

DTIC FILE COPY

2

PHYSICAL FITNESS GAINS FOLLOWING SIMPLE ENVIRONMENTAL CHANGE

AD-A223 781

DTIC
ELECTE
JUL 12 1990
S D & D

**J. M. LINENGER
C. V. CHESSON
D. S. NICE**

REPORT NO. 90-6

Approved for public release: distribution unlimited.

**NAVAL HEALTH RESEARCH CENTER
P.O. BOX 85122
SAN DIEGO, CALIFORNIA 92186-5122**

**NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
BETHESDA, MARYLAND**



90 07 12 008

PHYSICAL FITNESS GAINS FOLLOWING SIMPLE ENVIRONMENTAL CHANGE

Jerry M. Linenger, M.D., M.S.S.M., M.P.H., Ph.D.
Department of Epidemiology
University of North Carolina
Chapel Hill, North Carolina
and
Naval Health Research Center,
San Diego, California

and

Charles V. Chesson, II, LT, MSC, USNR, and
D. Stephen Nice, Ph.D.

Naval Health Research Center
P.O. Box 85122
San Diego, California



Accession For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

Report No. 90-6 was supported by the Naval Medical Research and Development Command, Department of the Navy, under Work Unit No. 63706N M00095.005 and the Naval Military Personnel Command (Work Order No. N0002289 WRWW542). The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government. Approved for public release, distribution unlimited.

We thank Victor Schoenbach, Ph.D., and Carl Shy, M.D., of the Department of Epidemiology, University of North Carolina-Chapel Hill; Robert Fletcher, M.D., editor, Annals of Internal Medicine; Gordon DeFries, Ph.D., Director, Health Services Research Center, University of North Carolina-Chapel Hill; and Lars-Goren Ekelund, Department of Biostatistics, University of North Carolina-Chapel Hill for their invaluable assistance. We also thank VADM James Service, USN (retired), CAPT John Butterfield, USN (retired), CAPT Dallas Boggs, USN, and CAPT Ronald Ohlund, MC, USN, who cared enough about the sailors and were salty enough to make the Health Promotion Program happen.

Summary

Inactivity is the risk factor with potentially the greatest public health impact according to the 1989 U.S. Preventive Services Task Force report. This study reports changes in the physical fitness level following simple changes aimed at enabling community members to more easily adapt active life-styles.

Simple environmental and social alterations were made at a San Diego Naval Air Station. A cohort of active-duty personnel from within this community (n=1,609) was administered both a physical readiness test (PRT) and a lifestyle questionnaire at baseline and at one year. The PRT consisted of a 1.5-mile timed run, sit-ups, push-ups, and percent body fat components, while the questionnaire addressed demographics, current exercise behavior, and attitudes toward exercise. Similar measures were taken within a comparison community cohort (n=217) and within a Navy-wide sample cohort (n=546).

Overall PRT category and 1.5-mile run time both improved significantly ($P<.05$) over time at the intervention community (0.3 category points and 18 seconds, respectively). The increase was significantly greater ($P<.01$) than at either the control community or within the Navy-wide sample. Subgroup analysis showed that at the intervention community 12.4% failed the overall fitness test in 1987, but only 5.1% failed in 1988. Similarly, the 1.5-mile run failures decreased from 8.4% to 4%. Reported leisure time kilocalorie expenditure showed no significant improvement.

This simple program was successful in improving fitness performance. The improvement was distributed throughout the community and included those who were substandard at baseline. Similar programs could easily be adopted in a variety of communities.

Physical Fitness Gains Following Simple Environmental Change

Jerry M. Linenger, Charles V. Chesson, D. Stephen Nice

Introduction

The U.S. Preventive Services Task Force, after performing meta-analysis of 43 studies, found that coronary heart disease (CHD) is 1.9 times as likely to develop in a physically inactive person than in a physically active person.¹ They noted that persons who are physically active on a regular basis live an average of two years longer than physically inactive persons and have a lower death rate from a variety of causes. They also suggested that the most significant potential health gains from exercise could be achieved by those who are presently most ill-conditioned and/or sedentary.

Fostering greater physical activity in large segments of the population thus becomes critical. The Office of Disease Prevention and Health Promotion recommends that due to (1) the widespread prevalence of risk factors across the population and (2) the difficulties in targeting high-risk populations, the best approach is to intervene across entire populations.² A community or public health intervention model may be more effective in producing the widespread exercise changes.³ These programs should systematically introduce risk-factor modifying interventions aimed not at specific clusters in the target population, but rather at the entire worksite or the community as a whole. Targeting specific subgroup clusters has not proven cost-effective due to the huge population burden of cardiovascular vascular disease and to the inability to segregate effectively those at higher risk from the generally high-risk background population.² In this report, a simple environmental/social change program designed to facilitate a more active lifestyle is evaluated.

Methods

Design. The study was conducted in a prospective manner using before-and-after measures. It compared changes in fitness in a San Diego, CA intervention community to a Sunnyvale, CA control community and to a Navy-wide sample over a one-year period. The communities were selected to be similar based on the following criteria: (1) size, (2) aviation

mission, (3) mix of personnel, (4) climatic conditions, and (5) comparable facilities.

The study proceeded as follows: (1) the three cohorts were administered both a physical readiness test (PRT) and a questionnaire over a two-month period, (2) the intervention community underwent environmental and social interventions aimed at lessening the barriers to increased activity, and (3) the PRT and questionnaire were repeated one year after baseline. The primary measure was a change in the 1.5-mile run time and overall physical readiness test (PRT) score from baseline until one year. Secondary outcomes included changes in attitudes and/or knowledge concerning the importance of fitness, the utility of exercise, and the self-rating of current fitness. Changes in the average number of kilocalories (kcal) expended per week were also assessed. Variables considered for control were gender, age, officer/enlisted status, paygrade, education, marital status, and baseline performance.

Following the National Institute of Health's National Heart, Lung, and Blood Institute's and National Cancer Institute's guidelines for research phases for the development of health promotion programs as integrated by Flay, the study is a phase IV prototype study.⁴ As defined, phase IV prototype studies are either experimental or quasi-experimental tests of complete programs, using a small number of aggregate units (e.g. worksites, schools, or communities) per condition, with measures that include behavioral outcomes. The proposed study meets the criteria measuring behavior change by both objective Physical Readiness Test (PRT) results and subjective (survey response) methods. By U.S. Preventive Services Task Force criteria modified from those originally developed by the Canadian Task Force on the Periodic Health Examination, it meets grade II-2 rules of evidence: comparison between time or places with or without intervention.⁵

Study population. Since the intervention was applied to the entire community, all active duty military personnel were initially eligible to be included in the study. If a squadron was deployed during the initial two-month testing period (deployment usually lasting six months), all members of the squadron were considered ineligible. Within eligible squadrons, baseline physical readiness test (PRT) and survey were given

only to those individuals who were not expecting transfer orders for at least six months. Surveys were completed only by those individuals eligible for PRT testing during the two-month testing period. The major reasons for missing squadron PRT testing included vacation, awaiting required medical screening, short-term duty away from the squadron, or previous PRT testing within the four prior months. PRT testing is a mandatory semi-annual requirement for all Naval personnel. Individuals do not have the option to refuse testing.

As shown in Table 1, of the 10,500 military personnel stationed at the intervention worksite, approximately 7,875 were eligible to be tested. Only 3,402 received their PRT during the 2-month testing period. Of these, 1,609 completed testing one year later for a 47% follow-up rate.

