellness further. The aerobic component of the typical work-site exercise class is also quite short (13 to 17 minutes in the Canada Life study (19), for example), and in part for safety reasons, the intensity is held to a moderate level (2). Finally, many employees attend programs sporadically. But if our objective is to enhance corporate health, we cannot focus on the minority of workers who become enthusiastic program participants; we must consider instead the response of the average worker, which is small if not nonexistent.

Enhanced health without increased fitness? There have been suggestions that physical activity of quite low intensity can enhance health without changing aerobic fitness (24), achieving this by such means as controlling body weight or enhancing the serum lipid profile (25,26). Such gains are certainly worth considering. But again, objective data are disappointing. In the Canada Life study (19), about 20 of 1,200 workers became interested in long-distance running, and this was the only group that showed a long-term improvement in serum lipid concentrations (27).

Resistance training is now a popular component of some work-site exercise programs. Such activity could reduce risks of osteoporosis and low-back injuries (28). However, any gains from resistance training would be overlooked if assessments were based simply on the scores obtained in submaximal tests of aerobic fitness.

Critique of the meta-analytic approach. Meta-analysis has its own limitations and critics. Conclusions drawn by combining effects from studies that use different interventions and different methods of assessing physical activity and fitness can be no substitute for a large, well-designed, randomized, controlled experiment with a clear intervention and equally clear measures of gains in employee wellness.

Moreover, a small increase in the physical activity of the average worker might do much to enhance public health (29). Finally, those reviewing programs must accept the slow pace of social change. It has taken some 40 years for the public to accept public health messages about smoking, and a similar period may be required to change the activity habits of the general population.

Evaluating Impacts on Health

Data on health benefits suffer from many of the design flaws discussed above. At best, changes in health status reflect what could be achieved if a wellness initiative succeeded in enhancing physical activity and fitness. The data do not necessarily indicate what will actually happen in the average work-site program, where only a few employees become enthusiastic participants.

Surveying the literature. One literature search revealed 52 studies of the effects of work-site wellness programs on health (16). Five were controlled experimental investigations, 14 were quasi-experimental studies with matched control groups, and 33 other reports described uncontrolled studies of varying quality. Two of the controlled studies did not comment on sample attrition, but a third report noted a substantial loss of participants over time. Such attrition leads progressively to a selective bias in both experimental and control groups. Analysis must thus be based on the initial assignment of participants (the "intention to treat" hypothesis), an approach that can greatly weaken the apparent effectiveness of a given treatment.

Only one of the five controlled studies measured maximal oxygen intake directly. The other four used much weaker indices: the distance walked in 12 minutes or a heart-rate-based prediction of maximal oxygen intake. Probably because of practical difficulties in recruiting volunteers to a randomized trial, three of the five trials also included only small numbers of subjects.

Several quasi-experimental studies involved much larger numbers of workers, and some continued for as long as 10 to 12 years. Again, their main weakness was a limited measure of program participation: a change in predicted maximal oxygen intake, an increase in treadmill endurance time, or a self-report of increased exercise behavior.

The remaining 33 reports had very weak research designs. Some compared program participants with nonparticipants or dropouts, despite well-recognized differences in health behavior between these three categories of people. Other reports were based simply on a test-retest design, with potential problems of habituation, test learning, Hawthorne effects, seasonal and general trends in health behavior, and cyclic trends in the labor market that alter employee attitudes toward absenteeism and illness claims.

Limitations of available data. Very few interventions were designed to provide research information. Multiple wellness services were usually available, and little attempt was made to discern which components were accepted or contributed to gains in health. Few reports considered external factors influencing program success, such as organizational policies, involvement of management and supervisors, or company goals and objectives. The programs varied from offerings for senior executives to company-wide interventions for hourly-wage workers to required programs for police and firefighters. The charges levied and the extent of preliminary medical screening also varied widely.

Effects on Specific Health Variables

Despite the problems discussed above, the available reports provide data on a number of health and fitness variables, including changes in body mass, body fat percentage, aerobic power, muscle strength, flexibility, cardiac risk factors, life satisfaction, illness, and injury (table 4).

Table 4. Reported Health and Fitness Benefits from Participation in Work-Site Exercise and Health Programs

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Body mass. Typically 1%-2% decrease in 8-12 weeks, up to 3%-6% in more effective programs. Company-wide impact negligible.

Body fat. Average decrease 13% in 19 studies; best results from combination of exercise and diet programs. Company-wide impact only a 2% decrease.

