Impact of a Physical Fitness Program in a Blue-Collar Workforce

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Abstract:

The purpose of this study was to examine the impact of participation in the Wellness — Paths to Health Physical Fitness Program on selected physiological and personal health variables including blood pressure, pulse, body weight, trunk flexibility, cardiovascular endurance, abdominal strength, percent body fat and a cumulative fitness score.

The subjects (N=129) of this study were divided into four levels of adherence to this exercise-based health program. Data analysis examined relationships between adherence levels and changes in the selected physiological and personal health variables across two measures. In addition, data from high-risk participants were analyzed.

The results of the study found statistical significant changes in the selected variables between repeated assessment measures. In addition, statistically significant relationships were found between levels of adherence to the program and six of the dependent variables.

Article:

Research outcomes of worksite health and fitness programs have shown programs to be effective in improving employee productivity,[1-3] reducing absenteeism,[4-6] reducing health insurance and health-care costs[7-9] and improving health-related measures.[4,5,10,11] The nature of the business environment, often mandates an emphasis on short-term cost effectiveness measures as desirable outcomes of worksite health and fitness programs.

Emphasis on short-term outcomes has overshadowed the potential long-term benefits of continuing worksite health-enhancing programs. There is a strong and growing body of literature that supports the use of worksite fitness programs to reduce the incidence of major chronic health problems such as cardiovascular disease.

Several authors have examined the relationship between physical activity and health, concluding that increased physical activity is associated with reduced risk of cardiovascular disease.[12-15] Knadler, and colleagues[16] indicate that individuals involved in physical activity, as compared to sedentary individuals, can favorably modify cardiovascular risk factors such as hypertension, elevated blood lipids, and obesity, thereby reducing the incidence of cardiovascular disease. [16]

The definition of physical activity and fitness presents a problem for researchers in this field.[17] Definitions of physical activity/fitness have varied from job descriptions requiring heavy labor (e.g., loggers)[18] to self-appraisal of physical activity.[19,20] Physical fitness has been defined as the capacity to perform prolonged heavy work, thereby indicating body strength and cardiovascular function.[21] Some researchers have questioned the use of physical fitness in the study of cardiovascular disease due to the influence of genetic factors in determining physical fitness.[22-24] However, these concerns can be minimized through the measurement of fitness gains as an outcome of regular physical activity.

In this paper the authors examine the impact of a pilot physical fitness program in a blue-collar workforce. More specifically, a summary of fitness gains of blue-collar workers engaging in a company sponsored fitness program will be provided in detail.

Physical Fitness at the Worksite

Although studies abound on the positive benefits of physical activity at the worksite, many are lacking in regard to rigorous scientific analysis. Most physical fitness programs are offered in concert with other health-promotion initiatives. The interrelationship of program outcomes often complicates the researchers' ability to discern the true impact of a separate program initiative. Consequently, researchers need to be cautious When interpreting fitness data and health outcomes.

Worksite fitness programs that are of short duration (14-15 weeks) have demonstrated positive improvements of cardiovascular risk factors. Bjurstrom and Alexion[25] studied 847 volunteers in a 15-week fitness program. Subjects participated in aerobic activities for one and one-quarter hours per work day. Statistical analysis of fitness data indicated significant and positive changes in blood cholesterol, body weight. and maximum oxygen uptake ($V0_2$max). No changes were detected in systolic and diastolic blood pressure. Similar results were obtained by Pauly et al.[26] Pauly and colleagues examined 73 subjects who participated three times or more per week in a worksite fitness program. This program lasted 14 weeks, and participants used a self-selected work schedule consisting of an aerobic program. Significant and positive changes were observed in VO^2max, blood cholesterol, and systolic blood pressure. No significant changes were detected for diastolic blood pressure and body weight. Studies of greater duration have demonstrated that fitness gains persist over longer intervals.