The control 1 community (Naval Air Station Moffett) had 5,250 active duty members. Approximately 3,937 were eligible for testing at baseline, with 326 reports of completed PRT's obtained during the 2-month 1987 data-collection period. Of this group, 217 completed testing one year later for a 67% follow-up rate. The primary reason for not obtaining more testing results at baseline was that the test had already been completed within the previous four months and that the squadrons at this location were unwilling to repeat testing for study purposes only. Logistical problems and inter-organizational lack of cooperation also contributed to the low baseline coverage at this site.

Another investigator studied worldwide Navy trends in PRT performance using a random sample of Navy active duty personnel.⁶ The sample consisted of a dynamic cohort with a fitness test administered every six months and a survey yearly. Using these data, subjects with 1987 PRT results were selected to comprise control group 2. Of the 1,250 with PRT results recorded in 1987, 546 (44%) were followed through 1988.

Data analysis. An edit program which checked for out of range values was used to flag outliers. Outliers were then evaluated using the hard copy questionnaires and fitness test recording forms. The data were entered and stored on a VAX minicomputer at the Naval Health Research Center, San Diego. Analyses were done using the SPSSx Informational Analysis System (SPSSx, 1988). Descriptive statistics were done for

Table 1 - Cohort Selection Process for MAS North Island (intervention),
MAS Moffett (control 1) and Navy-Wide Sample (control 2)

	MAS NORTH ISLAND (intervention)	MAS MOFFETT (control 1)	NAVY-WIDE Sample (control 2)
Avg. daily count	10,500	5,250	605,000
# eligible at baseline ¹	7,875	3,937	N/A
# reporting results of fitness testing during the 2 month 1987 data collection period	3,402	326	1,250
Cohort (# completing fitness testing at both time 1 and time 2)	1,609	217	546
Cohort % follow-up	47%	67%	44%
% within cohort completing both questionnaires	69.9%	32.3%	58.1%

NOTES:

1. Satisfying entry criteria of not being scheduled to (1) leave the Navy or (2) change duty station or (3) deploy with their unit within six months of initial testing.
2. Fitness testing is required to be done every six months.
3. Navy-wide sample selected by a two-step process. The first step selected 119 command units from approximately 5,000 in the Navy. Second, individuals were randomly selected from each of the 119 command units.

overall PRT score, each component PRT score, demographics, and questionnaire data. Plots of the distributions were made and assessed for normality. Both maximal aerobic capacity and run times have been shown to be both age- and sex-dependent.⁷⁻⁸ Performance on both the 1.5-mile run and the overall physical readiness test (PRT) have been shown to be both age- and sex-dependent in the U.S. Navy population.⁹ Since the three cohorts do not share identical age and sex distributions, all comparisons were made after weighting for both age and sex. A direct weighting method was used, setting the entire U.S. Navy in 1988 (n = 605,000) as the standard population.

The repeated measures MANOVA procedure was used to test for differences between the intervention and control groups for overall physical readiness test (PRT) score, PRT component scores, total leisure time kcals expended per week, and questionnaire response items. All comparisons were made between the three cohorts. The use of two control groups should strengthen the validity of any result since the similar worksite and the Navy-wide sample provide a good estimate of the overall fitness trends within the U.S. Navy. Statistical significance (F test) of changes over time within the cohorts as well as differences over time among all three cohorts were tested. The interaction F-statistic reflects any difference between the three cohorts (i.e., including differences between the two control groups) and must be interpreted based on the change values for the three groups.

Questionnaire items regarding exercise behavior, knowledge, and attitudes toward fitness were scaled into four major categories: perceived top level support for fitness programs, personal importance of fitness, perceived utility of exercise, and opportunity to exercise. A single response item measuring the self-rating of current fitness was also reported.

Treatment. During the study period, personnel at the intervention community were exposed to an environment that emphasized and supported more active life-styles. Unless the environment is supportive of life-style change, success in reaching individual goals is limited.¹⁰ While many health promotion programs attempt to change behavior through various individual motivational techniques and through education

programs aimed at producing healthy life-styles, few actually attempt to alter the surroundings.¹¹⁻¹⁷

Some of the specific environmental interventions introduced at the intervention community included:

- Bicycle paths built along roadways
- Extended hours at recreation facilities
- New exercise equipment purchased at gyms
- Numerous base-wide athletic events scheduled
- Running and bicycling clubs organized
- 1.5-mile run courses marked at various sites
- Women's fitness center opened
- Highly visible and convenient placement of healthy foods, including salad bar, fruits and low-calorie drinks
- Low visibility and less convenient placement of high-fat food items, dessert bars and high-salt snack foods
- Nutrition information pamphlets placed on dining tables
- "Best for You" color-coded labeling system at base commissary (different colors to identify low fat, salt, and cholesterol)
- Base snack shops offering salad bars, fruit, and whole wheat items
- No smoking rule enforced aboard aircraft and inside buildings

These measures were aimed at improving physical fitness and general health by removing barriers to change. While these simple "enabling" changes were the backbone of the intervention, some social changes also were incorporated. Higher level commands continually stressed the expectancy of improved performance, encouraged release time for exercise, emphasized the importance of improved appearance for future transfer and promotion, and stressed that individuals would be held accountable for their own fitness. Sustained superior performance or improved performance over previous test results was rewarded with Certificates of Achievement. The local newspaper listed the top performers in each category of testing, while higher levels of command acknowledged superior squadron performance with Certificates of Achievement. A software program was developed to allow ranking of all individuals by either overall test score or test score by category. This system provided timely feedback to both the individual tested as well as to the squadron regarding their relative standing. Finally, the Fitness Center staff organized numerous races, competitions, and remedial programs.

Results

Demographics. The intervention community cohort (Naval Air Station, North Island, NASNI) consisted of 1,609 people with a mean age of 28.6 years. It was predominantly male (85%), Caucasian (69%), high-school educated (69.9%), with 54.4% married and 9.5% widowed or divorced. The majority (85.5%) were enlisted (Table 2).

The comparison community (Naval Air Station Moffett Field, control 1) cohort numbered 217 with a mean age of 28.4. It had a higher male percentage (89.9%), enlisted (92.6%), high-school educated (74.5%) Caucasian, (76.7%), and married (62.7%) than the intervention cohort. A similar percentage to NASNI (9.2%) were divorced or separated. Overall, the differences were very slight between these two communities.

The Navy-wide sample (n=546) had an older mean age (30.4 years) than either worksite group. They were also more educated, with 55.1% of the sample with greater than 12 years of education and only 1% with less than a high-school education. The sample also contained fewer enlisted personnel (77.8%) than the two community cohorts. More of its members were married (69.2%) with slightly less separated or divorced.

Physical fitness changes. Within the intervention community (NASNI), there were statistically significant changes ($P < .05$) from 1987 until 1988 for both primary outcome measures (Table 3). The 1.5-mile run time improved by a mean of 18 seconds, while overall PRT score gained 0.3 points on the four point failure-to-outstanding scale. Statistically significant changes ($P < .05$) were also observed for some of the secondary outcome measures. Sit-ups improved by 1.9 sit-ups per 2 minutes, while pushups improved by 2.5 push-ups per 2 minutes. There was no change in percent body fat. The only other statistically significant change ($P < .05$) from 1987 to 1988 occurred in control group 1 (NAS Moffett) where the percent body fat increased by 1% over the year.

Overall PRT scores show a positive significant ($F=18.2$, $P > .01$) main effect for time and a significant ($F=10.4$, $P < .01$) (Table 4) time by group interaction. Similarly, the 1.5-mile run times show a significant ($F=4.3$, $P < .05$) effect for time and a significant ($F=13.7$, $P < .01$) time by group interaction in the direction of faster run times.