Aerobic power. Apparent gains up to 20% over 3 months in enthusiastic participants but exaggerated by test learning and habituation. One large program yielded a company-wide benefit of 7.4% in women and 4.4% in men over 2 years.

Muscle strength and endurance. Variable effect depending on type of exercise. With purely aerobic program, some muscle groups show loss of strength.

Flexibility. Gains of 10% or more in some participants, but most studies uncontrolled.

Cardiac risk factors

> Blood pressure decreases of 3-10/2-10 mm Hg in participants. One large program produced a company-wide decrease of 4/1 mm Hg.
> Serum cholesterol often unchanged.
> Percentage of cigarette smokers commonly decreases 1 to 3 points.

Mood state. Participants report "feeling better," but job and life satisfaction not necessarily enhanced.

Illness and injury. Medical claims decrease by $100-$400 per year relative to controls. Back-education programs do not seem to reduce number of back injuries.

Compiled from Shephard (16).

Body mass. Many studies show a 1% to 2% decrease in body mass over periods as short as 8 to 12 weeks. In the more effective programs, decreases as large as 3% to 6% persisted as long as 3 years. Factors that contributed to a favorable outcome included regular, supervised participation, exercise of adequate intensity and duration, associated dieting plans, and supplementation of group wellness programs by personal counseling and plant reorganization (16). Despite benefits among faithful participants, the community-wide impact was often small. In the demonstration project at Johnson & Johnson (18), weight loss averaged only 0.2% even in the enthusiasts who showed the largest gains in aerobic power.

Skinfolds and body fat. It is probably more important to reduce body fat than control body mass; indeed, a zero change in weight may reflect a loss of fat that is offset by an advantageous increase in muscle mass. Most work-site studies involved measurements of three or four skinfolds. Changes ranged from 0% over 10 weeks to a 35% decrease in body fat content over 10 years, the average response in 19 studies being a 13% decrease (16). The best results were obtained from combined exercise-and-diet programs, where body fat sometimes decreased by as much as 20% to 24% over 12 weeks. Benefits were similar for moderate or intensive counseling, and perhaps because some participants exercised away from work, fat loss was as great among infrequent as among frequent program attendees.

The least effective programs included a company-wide initiative focused on an annual medical examination, and a program in which participation was self-regulated. From a public health perspective, the numbers are not particularly encouraging. At Johnson & Johnson (18), the decrease in body fat ranged from 1.5% in workers with a small gain in aerobic power to 2.9% in those with the largest aerobic training response.

Aerobic power. Most studies have estimated gains in aerobic power from responses to repeated submaximal ergometer tests (16). With this approach, a false impression of aerobic training can result from habituation or test learning. In a few instances, scores have been based on treadmill endurance times, Canadian Home Fitness Tests scores, or 12-minute walk/jog distances. In such tests, scores can also increase because of a decrease in body mass.

Enthusiastic program participants have sometimes shown gains in aerobic power as large as 20% over 3 to 4 months, but in the Johnson & Johnson study, the 2-year difference in cycle-ergometer predictions between experimental and control work-sites averaged 7.4% in women and 4.4% in men (18). Among workers older than 45 years, the net benefit dropped to a slender 0.9 mL [kg X min], or 2.8%. Nevertheless, even this small gain may enhance community health, since recent data suggest that the largest benefit is associated with progression from the lowest to the next-lowest fitness category.

Muscle strength and endurance. Gains in muscle strength and endurance have usually been assessed from performance test scores (16). Such values depend on test learning, motivation, self-efficacy, and perceived health. A few observers have reported grip-strength scores, which are subject to the same influences as other strength measures. Moreover, the forearm muscles receive little stimulation during a typical work-site fitness program, and indeed participants sometimes show a *decrease* in grip strength. In contrast, one uncontrolled study of circuit training found a 7% increase in strength over a 12-month period.

Flexibility. Nine studies have examined changes in lower back flexibility as measured by the sit-and-reach test (16). This test, commonly used by physical educators, is very simple to perform. It is unclear how well this test reflects either the overall flexibility of the body or the risk of low-back injuries. Most studies found gains in sit-and-reach score, sometimes amounting to 10% or more, although only two studies were controlled. Cox and associates (19) found similar gains in low and high adherents, whereas Ostwald (30) noted larger improvements among frequent program participants.

Two studies looked at upper-body flexibility. Hilyer and associates reported substantial program-related improvements in shoulder extension (31), and Stone and colleagues noted an 11% gain in upper-body flexibility after 10 years of program operation (32).

