SMOKING AND PHYSICAL FITNESS AMONG NAVY SHIPBOARD PERSONNEL

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Smoking and Physical Fitness Among Navy Shipboard Personnel[1,2]

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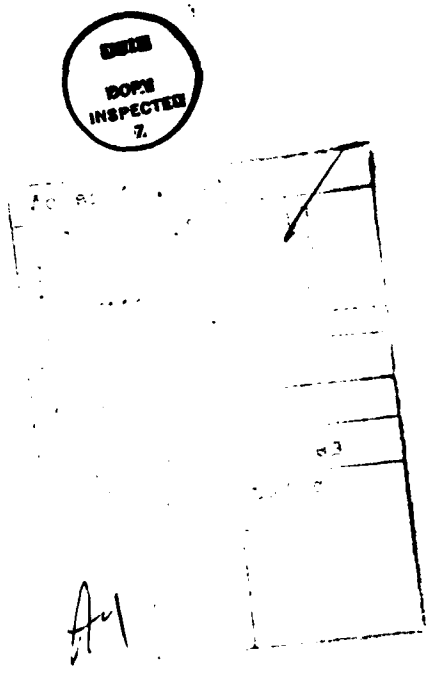


SUMMARY

Problem

Cigarette smoking is the single greatest cause of preventable death and disability in the United States. A substantial body of medical and epidemiological research on smoking has convinced most health professionals that cigarette smoking produces long-term ill effects (e.g., higher mortality rates and greater morbidity for diseases such as cancer, cardiorespiratory disease, and emphysema). A smaller body of literature is also developing which indicates that smoking has rapid-onset adverse effects on health (e.g., respiratory symptoms), physiological (e.g., pulmonary) functioning, and physical fitness even among healthy young individuals. Such rapid-onset negative effects of smoking could have important implications for the military, as it has even higher smoking rates than the U.S. population at large.

Objective

The purpose of this study was to examine smoking prevalence in a large group of Navy men and to assess the impact of smoking on their physical fitness.

Approach

Self-reported demographic and smoking information was provided by 1,357 Navy men stationed aboard ships in the San Diego area. Demographic variables examined were age, years of schooling, race/ethnicity, officer/enlisted status, pay grade, and years in the Navy. Smoking variables included smoking status (e.g., never smoked, former smokers, current smokers) and average amount smoked per day. Physical fitness was measured as performance on the Navy's annual physical readiness test which includes a 1.5-mile run/walk, 2-minute sit-ups test, sit-reach flexibility test, and a percent body fat assessment. Physical fitness scores were provided by ship personnel assigned to administer the annual test.

Results

Self-reported smoking status indicated that 49.8% were current smokers, 20.3% were former smokers, and 29.9% had never smoked. Four demographic variables were significantly associated with smoking status: race, education, officer/enlisted status, and years in the service. Smokers were more likely to be non-Black enlisted personnel with lower education who had been in the Navy longer and tended to be older. Smoking also had a clear negative impact on physical fitness, most notably on cardiorespiratory endurance (1.5-mile run performance) and muscular endurance (sit-ups test).

Conclusions

The high rate of smoking among Navy personnel and the clear negative impact of smoking

on physical fitness suggest that the Navy should implement strong anti-smoking programs. These programs should focus heavily on prevention as men who had never smoked tended to be leaner, could do more sit-ups, and scored higher on the overall physical fitness rating than current smokers and former smokers. Programs which get people to stop smoking should also improve cardiorespiratory and muscular endurance as former smokers performed better on the 1.5-mile run and sit-ups tests than current smokers. In addition to the adverse impact on physical fitness, the high rates of smoking should be a cause for general concern in the Navy because previous research has shown that smokers are more costly to employers. These costs include higher health care costs, lost productivity, and increased absenteeism. Smokers also have been found to have increased illness and premature death. Reducing the number of Navy smokers (almost 50% in this group of shipboard men compared to 39% in a comparable group of U.S. population males) should produce substantial benefits for the Navy. Future research should focus on why smoking rates in the Navy are so high (e.g., does the Navy attract smokers or encourage smoking through social pressures or organizational rewards?). Identification of factors related to smoking in the Navy would provide useful information for developing interventions to lower smoking rates. Successful interventions are vitally needed to help the Navy reach its goals for maintaining a healthy and fit force.

Background

Cigarette smoking is the single greatest cause of preventable death and disability in the United States (USDHHS, 1982). When measured by morbidity and mortality, cigarette smoking is now the most serious as well as the most widespread form of addiction in the world (Ravenholt, 1985). This addiction has been linked to cardiovascular disease, including coronary heart disease, aortic aneurysm, and cerebral vascular disease; cancers of the pharynx, larynx, lung and bronchus, esophagus, stomach, colon, rectum, liver, pancreas, and bladder; and emphysema (Ravenholt, 1985). In 1983 the Surgeon General reported that 30% of all coronary heart disease deaths in the United States could be attributed to cigarette smoking. The American Cancer Society estimates that cigarette smoking is responsible for 325,000 early deaths each year for diseases of the lung, heart, and circulatory system (Health, Education, & Welfare, 1977). About one in ten heavy smokers eventually gets lung cancer. Hammond and Horn (1958) have found that smokers were 15 times more likely to die of emphysema than nonsmokers.