Of the secondary measures, statistically significant findings were seen for push-ups where all three groups improved: NAS Moffett (control

Table 2 - Demographic Summary of the Three Cohorts and the Entire U.S. Navy in 1988

	WAS North Island (intervention)	WAS Moffett (control 1)	Navy-Wide Sample (control 2)	U.S. Navy
AGE (years)				
Mean	28.6	28.4	30.4	27.0
St dev	6.3	6.0	7.2	—
Range	18-53	19-46	18-56	17-65
N	1609	217	545	608,102
SEX (percent)				
Male	85.1	89.9	85.3	91
Female	14.9	10.1	14.7	9
N	1609	217	546	605,681
PAYGRADE (percent)				
Officer	14.5	7.4	22.2	12
Enlisted	85.5	92.6	77.8	88
N	1609	217	546	605,681
EDUCATION (percent)				
<12 yrs	3.7	4.6	1.1	6
12 yrs	69.9	74.5	43.8	73
>12 yrs	26.5	20.9	55.1	21
N	1507	216	372	600,272
RACE (percent)				
White	69.0	76.7	85.5	—
Black	12.2	11.7	12.5	—
Other	18.8	11.6	2.0	—
N	1150	63	392	—
MARITAL (percent)				
Single	36.0	28.1	22.2	—
Married	54.4	62.7	69.2	—
Separated/Divorced/Widowed	9.5	9.2	8.6	—
N	1523	217	464	—

Table 3 - Mean Adjusted¹ Changes in Fitness Parameters for Participants at
NAS North Island, NAS Moffett (control 1), and Navy-Wide Sample (control 2) in 1987 and 1988

Assessment Areas	1987	1988	Change
1.5 Mile Run (minutes)			
NAS North Island	12.6	12.3	-0.3*
NAS Moffett	12.3	12.2	-0.1
Navy-Wide Sample	12.1	12.2	+0.1
Push-ups (# per 2 minutes)			
NAS North Island	41.5	44.0	+2.5*
NAS Moffett	40.3	43.6	+3.3
Navy-Wide Sample	40.8	41.7	+1.7
Sit-ups (# per 2 minutes)			
NAS North Island	60.6	62.5	+1.9*
NAS Moffett	58.2	58.6	+0.4
Navy-Wide Sample	58.8	59.5	+0.7
% Body Fat			
NAS North Island	15.7	15.7	0.0*
NAS Moffett	15.7	16.7	+1.0
Navy-Wide Sample	15.9	16.0	+0.1
Overall Physical Readiness Test ₂ (PRT) category Score			
NAS North Island	1.8	2.1	+0.3*
NAS Moffett	1.6	1.7	+0.1
Navy-Wide Sample	1.9	2.0	+0.1
Leisure-time Kcals expended per week			
NAS North Island	4140	3864	-276
NAS Moffett	3983	3029	-954
Navy-Wide Sample	3719	3506	-213

¹ Adjusted to the entire U.S. Navy population in 1988 for age and sex.

² Physical Readiness Test (PRT) score categories are as follows: 0=Failure 1=Satisfactory 2=Good 3=Excellent 4=Outstanding. The score represents a composite of 1.5 mile run time, push-up, sit-up, and percent body fat scores.

* Significant change ($p < .05$) from 1987 to 1988.

Table 4 - Mean Adjusted¹ Physical Readiness Test (PRT) Scores with 95% Confidence Intervals and Univariate F Scores for MAS North Island (intervention), MAS Moffett (control 1), and Navy-Wide Sample (control 2)

	MAS NORTH ISLAND		MAS MOFFETT		NAVY-WIDE SAMPLE		TIME F		GROUP F		TIME/GROUP F	
	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988
1.5 mile run (minutes)	12.6 (12.5-12.6)	12.3 (12.2-12.4)	12.3 (12.0-12.5)	12.2 (11.9-12.5)	12.1 (11.9-12.2)	12.2 (12.0-12.3)	4.3 ^a	4.3 ^a	6.9 ^{**}	6.9 ^{**}	13.7 ^{**}	13.7 ^{**}
Sit-ups (8 in 2 min)	60.6 (59.8-61.5)	62.5 (61.6-63.5)	58.2 (55.6-60.8)	58.6 (56.0-61.2)	58.8 (57.1-60.4)	59.5 (57.8-61.6)	5.1 ^a	5.1 ^a	6.4 ^{**}	6.4 ^{**}	1.8	1.8
Push-ups (8 in 2 min)	41.5 (40.8-42.2)	44 (43.2-44.8)	40.3 (38.3-42.3)	43.6 (41.2-46.0)	40.8 (39.3-42.3)	41.7 (40.3-43.2)	36.8 ^{**}	36.8 ^{**}	2.2	2.2	3.7 ^a	3.7 ^a
Percent Body Fat	15.7 (15.4-16.0)	15.7 (15.4-16.0)	15.7 (15.4-16.0)	16.7 (16.0-17.5)	15.9 (15.4-16.4)	16.0 (15.6-16.5)	16.1 ^{**}	16.1 ^{**}	1.0	1.0	8.7 ^{**}	8.7 ^{**}
Overall Physical Readiness Test (PRT) Score ²	1.8 (1.8-1.9)	2.1 (2.0-2.1)	1.6 (1.4-1.8)	1.7 (1.5-1.9)	1.9 (1.8-2.1)	2.0 (1.9-2.1)	18.2 ^{**}	18.2 ^{**}	6.0 ^{**}	6.0 ^{**}	10.4 ^{**}	10.4 ^{**}

¹ Adjusted to the entire U.S. Navy population in 1988 for age and sex.

² Physical Readiness Test (PRT) score categories are as follows: 0=Failure 1=Satisfactory 2=Good 3=Excellent 4=Outstanding. The score represents a composite of 1.5 mile run, sit-up, push-up, and percent body fat scores.

^a p < .05

^{**} p < .01

1) +3.3, NASNI (intervention) +2.5, and Navy-wide (control 2) +1.7, with significant time ($F=36.8$, $P<.01$) and time by group interaction ($F=3.7$, $P<.05$) (Table 4). Average percent body fat remained unchanged within the intervention cohort, but increased in both control 1 and control 2 (+1.0%, +0.1%), for a significant time by group interaction ($F=8.7$, $P<.01$).

Given the above statistically significant changes in both primary outcome measures (1.5-mile run and overall PRT category score), Tables 5 and 6 are useful in partially assessing which subgroup appears to have benefited most from the intervention. For the intervention community, while 8.4% failed the 1.5-mile run at baseline, only 4.0% failed in 1988 (Table 5). Improvement was seen in both males and females, within each age category, and among both officers and enlisted personnel. Concerning the overall PRT category scores, while 12.4% failed at the intervention worksite in 1987, only 5.1% failed in 1988 (Table 6). While 13% of males failed in 1987, only 5.0% failed in 1988. For females, a smaller reduction (6.7% to 5.3%) was observed. When interpreting these results, two factors should be considered: the much smaller n (1,462 males versus 134 females) and the fewer initial failures for females. Furthermore, any subgroup analysis for control 1 (NAS Moffett) should be cautiously interpreted due to the small numbers in many of the subgroup cells.

Also of interest is the effect of the intervention on those who scored poorly at baseline in 1987 (Table 7). Selecting only those who scored in failure, satisfactory, or good categories, in the combined three groups, improvement was seen from 1987 until 1988 in the 1.5-mile run category score (intervention: 0.3, control 1: 0.2, control 2: 0.1) and overall PRT category score (intervention: 0.4, control 1: 0.2, control 2: 0.2). Time by group interaction for the 1.5-mile run category was significant ($F=9.3$, $P<.01$) as well as the overall PRT time by group interaction ($F=5.2$, $P<.01$).