Cardiac risk factors. The influence of program participation on cardiac risk factors has sometimes been reported as a global risk score and sometimes as a change in the prevalence of individual risk factors.

The Canada Life study applied the Canadian Health Hazard Appraisal questionnaire (33). This instrument calculates the risk of death from each of 12 major diseases over the next 10 years. This risk is compared with population norms, and each participant is then assigned a biological, or "appraised," age. Risk-taking behaviors increase appraised age relative to calendar age, but this discrepancy is reduced as the risk-taking behaviors are corrected. After 6 months, post-hoc analyses showed a 2-year decrease in appraised age among male high adherents. However, in part because they entered the study with lower health risks and in part because they valued the program as much for its social aspects as for the exercise, female participants showed little change in appraised age.

In another study, Heirich and associates (34) noted a 35% to 45% decrease in overall cardiac risk over 3 years. The most effective intervention involved ready access to a fitness facility, combined with a vigorous outreach program, personal counseling, and organizational changes that facilitated work-site exercise. In addition, Blair and associates (18) saw a substantial decrease in overall cardiac risk after 2 years in the Johnson & Johnson program. Again, the decrease in risk was associated with program participation, as judged from the individual's gain in maximal oxygen intake.

Among individual cardiac risk factors, decreases in body fatness have already been noted. Effects on blood pressure, serum cholesterol, and cigarette smoking have also been studied.

Blood pressure. In terms of resting blood pressure there have been one or two negative reports. Most observers have described program-related decreases in blood pressure in the range of 3 to 10 and 2 to 10 mm Hg for systolic and diastolic readings, respectively (16). However, blood pressures are quite sensitive to habituation, and only four of the blood pressure studies were controlled. In the Johnson & Johnson trial (18), the net effect after 2 years was a decrease of 4 mm Hg systolic and 1 mm Hg diastolic pressure relative to controls. Although statistically significant, such a change would have only a marginal clinical impact.

Serum cholesterol. Several authors have described up to a 15% decrease in serum cholesterol, sometimes accompanied by significant increases in HDL cholesterol (16). Ten of 15 such studies were uncontrolled and thus were susceptible to the general trend to lower consumption of animal fat. Some programs included specific advice on how to lower cholesterol levels. Spilman et al (35) commented that in their study group, improvement was limited to those who enrolled in the cholesterol reduction module of the program. One controlled study with a relatively low level of energy expenditure per exercise bout found little change in serum cholesterol at either 6 months or 10 years (27). Both Ostwald (30) and Blair et al (18) described beneficial changes; these seemed related to exercise intensity, but were less clearly linked to the gain in aerobic power.

Cigarette smoking. Smoking cessation has commonly been assessed from self-reports. Such information is susceptible to wish-bias; some 10% of smokers claim to have stopped smoking when in fact they have failed to do so. Nine of 10 work-site studies reported a decrease in smoking (16), commonly a 1- to 3-point decrease in the percentage of smokers. The one study where there was no change involved blue-collar workers (36), a group where smoking retains much greater peer support. The Canada Life study (33) noted a better response in men than in women. Other observers commented that the response to an exercise program was as good as that elicited by completion of a lifestyle inventory or a health-risk profile. One report stressed that the success rate was enhanced by a specific smoking withdrawal module (35).

Life satisfaction and well-being. Exercisers often comment that physical activity makes them "feel better." There has been less formal exploration of changes in life satisfaction, mood state, and well-being (37-39). Suggested reasons for "feeling better" have ranged from relief of boredom and/or tension and stress to an optimization of arousal and a secretion of catecholamines and endorphins.

People who like exercise certainly feel better if they exercise. But it is less clear whether sedentary people find an increase in well-being if they start a low-level exercise program; in the first few weeks, pain may exceed gain. A number of work-site initiatives have claimed an enhanced mood state, but most have lacked controls (16). Skepticism about such claims is increased because there seems to be little carryover into formal measures of job satisfaction, job performance, job-related stress, or the reporting of repetitive strain injuries.

Perhaps the most convincing indicator of improved mood is an early reduction in medical claims (10). A person who feels better is less likely to visit a physician with minor complaints. The drop in demand for medical services is greatest in programs directed to executives, suggesting that the mechanism may be a reduction in stress. In support of this view, one study of firefighters (40) found that the increase in heart rate when responding to a fire alarm was reduced by participation in a fitness program, the benefit being proportional to the increase in maximal oxygen intake.