Yarvote examined 309 volunteers involved in a worksite fitness program. The fitness program consisted of an interval-circuit form of training. Statistical comparisons of initial fitness measures and six-and-twelve month measures showed significant and positive improvements in body weight, body fat, systolic blood pressure, diastolic blood pressure, and maximum oxygen uptake ($V0_2$max). Analysis of blood cholesterol indicated significantly lower levels at six months but not at the 12-month measure.[27]

Blair, Piserchia, Wilbur, and Crowder examined the impact of a public-health intervention model for worksite health promotion on exercise and physical fitness over a two-year period.[10] In this study, four corporations served as the experimental group (N-2600) while three corporations where employees were offered only annual health screenings served as the control group (N-1700). These researchers found statistically significant decreases in body weight, percent body fat and systolic blood pressure in maximum oxygen uptake ($V0_2$max) change categories; indicating that as employees improved in VO_2max, they also improved in these three categories. Data also indicate that employees showed improvements in diastolic blood pressure, cholesterol levels, and HDL levels, but there was no significant difference between VO_2max change groups in the 24-month period. On these measures, all VO_2max change groups improved. [10]

The findings of Cady et al, on a group of Los Angeles firefighters has further demonstrated the cardiovascular benefits to be gained from ongoing fitness programs.[28] These researchers have assessed a group of firefighters previously examined by Barnard and Anthony. Barnard and Anthony's findings showed that firemen involved in an ongoing fitness program had significantly better VO_2max, diastolic blood pressure, and cholesterol measures. Cady's analysis of this group, 10 years into a fitness program, shows continued improved fitness levels and reduced cardiovascular disease risk factors for the experimental group of firefighters over the comparison group.[28]

Although research findings of worksite fitness and health programs are demonstrating positive gains with regard to cardiovascular disease risk factors, there have been some limitations in these studies. Most studies have examined white-collar workers, and it remains to be demonstrated whether similar worksite and health enhancing will impact as effectively on the blue-collar workforce. This manuscript highlights the impact of a program designed for a blue-collar workforce on selected physiological and physical health measurements. It will serve to highlight the notion that results similar to those found in the research on white-collar workers can accrue from programs designed for blue-collar workers.

Method

All participants in this study were employed at the Philadelphia plant of Rohm and Haas, Inc. This division of Rohm and Haas, a chemical manufacturing firm, is a production-oriented workforce. The Philadelphia plant employs 800 workers, of which 75% are male. The average age of the workforce is 49 years, and there is greater than expected incidence of cigarette smoking, obesity, alcohol consumption, and hypertension among the workforce studied at Rohm and Haas.

Because the potential participants displayed a higher incidence of "at risk" health behaviors, some would speculate) that this group would be less likely to initiate and adhere to a physical fitness' program. This notion has not been rigorously examined.

A comprehensive health and fitness, program titled “Wellness - Paths to Health” was established for Rohm and Haas employees in 1985. The overall goal of this program is to reduce employee health risks through effective programming.

“Wellness - Paths to Health” is the formal name for the company health promotion program. It includes the following components: preventive medical exams, hypertension screening and counseling, smoking cessation, rehabilitation of disabled employees, general health education, and employee assistance programs. The Philadelphia plant of Rhom and Haas began this pilot project in December 1985.

The pilot project used structured physical exercise as the centerpiece for health-improving activities. This approach was based on the belief that improvements in health will more readily occur once an employee is involved in a program of regular exercise. An 8,000 square foot multi-purpose health and fitness center was constructed on company grounds. All employees at the Philadelphia Plant were invited to participate in the exercise program. Eligibility for participation was based upon the completion of a 4-step screening process that included a physical exam, fitness and lifestyle assessment, review of fitness and lifestyle data, and an exercise orientation.