Leisure time kilocalories expended. In 1987, the average weekly kcal expenditure at the intervention worksite was 4,140 kcals. Reported expenditure in 1988 was 3,864 kcals, showing a statistically nonsignificant overall mean drop of 276 kcals. Similarly, both the worksite control cohort and Navy-wide sample cohort experienced

Table 5 - Weighted¹ Summary of 1.5 Mile Run Categories at MAS North Island (intervention),
 MAS Moffett (control 1), and Navy-wide Sample (control 2) in 1987, 1988 in Percentages

Group			Fail Satisfactory					Good			Excellent		Outstanding		Mean		SD		N
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Overall	MAS MI	1987	8.4	41.3	33.5	14.7	2.1	1.61											1453
		1988	4.0	38.5	37.1	15.8	4.7	1.79											1561
	MAS MFT	1987	8.4	34.7	34.7	16.9	5.3	1.76											209
		1988	1.7	44.9	27.9	22.1	3.4	1.80											212
	Navy-Wide	1987	2.5	38.3	34.9	18.9	5.4	1.86											506
Sex		1988	4.8	39.9	30.1	18.4	6.8	1.83											511
	Male	1987	8.7	41.5	33.5	14.2	2.1	1.59											1234
		1988	4.1	38.6	37.2	15.6	4.5	1.78											1331
	MAS MFT	1987	8.6	35.7	35.4	15.3	5.0	1.72											190
		1988	1.4	45.8	28.8	20.7	3.3	1.79											191
Female	Navy-Wide	1987	2.6	38.3	34.4	19.3	5.4	1.86											439
		1988	5.0	39.9	30.0	18.1	7.0	1.82											437
	MAS MI	1987	5.1	38.6	33.4	20.3	2.6	1.77											219
		1988	3.0	36.6	35.9	18.4	6.0	1.88											230
	MAS MFT	1987	6.1	22.9	25.9	33.9	9.2	2.19											19
Age		1988	5.0	36.5	20.1	34.6	3.8	1.96											21
	Navy-Wide	1987	0.7	37.8	41.3	14.9	5.3	1.86											72
		1988	1.8	39.9	31.8	21.4	5.0	1.88											69
	MAS MI	1987	9.4	43.4	28.3	18.9	0.0	1.57											11
		1988	7.0	25.4	60.6	7.0	0.0	1.68											14
20-29		1987	9.3	43.5	32.3	12.6	2.3	1.55											885
		1988	4.5	43.6	32.5	14.1	5.2	1.72											947
	30-39	1987	6.6	35.8	38.1	17.1	2.5	1.73											472
		1988	2.2	32.8	37.0	22.3	5.7	1.97											503
	40-49	1987	5.4	39.1	34.8	18.5	2.2	1.73											83
50+		1988	0.0	42.0	30.0	23.0	5.0	1.91											93
		1987	0.0	0.0	50.0	50.0	0.0	2.50											2
		1988	0.0	0.0	75.0	25.0	0.0	2.25											4

Table 5 (cont) - Weighted¹ Summary of 1.5 Mile Run Categories at NAS North Island (intervention), NAS Moffett (control 1), and Navy-Wide Sample (control 2) in 1987, 1988 in Percentages

Group		0	1	2	3	4	Mean	SD	N
		Fail	Satisfactory	Good	Excellent	Outstanding	(category)	(category)	
NAS NPT	17-19	1987 0.0	43.8	43.8	12.4	0.0	1.69	.699	3
		1988 0.0	61.0	30.5	8.6	0.0	1.48	.661	4
	20-29	1987 11.2	32.5	33.8	16.1	6.4	1.74	1.064	118
		1988 1.7	47.4	23.2	23.0	4.8	1.82	.967	121
	30-39	1987 6.7	31.7	34.6	21.1	5.9	1.88	1.018	76
NAS NPT	40-49	1988 3.2	34.4	34.7	25.4	2.3	1.89	.907	77
		1987 0.0	53.8	30.8	15.4	0.0	1.62	.766	12
	50-59	1988 0.0	27.3	45.5	27.3	0.0	2.00	.772	10
		1987 0.0	0.0	0.0	0.0	0.0	—	—	0
	1988 0.0	0.0	0.0	0.0	0.0	0.0	—	—	0
<u>Navy-wide</u>									
17-19		1987 0.0	27.3	45.5	18.2	9.1	2.09	.907	8
		1988 10.0	60.0	10.0	0.0	2.0	1.6	1.291	8
	20-29	1987 2.1	47.1	29.7	16.5	4.6	1.75	.917	238
		1988 5.0	42.1	30.6	18.7	3.6	1.74	.942	236
	30-39	1987 4.9	25.2	41.0	24.4	4.6	1.99	.938	191
40-49		1988 2.4	22.7	27.3	28.6	6.9	2.09	1.004	190
		1987 2.8	22.0	43.2	23.6	8.4	2.13	.957	71
	50-59	1988 0.0	27.0	45.6	19.1	8.3	2.08	.900	69
		1987 0.0	0.0	33.3	33.3	33.3	3.00	—	3
	1988 0.0	33.3	33.3	33.3	0.0	33.3	2.33	1.63	3
<u>Rank</u>									
Officer	NAS NI	1987 2.1	19.7	43.9	29.7	4.6	2.15	.863	204
		1988 1.1	21.0	33.4	32.4	12.2	2.34	.977	226
	NAS NPT	1987 6.6	14.8	23.4	33.6	21.5	2.49	1.208	16
		1988 0.0	16.7	18.6	33.4	31.3	2.79	1.097	16
	NAVY-WIDE	1987 2.1	14.6	42.6	31.2	9.5	2.31	.914	109
Enlisted	NAS NI	1988 0.0	13.7	37.0	33.4	15.9	2.51	.924	105
		1987 9.5	44.3	31.9	12.5	1.8	1.53	.893	1199
	NAS NPT	1988 4.6	42.4	35.5	13.8	3.8	1.70	.896	1247
		1987 8.7	36.8	34.9	15.7	4.0	1.70	.970	191
	NAVY-WIDE	1988 1.9	47.4	27.9	21.5	1.4	1.73	.866	194
		1987 2.6	41.3	33.9	17.4	4.9	1.81	.921	402
		1988 5.4	43.4	29.2	16.4	5.6	1.73	.985	401

¹ Weighted to the entire U.S. Navy in 1988 by age and sex category.

Table 6 - Weighted¹ Summary of Overall Physical Readiness Test (PRT) Score² at NAS North Island (intervention),
NAS Moffett (control 1), and Navy-wide Sample (control 2) in 1987, 1988 in Percentages