Illness and injury. Many authors (41,42) have pointed to a small decrease in absenteeism among program participants, typically no more than half a day per worker per year. This may reflect an improved mood state or an increase in organizational loyalty rather than improved health. Self-reports of illness, physician and hospital visits, drug purchases, and perceived health certainly show favorable change with involvement in work-site wellness programs (16), but such data are vulnerable to seasonal and general changes in the prevalence of illnesses. A further difficulty is that a few employees are responsible for much of the absenteeism and medical claims. Moreover, during the first year of an exercise program, claims may be distorted by minor exercise-induced injuries and medical clearance procedures (5,6).

Nevertheless, a few studies have obtained data on claims against either government or private health insurance programs. The costs incurred by exercise program participants have decreased by $100 to $400 per worker per year relative to control sites (10). One study (43) obtained a breakdown of diagnostic categories, and it showed no increase in diagnostic cardiology, though an increase might have been expected from medical clearance procedures. Likewise, there was no increase in musculoskeletal treatments, which might have been expected from exercise-induced injuries. In contrast, a few studies (44, 45) from Europe have suggested that participation in highly competitive team sports such as soccer can boost medical expenditures.

Exercise and educational programs designed to minimize back injuries have had varying success. An uncontrolled study (46) suggested that a combination of counseling and an aerobics program reduced such injuries among firefighters. However, an insurance company found no evidence of reduced injury rates in companies that provided employees with specific training in lifting techniques (47). Daltroy and associates noted that education and reinforcement of safe lifting techniques increased the theoretical knowledge of postal workers, but it did not diminish the number of "tired backs" (48). Likewise, a hospital study (49) showed a 19% improvement in employees' lifting techniques, but no changes in either fatigue or back pain. Wood (50) suggested that any benefit from a back education program was quickly outweighed by the consequences of an associated personnel program that increased liaison between injury claimants, the personnel manager, and workers' compensation officials.

Future Directions

The major lesson from meta-analysis is that most work-site wellness programs are not very effective in enhancing habitual physical activity or markers of wellness. Nevertheless, meta-analysis also provides some clues to directions for future research. Suggestions that effect size can be increased by behavioral modification and the use of incentives merit careful confirmation on larger samples of subjects. The apparently greater response in university populations is intriguing; the relaxed schedules of a university may allow more faithful program participation, or a higher level of education among program participants may enhance the impact of the wellness message. Suggestions that effects can be increased by behavior modification and the use of incentives merit further investigation. It may be helpful to focus attention on dropouts, encouraging them to make repeated attempts to adopt a healthy lifestyle until they succeed. There is also likely to be a greater emphasis on manipulating the overall environment to encourage adoption of a healthy lifestyle.

Another challenge will be to take programs that have been effective in large corporations and adapt them to the needs of small companies, service industries, and the self-employed. Planners must also take account of the globalization of our economy. In the short term, major corporations may be tempted to export work to third-world countries where there is little incentive to provide work-site wellness initiatives. But in a longer perspective, the trend to globalization offers an opportunity to export effective tactics to enhance work-force and population wellness. Finally, in seeking continued support for wellness initiatives, it may be helpful to enlist experienced health economists who can demonstrate more conclusively the potential linkage between enhanced health and corporate profitability.

Conclusions

Enthusiastic participation in work-site wellness programs can yield a variety of health benefits: decreases in body fat, increases in aerobic power, muscle strength, and flexibility; enhanced mood state; and reduced medical insurance claims, with associated decreases in absenteeism and increases in productivity. However, only a minority of employees participate in work-site wellness programs, and even fewer have the enthusiasm needed to realize health benefits. Neither program participation nor wellness response rises in direct proportion to the capital invested in wellness personnel, programs, facilities, and equipment.

It seems that the most effective--and certainly most cost-effective--tactic is to provide a moderately well-equipped facility coupled with an active outreach to nonparticipating employees, one-to-one counseling, and a corporate environment that encourages a healthy lifestyle. The optimal approach probably is to supplement a simple exercise facility with optional program modules addressing such issues as diet, weight loss, cholesterol reduction, smoking withdrawal, substance abuse, and stress reduction.

Nevertheless, the development of wellness programs that will sustain the involvement of the majority of employees is a continuing research challenge.

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Dr Shephard is a professor emeritus of applied physiology on the Faculty of Physical Education and Health at the University of Toronto. He is a fellow and past president of the American College of Sports Medicine. Address correspondence to Roy J. Shephard, MD, PhD, DPE, PO Box 521, Brackendale, BC V0N 1H0, Canada; e-mail to royjshep@mountain-