It is important to note that no suitable control group within Rohm and Haas was available for this study. Therefore, it was not possible to control for endogenous variables. Eddy, Gold, and Zimmerli state that "endogenous change occurs independently from a health promotion program and often reflects a widespread societal phenomenon."[30] Endogenous change may obscure the evaluation of program effectiveness. Clearly, societal changes in health-related attitudes and behaviors may yield a change in participation rates in physical fitness in the general population. Consequently, it is not possible to assess to what extent changes resulting from program participation would have occurred even if no program had been provided to employees. The inability to control for such extraneous variables is a limitation of this study.

Data were collected using the General Fitness Assessment Inventory designed specifically for the health and fitness Program at Rohm and Haas. The inventory form records demographic data, test Monitoring data, and data on the physiological variables including resting heart rate, resting systolic and diastolic blood Pressure, percent body fat, body weight, upper-body strength, abdominal strength. and low-back flexibility. Guidelines of the American College for Sports Medicine were followed for all health-related fitness evaluation and programming in the health and fitness center.

Resting heart rate was measured via carotid palpation for a 30-second interval. Blood pressures were measured using a pneumatic mercury-column sphygmomanometer (PyMaH Trimline) and were taken on the nondominant arm. Percent body fat measures were taken using the Jackson and Pollock protocol, taking three skinfold sites and using the Lange skin-fold calipers. Calculations of percent body fat were made using the regression equations from the Jackson and Pollock protocol. Weight and height were measured using the standard balance scale (Detecto Medic). Upper-body strength was assessed by having the participant do as many push-ups as possible; abdominal strength was assessed with a 60-second sit-ups protocol. Low-back flexibility was evaluated using a Trunk Flexibility Tester allowing the participant a "best of three" score for his performance on this sit-and-reach task.

Cardiovascular endurance measurements were made using a six-minute bicycle ergometer test following the Astrand-Rhyming protocol for a 70-85% achieved (submaximal) increase in heart rate. Exercise heart rates were recorded via carotid palpation at the completion of each minute. A participant's cardiovascular endurance level was computed using the Astrand and Rhyming nomogram for estimating oxygen consumption at specific workload and heart rate combinations. The results of this calculation were then adjusted for body weight and multiplied by the appropriate age correction factor as recommended by the Astrand Rhyming protocol.

In this study, adherence to the program was identified as the independent variable. The staff of the health and fitness center carefully monitored the frequency of employee use in terms of absolute visitations to the center. The length and relative fitness value of each visit was not recorded. For the purpose of this study, program adherence was classified as follows:

1. Non-Exercisers—joined but never participated.

2. Low Adherence—participated less than one time per week.

3. Adherence —participated one to two times per week.

4. High Adherence —participated three or more times per week.

It was found after data collection that there were no employees in the non-exerciser category in the study population so this category was eliminated from the analysis.

The dependent variables examined were all those physiological measures recorded on the inventory form. These variables included the following:

- Low-Back Flexibility (Trunk Flex)
- Cardiovascular Endurance (C.V.E.)
- Resting Heart Rate
- Resting Blood Pressure (systolic)
- Resting Blood Pressure (diastolic)
- Weight
- Percent Body Fat
- Upper-Body Muscular Endurance (push-ups)
- Abdominal Muscular Endurance (sit-ups)
- Fitscore — A Combined Fitness Score

A time-series repeated-measure design was used to answer the following research questions:

1. Was there a statistically significant change in the ten physiological variables across repeated measures?

2. Was there a statistically significant relationship between adherence levels and changes in the six of the ten physiological variables?

3. Was there a relationship between selected demographic variables across repeated measures for high-risk employees?

With regard to data analysis, t-values were calculated to assess changes between the baseline and first follow-up assessment, and Pearson correlation coefficients were used to examine the relationship between changes in the dependent variables and adherence levels.