Group			Overall PRT					Mean (category)	SD (category)	N
			0 Fail	1 Satisfactory	2 Good	3 Excellent	4 Outstanding			
Sex	Male	MAS MI	1987 12.4	27.9	32.3	17.2	10.2	1.85	1.156	1464
			1988 5.1	29.8	29.5	21.1	14.4	2.10	1.132	1554
		MAS NPT	1987 20.5	31.9	29.0	10.6	8.0	1.54	1.165	156
			1988 17.8	34.0	20.8	17.5	9.8	1.68	1.235	155
		Navy-wide	1987 8.5	35.7	25.9	16.7	13.3	1.91	1.178	480
			1988 7.8	36.1	25.6	16.3	14.2	1.93	1.184	490
Female	Male	MAS MI	1987 13.0	28.1	32.0	16.5	10.4	1.83	1.164	1243
			1988 5.0	29.9	29.2	21.2	14.7	2.11	1.136	1321
		MAS NPT	1987 20.9	33.7	27.7	9.4	8.3	1.51	0.095	139
			1988 18.9	35.2	19.6	16.0	10.3	1.64	1.248	139
		Navy-wide	1987 9.1	36.4	25.0	16.2	13.3	1.88	1.188	407
			1988 8.3	37.4	24.9	15.0	14.5	1.90	1.194	413
Age	Female	MAS MI	1987 6.7	25.3	35.3	24.5	8.2	2.02	1.049	221
			1988 5.3	29.3	33.0	20.5	11.9	2.04	1.092	233
		MAS NPT	1987 16.8	15.1	41.2	21.8	5.0	1.83	1.139	17
			1988 6.9	22.6	33.0	32.2	5.2	2.06	1.050	16
		Navy-wide	1987 1.2	27.5	36.0	22.5	12.8	2.18	1.024	73
			1988 3.3	22.6	33.4	29.7	10.9	2.22	1.032	77
Age	MAS MI	17-19	1987 28.3	34.0	18.9	9.4	9.4	1.38	1.251	11
			1988 7.0	57.8	0.0	35.2	0.0	1.63	1.040	14
		20-29	1987 11.9	28.1	34.1	16.7	9.3	1.84	1.126	891
			1988 5.7	27.4	34.1	17.4	15.5	2.10	1.134	945
		30-39	1987 8.6	24.6	32.6	20.4	13.8	2.06	1.160	477
Age	MAS NPT	17-19	1987 7.6	22.6	32.2	22.2	20.1	2.34	1.122	499
			1988 3.0	30.4	35.9	20.7	5.4	1.86	1.012	83
		20-29	1987 3.9	25.5	38.2	20.6	11.8	2.11	1.043	92
			1988 0.0	0.0	0.0	50.0	50.0	3.50	—	2
		30-39	1987 0.0	0.0	25.0	50.0	25.0	3.00	—	4
Age	MAS NPT	17-19	1987 43.8	0.0	56.2	0.0	0.0	1.12	1.021	3
			1988 91.4	0.0	0.0	8.6	0.0	.26	0.856	4
		20-29	1987 22.0	36.4	21.4	10.4	9.9	1.50	1.277	89
			1988 2.4	43.6	22.4	18.6	12.9	1.96	1.177	85
		30-39	1987 9.1	31.7	36.0	13.8	9.5	1.83	1.095	54
Age	MAS NPT	17-19	1987 7.3	31.9	28.9	21.1	10.8	1.96	1.133	60
			1988 9.1	45.5	27.3	18.2	0.0	1.55	0.931	10
		20-29	1987 0.0	50.0	33.3	16.7	0.0	1.67	0.811	6
			1988 0.0	50.0	33.3	16.7	0.0	1.67	0.811	6
		30-39	1987 7.3	31.9	28.9	21.1	10.8	1.96	1.133	60
			1988 9.1	45.5	27.3	18.2	0.0	1.55	0.931	10
Age	MAS NPT	17-19	1987 7.3	31.9	28.9	21.1	10.8	1.96	1.133	60
			1988 9.1	45.5	27.3	18.2	0.0	1.55	0.931	10
		20-29	1987 0.0	50.0	33.3	16.7	0.0	1.67	0.811	6
			1988 0.0	50.0	33.3	16.7	0.0	1.67	0.811	6
		30-39	1987 7.3	31.9	28.9	21.1	10.8	1.96	1.133	60
			1988 9.1	45.5	27.3	18.2	0.0	1.55	0.931	10

Table 6 (cont) - Weighted¹ Summary of Overall Physical Readiness Test (PRT) Score² at MAS North Island (intervention),
MAS Moffett (control 1), and Navy-wide Sample (control 2) in 1987, 1988 in Percentages

Group		0	1	2	3	4	Mean (category)	SD (category)	N
		Fail	Satisfactory	Good	Excellent	Outstanding			
Navy-wide	50-59	1987	—	—	—	—	—	—	—
		1988	—	—	—	—	—	—	—
	17-19	1987	18.2	0.0	18.2	27.3	36.4	1.442	8
		1988	10.0	50.0	20.0	10.0	10.0	1.123	8
	20-29	1987	6.6	46.5	25.0	12.7	9.2	1.71	223
		1988	9.3	36.7	25.4	15.9	12.7	1.179	224
	30-39	1987	8.9	29.0	31.6	19.7	10.8	1.132	182
		1988	4.8	29.5	28.7	18.5	18.5	1.181	186
	40-49	1987	5.3	26.6	27.3	26.2	14.5	1.155	64
		1988	0.0	30.4	26.6	21.4	21.6	1.143	69
Rank Officer	50-59	1987	0.0	0.0	0.0	0.0	100.0	—	3
		1988	0.0	50.0	0.0	50.0	0.0	2.00	3
	MAS MI	1987	2.1	13.3	31.1	25.6	28.0	1.089	209
		1988	1.5	13.1	23.0	24.1	38.3	1.119	223
	MAS NPT	1987	35.4	19.6	45.0	0.0	0.0	1.10	2
		1988	0.0	0.0	100.0	0.0	0.0	2.00	1
	Navy-wide	1987	3.5	13.7	30.0	31.4	21.4	1.086	106
		1988	2.7	11.6	24.8	31.7	29.3	1.091	107
	MAS MI	1987	14.1	30.3	32.4	15.6	7.6	1.117	1205
		1988	5.7	32.8	31.1	19.2	11.1	1.092	1242
Enlisted	MAS NPT	1987	20.3	32.4	28.9	10.9	7.5	1.53	153
		1988	18.1	34.6	20.1	17.8	9.3	1.66	152
	NAVY-WIDE	1987	9.1	38.6	25.3	14.8	12.2	1.82	374
		1988	8.6	39.5	25.7	14.1	12.1	1.159	383

¹Weighted to the entire U.S. Navy in 1988 by age and sex category.

²Overall PRT score represents a composite of 1.5 mile run, 2 minute timed sit-ups, 2 minute timed push-ups, and percent body fat scores.

Table 7 - Mean Adjusted¹ Physical Readiness Test (PRT) Category Scores with 95% Confidence Intervals for Those Scoring Category 2 or Less (2=Good 1= Satisfactory 0=Failure) at Time 1 for 1.5 Mile Run and Overall PRT Score. NAS North Island (intervention, N=1111), NAS Moffett (control 1, N=136); and Navy-wide Sample (control 2, N=348)

	NAS NORTH ISLAND		NAS MOFFETT		NAVY-WIDE SAMPLE		TIME F		GROUP F		TIMEXGROUP	
	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988	F	F
1.5 mile run category	1.3 (1.3-1.3)	1.6 (1.5-1.6)	1.4 (1.3-1.5)	1.6 (1.5-1.7)	1.4 (1.4-1.6)	1.5 (1.4-1.6)	65.3**		.43		9.3**	
Overall Physical Readiness Test Score	1.3 (1.2-1.3)	1.7 (1.7-1.8)	1.2 (1.0-1.3)	1.4 (1.2-1.6)	1.3 (1.2-1.3)	1.5 (1.4-1.6)	71.3**		6.9**		5.2**	

¹Adjusted to the entire U.S. Navy population in 1988 for age and sex

² Overall PRT score represents a composite of 1.5 mile run, 2 minute timed sit-ups, 2 minute timed push-ups, and percent body fat scores.

* P<.05

** P<.01

statistically nonsignificant drops in kcals over the year period (-954 kcals and -213 kcals, respectively). Comparison of kilocalorie changes from 1987 until 1988 showed a significant ($F=10.8$, $P<.01$) time main effect but a nonsignificant time by group interaction (Table 8).