This now substantial body of medical and epidemiological research on smoking has convinced most health professionals that cigarette smoking produces long-term ill effects on health (e.g., higher mortality rates and types of morbidity such as cancer which take many years to develop). Smoking also appears to have short-term (i.e., rapid onset) effects on health and physiological functioning. One investigator found that 72% of recruits on an acute respiratory disease ward smoked at least one-half pack of cigarettes per day (John, 1977). In addition, he found that the diagnosis of bronchitis or lower respiratory infection was made three times more often in smokers than nonsmokers. Enjeti, Hazelwood, Permutt, Menkes & Terry (1978) examined the lung capacity of young smokers (18 to 25 years). They found reduced capacity in both males and females. Beck, Doyle, and Schachter (1981) did a cross-sectional survey of people seven years of age and older to determine the relationship between cigarette smoking and lung function. There were 7,203 participants who were divided into seven age groups (7-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65+). Pulmonary function data obtained on all respondents indicated an increasing progression of lung function loss with age in males and females in all smoking categories. Some decreased lung function was found in smokers as young as 15 to 24 years old. These rapid onset effects of smoking are insidious because smokers may not realize that they are experiencing reduced lung capacity for a decade or more.

A related area of physiological functioning that should be affected by cigarette smoking even among healthy young people is physical fitness. A study conducted by

Biersner, Gunderson, and Rahe (1972) examined the relationship between sports interests, smoking, and physical fitness in 241 Navy enlisted men enrolled in Underwater Demolition Team (UDT) training. They found that smoking was negatively correlated with both sports interest and physical fitness. Another study examined the relationship between smoking and physical fitness in a group of 54 Army enlisted personnel who were divided into six subgroups: male present smokers, former smokers, and nonsmokers, and female present smokers, former smokers, and nonsmokers (Jensen, 1986). Physical fitness performance scores included push-up and sit-up events and a two-mile run. The results indicated that male and female nonsmokers had higher scores on all of the physical fitness events than the smokers with one exception. The only event for which nonsmokers did not exceed former and current smokers was push-ups.

Although these studies show an inverse relationship between smoking and physical fitness, the sample size in the Army study (Jensen, 1986) was small and the Navy study (Biersner et al., 1972) was done with highly fit UDT trainees. Thus, the detrimental effects of smoking on physical fitness should be replicated in a larger group of more typical military personnel. Replication of these detrimental effects would have important implications because of the military's high rates of smoking. A Department of Defense survey conducted in 1983 (Bray, Marsden, Guess, Wheeless, Pate, Dunteman, & Iannacchione, 1986) showed that 56% of males and 48% of females in the military smoked. These rates can be compared to 36% for males and 29% for females in the United States population during 1983 (Schoenborn & Cohen, 1986). Because of the military's high smoking rates and because smoking may be related to decreased health and physical readiness, the impact of smoking in the military needs to be examined carefully. The purpose of this study was to examine the effects of smoking on physical fitness in a large group of Navy shipboard personnel.

Methods

Subjects

A group of 1,357 male shipboard personnel filled out self-report surveys asking about various lifestyle habits and attitudes toward health and fitness. These men were participants in a larger study examining baseline levels of physical readiness among Navy personnel (Conway & Dutton, 1985). They were stationed aboard nine ships whose home port was San Diego. These nine ships were part of a subgroup of 23 San Diego-based ships asked to participate if scheduling of their annual physical readiness testing coincided with the study's data collection phase (January through October, 1984). The ship types included one aircraft carrier, one cruiser, two frigates, two destroyers, and three amphibious warships. No female sailors were included in this

study because only 3 of 90 San Diego-based ships had women assigned to them, and none of these ships became part of the group studied.

The average age of the participants was 26.0 years (SD = 6.2) with a range from 18-51 years of age. The median paygrade was E-4. Enlisted personnel comprised 93% and officers 7% of the sample, which slightly overrepresents enlisted personnel relative to the 88% found in the Navy at large (Naval Military Personnel Command, 1984).

Measures

Physical Fitness. Physical fitness was measured by performance on the tests taken annually as part of the Navy's Health and Physical Readiness (HAPR) Program described in OPNAVINST 6110.1B. The four required HAPR tests include a 1.5-mile run/walk, 2-minute sit-ups test, sit-reach flexibility test, and an estimation of the percentage of body weight attributable to fat (percent body fat). The Navy also has age- and sex-adjusted standards which are used to convert performance on each test into classification ratings on a 6-point scale from "Fail" [0] to "Outstanding" [5]. An overall rating is set equivalent to the lowest rating on any of the above four tests (see OPNAVINST 6110.1B or Conway & Dutton, 1985 for a more detailed description of the HAPR tests and scoring). Physical readiness test (PRT) scores for each participant were provided by Command Fitness Coordinators, who are ship personnel assigned to conduct the required HAPR testing.