For the purpose of this study, high risk employees were identified to be "at risk" in three categories: blood pressure, percent body fat and fitness scores. For blood pressure, both moderate-and high-risk groups were identified. The moderate-risk group consisted of employees with blood pressures between 140 and 150 systolic and 90 to 95 diastolic. The high risk blood pressure groups were employees with blood pressure readings greater than 150 systolic and 95 diastolic. For percent body fat, only males with greater than 25% fat were examined. And, the risk group for low-fitness consisted of employees with scores lower than 2.5. All this group were assigned based on pre-assessment scores.

TABLE 1

Selected Demographic Variables

Job Category	Frequency	Percent
Mechanical	24	18.6
Production	51	39.5
Tech Services	19	14.7
Human Resources	7	05.4
Safety and Health	4	03.1
Management	11	08.5
Shipping	2	01.6
General Services	6	04.7
Research	3	02.3
Home Office	2	01.6
	129	100.0%
Job Classification		
Hourly	69	53.5
Salary	60	46.5
	129	100.0%
Participation Levels		
Low	24	18.6
Medium	47	36.4
High	58	45.0
	129	100.0%
Gender		
Males	117	90.7
Females	12	09.3
	129	100.0%

Results

Results of the analysis will be discussed as related to the pre-identified research questions. First, the demo-graphic variables will be examined to provide background information on the nature of program participants. Table 1 provides information on gender, job classification, job categories, and participation levels. Three job categories, mechanical, production, and technical services, composed 72.8% of the sample Population. Program participants were Predominately male (90.7%). Due to the extremely small sample size for females, the results of differences by gender were not reported.

In regard to participation levels (adherence to the program), it was encouraging to note that the high adherence group Was the largest subgroup, comprising 45.0% of the sample population. Anecdotal comments of the participants have indicated that those who tend to join the program tend to believe their participation is worthwhile and their adherence to the program is favorably influenced.

The first research question was designed to examine if a statistically significant change occurred in the physiological variables between measurements. Table 2 provides these data. For all variables there were statistically significant improvements between measurements. For example, systolic blood pressure on the average was reduced by approximately six points (mmHg) between measurements, while diastolic blood pressure was decreased by almost four points (mmHg). Even though the average blood pressure readings would be considered in the "normal" range, the staff at Rohm and Haas was encouraged by the reduction in blood pressure resulting from participation in their program.

The average fitness-score change reflected the cumulative effect of changes in blood pressure, resting heart rate, cardiovascular endurance, abdominal strength, upper-body strength, and percent body fat. Clearly, for those employees who participated in the program, there Was a statistically significant improvement in all of the dependent variables.

As a means to show the relationship between adherence levels and changes in the physiological variables, the second research question asked if changes in adherence levels were positively correlated with improvements on the physical fitness variables. These results are provided in Table 3. There were statistically significant relationships between pounds lost, decreased diastolic blood pressure, improved low-back flexibility, increased push-ups, reduced percent body fats, and improvements in total fitness as participation levels increased. These data support the notion that as participation increases so does the likelihood of improvement in the physical fitness variables.

TABLE 2
Changes in Selected Health and Fitness Variables Between Observations

Variable	N	Mean	Standard Deviation	T-Value	Probability
Weight					
Pre	127	186.72	29.08	-5.17	0.001
Post		183.81	27.62		
Systolic BP					
Pre	128	124.84	14.75	-6.67	0.001
Post		118.81	10.24		
Diastolic BP					
Pre	128	79.21	7.84	-6.75	0.001
Post		68.23	7.11		
Pulse					
Pre	128	72.70	10.78	-5.71	0.001
Post		68.23	10.11		
Cardiovascular Endurance					
Pre	126	29.63	8.99	14.47	0.001
Post		37.83	9.28		
Flexability					
Pre	126	15.16	3.05	7.52	0.001
Post		16.23	2.95		
Abdominal Strength (Sit-Ups)					
Pre	119	27.95	9.95	15.07	0.001
Post		37.04	10.54		
Upper-Body Strength (Push-Ups)					
Pre	116	18.60	11.39	9.95	0.001
Post		24.61	13.11		
Percent Body Fat					
Pre	126	21.73	5.07	-11.22	0.001
Post		19.26	4.72		
Fitness Score					
Pre	121	2.66	0.55	20.75	0.001
Post		3.42	0.47		