Because motivating sedentary individuals was one of the program goals, we selected for analysis those individuals who reported fewer than 2,000 kcals expended at (1987) baseline. Within this group kcals increased by +1,169 kcals at the intervention worksite ($P<.05$) (Table 8). Comparing the three groups, both the time main effect and the time by group interaction effects were statistically significant ($F=40.8$, $P<.01$ and $F=4.7$, $P<.01$, respectively) for the <2,000 kcal intervention group. However, the percentage of the population falling below the 2,000 kcal level increased at all 3 locations: from 21.8% to 24.5% in the intervention cohort, from 9.2% to 17.1% in the worksite control, and from 20.3% to 26.7% among the Navy-wide sample, indicating no population reduction in physical inactivity.

Questionnaire responses. The questionnaire analysis was based on response rates of 69.9%, 32.3%, and 58.1% for NASNI, NAS Moffett, and the Navy-wide sample, respectively, and must be cautiously interpreted. No nonrespondent analysis was undertaken. These results are presented as exploratory data only and no firm conclusions should be drawn nor action taken based upon these results.

At the intervention worksite, both the personal importance of fitness and the perceived utility of exercise dropped significantly ($P<.05$) over the year-long period (Table 9). None of the scales showed significant improvement over time. When compared to the other cohorts, the only significant time by group interaction ($F=12.6$, $P<.01$) that occurred in the postulated direction was the opportunity to exercise, where at the intervention community the scale increased 0.6 points as opposed to a negative 2.6-point drop at the worksite control and no change at the Navy-wide control (Table 10).

Not occurring in the postulated direction were significant time by group interaction for top level support ($F=3.2$, $P<.05$) favoring greater improvement at control 2 (1.0) than control 1 (0.6), with a slight decrease at intervention (-0.2). The personal importance of fitness measure dropped in all three cohorts as follows: control 1 -2.1,

Table 8 - Mean Adjusted¹ Reported Average Leisure-time Kilocalories (Kcals) Expended per Week² with 95% Confidence Intervals for NAS North Island (intervention), NAS Moffett (control 1), and Navy-wide Sample (control 2), in 1987, 1988.

	NAS NORTH ISLAND		NAS MOFFETT		NAVY-WIDE SAMPLE		TIME F	GROUP F	TIME/GROUP F
	1987	1988	1987	1988	1987	1988			
Overall Kcals/week									
	(N=1125)		(N=70)		(N=317)				
	4140	3864	3983	3029	3719	3506	10.8**	2.8	1.6
	(3943-4339)	(3653-4075)	(3237-4728)	(2327-3730)	(3392-4047)	(3175-3837)			
Inactives (<2,000 Kcals per week) at baseline									
	(N=350)		(N=20)		(N=111)				
	883	2052	857	2239	1003	1548	40.8**	1.5	4.7**
	(813-954)	(1836-2268)	(529-1185)	(1071-3406)	(894-1113)	(1309-1787)			
> Below 2,000 Kcals/wk									
	21.88	24.58	9.28	17.18	20.38	26.78			

¹Adjusted to the entire U.S. Navy population in 1988 for age and sex

²Computation of average Kcals/wk uses the product of self reported leisure time activity type, duration, and frequency, with activity values obtained from Exercise Physiology, McArdle, Katch, and Katch, 1986.

* p<.05

** p<.01p

Table 9 - Mean Adjusted¹ Questionnaire Response Scores² for Participants at MAS North Island (intervention), MAS Moffett (control 1), and Navy-wide Sample (control 2) in 1987 and 1988

Assessment Areas		1987	1988	Change
Top Level Support	MAS North Island	24.7	24.5	-0.2
	MAS Moffett	25.2	25.8	+0.6
	Navy-Wide	26.6	27.6	+1.0
Personal Importance of Fitness	MAS North Island	25.5	24.8	-0.7*
	MAS Moffett	26.7	24.6	-2.1*
	Navy-Wide	22.6	22.3	-0.3
Perceived utility of exercise	MAS North Island	33.4	32.7	-0.7*
	MAS Moffett	35.0	35.2	+0.2
	Navy-Wide	36.9	36.7	-0.2
Opportunity to Exercise	MAS North Island	10.4	11.0	+0.6
	MAS Moffett	10.5	7.9	-2.6*
	Navy-Wide	11.8	11.8	0
Self Rating of Current Fitness	MAS North Island	2.7	2.8	+0.1
	MAS Moffett	2.7	2.8	+0.1
	Navy-Wide	2.5	2.4	-0.1

¹ Adjusted to the entire U.S. Navy population in 1988 for age and sex.

² These are scaled items obtained from a combination of questionnaire responses with categories ranging from 0 (extremely negative) to 7 (always enough, extremely concerned).

* Significant change ($p < .05$) from 1987 to 1988.

Table 10 - Mean Adjusted¹ Questionnaire Response Scores with 95% Confidence Interval and Univariate F Score for MAS North Island (intervention), MAS Moffett (control 1), and Navy-wide Sample (control 2)

	MAS NORTH ISLAND		MAS MOFFETT		NAVY-WIDE SAMPLE		TIME F	GROUP F	TIME/GROUP F
	1987	1988	1987	1988	1987	1988			
Top Level Support	24.7 (24.4-25.1)	24.5 (24.0-24.9)	25.2 (23.6-27.0)	25.8 (24.1-27.5)	26.6 (25.7-27.4)	27.6 (26.8-28.3)	1.82	17.4**	3.21*
Personal Importance of Fitness	25.5 (25.2-25.8)	24.8 (24.5-25.1)	26.7 (25.8-27.7)	24.6 (23.5-25.7)	22.6 (22.0-23.3)	22.3 (21.7-23.0)	31.6**	38.0**	5.6**
Perceived Utility of Exercise	33.4 (33.8-34.0)	32.7 (32.1-33.3)	35.0 (32.9-37.1)	35.2 (32.9-37.4)	36.9 (36.0-38.0)	36.7 (35.7-37.7)	0.5	24.1**	0.6
Opportunity to Exercise	10.4 (10.1-10.7)	11.0 (10.7-11.3)	10.5 (9.4-11.6)	7.9 (6.6-9.1)	11.8 (11.2-12.3)	11.8 (11.2-12.3)	8.7**	14.4**	12.6**
Self Rating of Current Fitness	2.7 (2.7-2.8)	2.8 (2.8-2.9)	2.7 (2.6-2.9)	2.8 (2.6-3.0)	2.5 (2.4-2.6)	2.4 (2.3-2.5)	1.2	29.5**	2.3

¹ Adjusted to the entire U.S. Navy population in 1988 for age and sex

* p<.05

** p<.01

intervention -0.7, control 2 -0.3 with significant time main effect ($F=31.6$, $P<.01$) and time by group interaction ($F=5.6$, $P<.01$).

Discussion

The intervention was designed to remove environmental barriers to exercise and thereby enable individuals to integrate physical activity into daily routines. Over the one-year study period, the 1.5-mile run times improved by a mean of 18 seconds (2.4% of mean time). Mean overall physical readiness test (PRT) score, a composite of the 1.5-mile run, push-ups, sit-ups, and percent body fat component scores, improved 0.3 category points (16% of mean score) on the four point scale ranging from failure to outstanding. Both of these changes were significantly greater ($P<.01$) than in a similar community and in a Navy-wide sample. Further, the improvement in the 1.5-mile run and the overall PRT score was not limited to any single subgroup of the population, but was generally seen throughout the population.

Since inactive people have the most to gain from increasing their fitness level, it is important to examine whether the intervention was successful in changing the exercise performance within this subgroup. While 12.4% failed the physical readiness test at the intervention worksite in 1987, only 5.1% failed in 1988. Likewise, the 1.5-mile run failures dropped from 8.4% in 1987 to 4.0% in 1988. Looking at only those who scored at a "good" or below level at baseline, total PRT points improved by 0.4 category points, while run time category improved by 0.3 points. Both of these improvements were statistically significantly greater ($P<.01$) than those seen in either control group.

Total calculated kcals expended did not increase as expected in any of the three groups. This lack of significantly increased kilocalorie expenditure is inconsistent with the finding of improvement on fitness testing. The Johnson and Johnson worksite study found a convergence of these two measures which strengthened the argument that real change had occurred.³

While it is not entirely certain what amount of kcals expended per week will produce positive health effects, Paffenbarger concluded that positive health benefits occur at a level above 2,000 total kcals expended per week.¹⁸ Using 2,000 leisure-time calories as a cutoff at

baseline, in the intervention group those who reported expending fewer than 2,000 kcals per week increased their kcal expenditure from 883 to 2,052 kcals. This 1,169 kcal change was statistically significant in both time main effect and time by group interaction effect ($P < .01$) when compared to the control community and the Navy-wide sample. In contrast to this finding, in all three cohorts a greater percentage of the population had slipped below the 2,000 kcal per week level by the end of the year (from 21.8% to 24.5% in the intervention cohort, from 9.2% to 17.1% at the community control, and from 20.3% to 26.7% among the Navy-wide sample). Thus, simple regression to the mean, the phenomenon of repeat measurements moving closer to the center of the distribution, is the likely explanation for the increase in mean kcals among those expending less than 2,000 kcals per week at baseline. The finding that the kcal expenditure changed very little overall, coupled with the data showing that the percentage of people below the 2,000 kcal per week level increased slightly, are not consistent with the improvement in run times. This inconsistency could reflect the nonresponse to the questionnaire, on which the energy expenditure results were based, or different reliabilities of the questionnaire and run-time data.

There were no significant improvements noted within the intervention worksite on scaled questionnaire items concerning both the top level support and the opportunity to exercise. The perceived utility of exercise and the personal importance of fitness significantly declined. The single item self-rating of personal fitness, shown to be a key predictor of fitness testing performance, also did not improve despite the fact that the performance on the physical readiness test did.¹⁹ It is possible that the relatively high nonresponse rate to the questionnaire accounted for this general lack of concurrence, that a ceiling effect at baseline occurred, or that the questionnaire measures may not be sensitive enough indicators to detect the small changes seen in the physical readiness test results.

In order for a test to be valid, it must first be reliable. Distance run tests have shown correlations ranging from .75 to .90 indicating high reliability.²⁰ Further, distance runs have been shown to be related at a sufficient magnitude with laboratory tests of maximal oxygen uptake to conclude that cardiorespiratory function is the

dominant factor reflected by distance running performance. But when evaluating distance run times the user must consider that the performance scores reflect complex determinants. Individual differences on the distance runs may reflect characteristics other than cardiorespiratory endurance. Motivation, as influenced by rewards, competition, audiences, reference standards, and different forms of feedback, has also been shown to influence performance.²¹

Because many of the occupations within the U.S. Navy demand a physically fit person, and because military bearing and appearance are held in high regard, the fitness gains made at the intervention site are important to the organization. From the organizational viewpoint, the program was a success. Whether the magnitude of these observed changes have administrative or policy significance is a different matter. While the fitness levels did improve, the magnitude of improvement was not impressive. How an 18-second gain in a 1.5-mile run time translates into actual gain in health status and longevity can be answered only indirectly by inference from other research.

The following argument can be made that improvement in run time could translate into health gains. Cardiorespiratory fitness reflects the functional capacities of the heart, blood vessels, blood, lungs, and relevant muscles during various types of exercise demands. Endurance running has been widely used to test cardiorespiratory fitness.²¹ While no single field or laboratory test can be expected to evaluate, with specificity and precision, all of the individual factors that determine a person's cardiorespiratory fitness, the laboratory test that has achieved widest acceptance as a composite measure of cardiorespiratory fitness is the direct measurement of maximal aerobic power: maximal oxygen uptake ($\text{VO}_2 \text{ max}$). Performance on distance running tests of one mile or longer have been shown to correlate significantly with maximal aerobic power, with correlation coefficients varying between $-.22$ to $.90$.²¹ Thus, improvement in aerobic fitness has been shown to be associated with concomitant improvements in $\text{VO}_2 \text{ max}$. Finally, positive changes in $\text{VO}_2 \text{ max}$ have been shown to be associated with a decrease in total coronary heart disease risk.³

While the above sequence makes qualitative sense, it is not presently possible to show precisely how a 2.4% decrease in mean run

time quantitatively relates to VO_2 max nor how these improvements in VO_2 max precisely relate to changes in coronary risk. Concerning predictive validity of run tests, although persons continuing a physical conditioning program will have a lower risk of coronary heart disease (CHD) than if they were sedentary, it is not possible to predict the distance run performance that will "protect" a person from CHD.²¹ Conservatively, it is concluded that while the intervention was effective in improving exercise testing performance, present knowledge is insufficient to make public health statements concerning the intervention's protective effects on the future health of the population.

Generalizability. The environmental and social changes associated with the intervention can easily be applied in a wide variety of settings. In occupations having a predominantly male workforce with well-defined fitness standards (such as police and firefighters), very little modification would be necessary.

The literature is very sparse on studies reporting physical activity change using public health intervention models. In fact, the Johnson and Johnson study was the first to report encouraging results concerning improved overall fitness measures in a multicomponent health promotion program.³ In addition to the possible lack of evaluation efforts being made, a second explanation for this sparsity of reporting is the tendency toward selective publication of positive results. Since exercise habits are such an exceedingly difficult behavior to modify, this explanation seems highly plausible.

It has been shown that through intensive clinical one-on-one interventions physical fitness can be improved.³ The challenge is to find effective ways of reaching large numbers of people in order to reach our nation's exercise and physical fitness health goals. This simple intervention was successful in improving the fitness level of community members as reflected by physical readiness testing.

Timely program evaluation not only helps to establish the knowledge base on which to plan future programs, but can be immediately useful in making midcourse corrections and in providing feedback to the organization's leaders. Future research should be aimed at testing appropriately modified programs in a variety of settings, and then

expanding the breadth of the research to include not only physiological outcomes (physical fitness performance, VO2 max improvements) but also to the ultimate outcomes of possible improved health and longevity. The recommendation has been made by the U.S Preventive Services Task Force for all adults to increase their physical activity levels.¹ Quantifying the linkage from improved aerobic capacity to the primary prevention of such medical conditions as obesity, diabetes mellitus, and coronary heart disease is still necessary before stronger recommendations can be made or before cost-benefit analyses can be attempted.

REFERENCES

1. Harris SS, Caspersen CJ, DeFries GH, Estes EH. Physical activity counseling for healthy adults as a primary preventive intervention in the clinical setting: report for the U.S. Preventive Services Task Force. JAMA 1989;261(24):3590-3598.
2. ODPHP. Integration of risk factor interventions, monograph series. DHHS, Nov 1986.
3. Blair SN, Piserchia PV, Wilbur CS, et al. A public health intervention model for work-site health promotion. Impact on exercise and physical fitness in a health promotion plan after 24 months. JAMA 1986;255(7):921-926.
4. Flay BR. Efficacy and effectiveness trials (and other phases of research) in the development of health promotion programs. Prev Med 1986;15:451-474.
5. Spitzer W. The periodic health exam. Can Med Assoc J 1979;121:1193-1254.
6. Conway TL. Health and physical readiness: differences across the four Navy communities. Tech report 89-1. Naval Health Research Center, San Diego, CA., 1988.
7. Astrand PO, Rodahl K. Textbook of work physiology. New York: McGraw-Hill, 1974.
8. Cooper KH. The new aerobics. New York: Bantam, 1970.
9. Nice DS, Dutton L, Seymour GE. An analysis of baseline Navy health and physical readiness data from local shore facilities. Tech report 84-1. Naval Health Research Center, San Diego, CA., 1984.
10. Milio N. Promoting health through public policy. Philadelphia: F.A. Davis, 1981.