TABLE 3
Correlation Coefficients Between Adherence Levels and Selected Health and Fitness Variables

Variable	N	Correlation Coeffiecients	Probability
Change In			
Weight	127	-0.2080	.003*
Systolic BP	128	-0.0404	.570
Diastolic BP	128	-0.1566	.030*
Pulse	128	-0.0742	.294
Cardiovascular Endurance	126	0.1259	.077
Flexibility	126	0.2580	.001*
Abdominal Strength (Sit-Ups)	119	0.1734	.018
Upper-Body Strength (Push-Ups)	116	0.3429	.001*
Percent Body Fat	126	-0.2217	.002*
Fitness Scores	121	-0.2274	.002*

* statistically significant findings

Even though not all of the physical fitness variables were significantly correlated with adherence levels to the program (e.g., systolic blood pressure, pulse, cardiovascular endurance, and abdominal strength), changes in the total fitness score were related; indicating that as participation in the program increased, total fitness scores tended to improve.

Results of the analysis of the predetermined high risk groups are provided in Table 4. The results show statistically significant improvements for all at-risk categories except diastolic blood pressure. In essence, participation in the program generally yielded improvements for those "at-risk" in their at-risk category. In the case of fitscore and percent body fat such changes would be expected to occur as a result of participation in a physical fitness program over time. For example, those employees "at-risk" for percent body fat would be expected to weigh more than the average employee. Therefore, participation in a physical fitness program would be likely to yield reductions in both weight and percent of body fat.

TABLE 4
Changes in High Risk Groups for At-Risk Variables

At-Risk Group for Variable	N	Mean		T-Value
Systolic BP=140-150	15	Pre	142	-5.71***
		Post	126	
Systolic BP over 150	6	Pre	138	-5.41**
		Post	105	
Diastolic BP=90-95	9	Pre	90.0	-1.26
		Post	87.6	
Diastolic BP over 95	5	Pre	98.6	-5.48**
		Post	78.8	
Percent Body Fat over 25% (Males Only)	27	Pre	28.1	-9.70***
Fit Scores Less Than 2.5	49	Pre	2.1	-17.89***
		Post	3.1	

* p.05, ** p.01, *** p.001

High risk employees often have a greater likelihood of yielding statistically significant changes because of their baseline measures. The practical significance of these changes must be gauged on an individual basis. Yet, it is encouraging to note that "at-risk" participants can reduce their risk level by participating in a fitness program.

Since participants in this study were self-selected, there is no way of knowing if these employees would have changed levels of physical activity even without a company-sponsored program. Also, because no real control group was used in this study, it cannot be determined if non-participants were making similar lifestyle changes on their own or in other structured programs.

Summary and Conclusions

Based on the data analysis, the following statements concerning the effectiveness of the health and fitness program at Rohm and Haas, Inc., are offered:

1. Participation in the program resulted in an overall significant improvement on all of the health and physical fitness measures.

2. Increased adherence to the program was significantly related to improved low-back flexibility, fitscores, abdominal strength, upper body strength, a reduction in pounds lost and diastolic blood pressure.

3. Differences between hourly and salaried employees related to pounds lost, reduction of percent body fat and improved fitness scores were observed.

4. At-risk employee groups showed significant improvements in risky health behaviors. High-risk blood pressure groups improved blood pressure, percent body fat, and reduced fat; and the low fitness score group improved these scores also.

In conclusion, these results support the belief that the health and fitness program at Rohm and Haas is having a significant impact on improving the health of program participants. From a broader perspective, the authors believe that this study will help to enhance the literature base related to the benefits of worksite health promotion.

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