11. Farquhar JW, Fortmann SP, Maccoby N, et al. The Stanford five city project: design and methods. *Am J Epidemiol* 1985;122:323-34.
12. Fielding JE. Health promotion and disease prevention at the work-site. *Ann Rev Public Health* 1984;5:237-265.
13. Iverson DC, Fielding JE, Crow RS, et al. The promotion of physical activity in the United States population: the status of programs in medical, worksite, community, and school settings. *Public Health Rep* 1985;100(2):212-24.
14. Maccoby N, Farquhar JW, Wood PD, et al. Reducing the risk of cardiovascular disease: effects of a community-based campaign on knowledge and behavior. *J Community Health* 1977;3:100-114.
15. Puska P, Salonen JT, Koskela K, et al. The community-based strategy to prevent coronary heart disease: conclusions from the ten years of the North Karelia project. *Ann Rev Public Health* 1983;6:147-93.
16. Wear RF: The Campbell Soup Company program. *Prev Med* 1987;12: 667-71.
17. Wilbur CS. The Johnson & Johnson program. *Prev Med* 1983;12:672-81.
18. Paffenbarger RS, Hyde RT. Exercise in the prevention of coronary heart disease. *Prev Med* 1984;13:3-22.
19. Nice DS, Conway TL. Exercise patterns in the U.S. Navy. Tech report 88-1, Naval Health Research Center, San Diego, CA., 1988.
20. Baumgartner TA, Jackson AS. Measurement for evaluation in physical education. Boston: Houghton Mifflin, 1982.
21. AAHPERD: Health related physical fitness technical manual. Reston VA. American Alliance for Health, Physical Education, Recreation and Dance, 1984.

LIST OF TABLES

Table 1:	Cohort Selection Process for NAS North Island (intervention), NAS Moffett (control 1) and Navy- Wide Sample (control 2)	6
Table 2:	Demographic Breakdown of the Three Cohorts and the Entire U.S. Navy in 1988	10
Table 3:	Mean Adjusted Changes in Fitness Parameters for Participants at NAS North Island, NAS Moffett (control 1), and Navy-Wide Sample (control 2) in 1987 and 1988	11
Table 4:	Mean Adjusted Physical Readiness Test (PRT) Scores with 95% Confidence Intervals and Univariate F Scores for NAS North Island (intervention), NAS Moffett (control 1), and Navy-Wide Sample (control 2)	12
Table 5:	Weighted Summary of 1.5-Mile Run Categories at NAS North Island (intervention), NAS Moffett (control 1), and Navy-Wide Sample (control 2) in 1987, 1988 in Percentages	14
Table 6:	Weighted Summary of Overall Physical Readiness Test (PRT) Score at NAS North Island (intervention), NAS Moffett (control 1), and Navy-wide Sample (control 2) in 1987, 1988 in Percentages	16

Table 7:	Mean Adjusted Physical Readiness Test (PRT) Category Scores with 95% Confidence Intervals for Those Scoring Category 2 or Less (2=Good 1=Satisfactory 0=Failure) at Time 1 for 1.5-Mile Run and Overall PRT Score. NAS North Island (intervention, N=1111), NAS Moffett (control 1, N=136), and Navy-wide Sample (control 2, N=348)	18
Table 8:	Mean Adjusted Reported Average Leisure-time Kilocalories Expended per Week with 95% Confidence Intervals for NAS North Island (intervention), NAS Moffett (control 1), and Navy-Wide Sample (control 2), in 1987, 1988	20
Table 9:	Mean Adjusted Questionnaire Response Scores for Participants at NAS North Island (intervention), NAS Moffett (control 1), and Navy-Wide Sample (control 2) in 1987 and 1988	21
Table 10:	Mean Adjusted Questionnaire Response Scores with 95% Confidence Interval and Univariate F Score for NAS North Island (intervention), NAS Moffett (controls 1), and Navy-Wide Sample (control 2)	22

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION Unclassified			1b RESTRICTIVE MARKINGS N/A	
2a SECURITY CLASSIFICATION AUTHORITY N/A			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.	
2b DECLASSIFICATION/DOWNGRADING SCHEDULE N/A				
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NHRC Report No. 90-6			5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a NAME OF PERFORMING ORGANIZATION Naval Health Research Center		6b. OFFICE SYMBOL (If applicable) Code 60	7a. NAME OF MONITORING ORGANIZATION Chief, Bureau of Medicine and Surgery	
6c. ADDRESS (City, State, and ZIP Code) P.O. Box 85122 San Diego, CA 92136-5122			7b. ADDRESS (City, State, and ZIP Code) Department of the Navy Washington, DC 20372	
8a NAME OF FUNDING/SPONSORING ORGANIZATION Naval Medical Research & Development Command		8b OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code) NMC NCR Bethesda, MD 20814-5044			10. SOURCE OF FUNDING NUMBERS	
			PROGRAM ELEMENT NO M0095.	TASK NO 005
			WORK UNIT ACCESSION NO.	
11. TITLE (Include Security Classification) (U) PHYSICAL FITNESS GAINS FOLLOWING SIMPLE ENVIRONMENTAL CHANGE				
12. PERSONAL AUTHOR(S) LINENGER, Jerry M., M.D., M.S.S.M., M.P.H., Ph.D., CHESSON, Charles V. II, Ph.D., and NICE, D. Stephen, Ph.D.				
13a TYPE OF REPORT Final		13b TIME COVERED FROM TO		14 DATE OF REPORT (Year, Month, Day) 900302
15 PAGE COUNT				
16. SUPPLEMENTARY NOTATION To be submitted for publication to American Journal of Preventive Medicine				
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	Physical fitness, Inactivity, Exercise (Physiology)	
			Prevention, Lifestyle	
			Environmental change	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) Inactivity is the risk factor with potentially the greatest public health impact according to the 1989 U.S. Preventive Services Task Force report. This study reports changes in the physical fitness level following simple changes aimed at enabling community members to more easily adapt active life-styles. Simple environmental and social alterations were made at a San Diego Naval Air Station. A cohort of active-duty personnel from within this community (n=1,609) was administered both a physical readiness test (PRT) and a lifestyle questionnaire at baseline and at one year. The PRT consisted of a 1.5-mile timed run, sit-ups, push-ups, and percent body fat components while the questionnaire addressed demographics, current exercise behavior, and attitudes toward exercise. Similar measures were taken within a comparison community cohort (n=217) and within a Navy-wide sample cohort (n=546). (Continued on reverse)				
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED	
22a NAME OF RESPONSIBLE INDIVIDUAL Jerry M. Linenger, M.D.			22b TELEPHONE (Include Area Code) (619) 553-8391	22c OFFICE SYMBOL Code 60

UNCLASSIFIED:

Continued from Block 19. Abstract

Overall PRT category and 1.5-mile run time both improved significantly ($P < .05$) over time at the intervention community (0.3 category points and 18 seconds, respectively). The increase was significantly greater ($P < .01$) than at either the control community or within the Navy-wide sample. Subgroup analysis showed that at the intervention community 12.4% failed the overall fitness test in 1987, but only 5.1% failed in 1988. Similarly, the 1.5-mile run failures decreased from 8.4% to 4%. Reported leisure time kilocalorie expenditure showed no significant improvement.

This simple program was successful in improving fitness performance. The improvement was distributed throughout the community and included those who were substandard at baseline. Similar programs could easily be adopted in a variety of communities.