Self-Reported Survey Measures. Command Fitness Coordinators distributed lifestyle surveys to individuals on board each ship. Participants were asked to complete the survey and return it to the Command Fitness Coordinators. Demographic measures taken from this survey included age, years of schooling, race/ethnicity, officer/enlisted status, paygrade, and years in the Navy. Smoking measures included: 1) smoking status, which classified individuals as having never smoked, being a former smoker, or being a current smoker; and 2) average amount smoked per day. The latter measure was based on a 10-category response scale: 0, 1-5, 6-10, 11-15, 16-20, 21-25, 26-30, 31-35, 36-40, and 41+ of cigarettes, cigars, or pipefuls of tobacco.

Results

Smoking Prevalence

Table 1 presents the percentages of individuals who indicated they had never smoked, were former smokers, or were current smokers. Percentages are provided for the entire group of shipboard men as well as for subgroups based on seven demographic characteristics: age, education, race/ethnicity, officer/enlisted status, enlisted pay grade, officer pay grade, and years in the service. Overall, 49.8% of the men were current smokers compared to 29.9% who indicated they had never smoked and 20.3% who

reported that they were former smokers. Significant differences in expected smoking status were found for four of the seven demographic variables: years of education, race/ethnicity, officer/enlisted status, and years in the service.

Less educated individuals, particularly those with under 12 years of education, were more likely to be current smokers. On the other hand, individuals with some college education, especially those with 16 years or more of schooling, were less likely to be current smokers. Highly educated individuals were also more likely never to have smoked or to have quit smoking, whereas those with less than 12 years of education were less likely never to have smoked or to have quit smoking.

The most striking race/ethnicity finding was the high percentage of Black people who indicated they had never smoked (50.5% compared to the overall rate of 29.9%). Another notable difference was the low percentage of former smokers among Philippino/Malayans (8.6% compared to an overall rate of 20.3%). Although Philippino/Malayans also showed a higher rate of those who had never smoked (38.6% compared to 29.9% overall), the slightly higher percentage of Philippino/Malayan current smokers (52.9% compared to 49.8% overall) indicated that once they had started smoking they were less likely to quit.

Considering officer/enlisted status, a much higher percentage (42.4% compared to 29.9% overall) of officers said they had never smoked. Also, more officers were former smokers (27.2% compared to 20.3% overall), and fewer officers said they were currently smokers (30.4% compared to 49.8% overall).

Finally, the length of time a person had been in the Navy was associated with smoking. The main deviation from the expected frequencies was for those who had been in the service 16 or more years: these individuals were more likely to be current smokers (63.3% compared to 49.8% overall). Conversely, those who had been in the service for one year or less were somewhat less likely to be current smokers (44.0% compared to 49.8% overall).

Table 1

Smoking Status by Demographic Characteristics

	(N)	Never Smoked %	Former Smoker %	Current Smoker %	Chi-Square	Sig. Level
Overall	(1323)	29.9	20.3	49.8	--	--
Age Group (years)					11.9	(.157)
17-20	(234)	33.8	19.2	47.0		
21-25	(512)	32.0	20.9	47.1		
26-30	(230)	26.5	21.3	52.2		
31-35	(157)	30.6	20.4	49.0		
36 or older	(129)	19.4	20.9	59.7		
Education (years)					21.6	(.001)
11 or fewer	(72)	16.7	13.9	69.4		
12	(810)	30.1	19.6	50.2		
13-15	(190)	30.0	23.7	46.3		
16 or more	(97)	40.2	24.7	35.1		
Race/Ethnicity					36.4	(.000)
White	(892)	28.0	20.4	51.6		
Black	(99)	50.5	20.2	29.3		
Philipino/Malayan	(70)	38.6	8.6	52.9		
Hispanic/Puerto Rican	(52)	36.5	23.1	40.4		
Unspecified	(210)	23.8	22.9	53.3		
Officer/Enlisted Status					14.8	(.001)
Officer	(92)	42.4	27.2	30.4		
Enlisted	(1169)	29.0	19.8	51.2		
Enlisted Pay Grade					2.4	(.664)
E1-E3	(383)	30.5	18.8	50.7		
E4-E6	(704)	28.6	20.7	50.7		
E7-E9	(83)	25.3	16.9	57.8		
Officer Pay Grade					5.8	(.450)
W1-W4	(13)	30.8	30.8	38.5		
01-02	(26)	61.5	19.2	19.2		
03	(28)	35.7	32.1	32.1		
04-010	(24)	37.5	25.0	37.5		
Years in Service					19.7	(.032)
1 or less	(209)	35.4	20.6	44.0		
2	(215)	31.6	18.6	49.8		
3-4	(270)	33.3	18.9	47.8		
5-10	(213)	23.9	25.4	50.7		
11-15	(174)	29.3	19.0	51.7		
16+	(90)	16.7	20.0	63.3		

Smoking and Physical Fitness

Two types of analyses were used to examine the relationship between smoking and physical fitness. First, analyses of variance were computed to compare PRT scores across the three smoking status groups: never smoked, former smoker, and current smoker. Second, Pearson product-moment correlation coefficients were computed to examine the degree of association between PRT performance and the average amount smoked per day. The latter analysis was done two ways: 1) with nonsmokers and former smokers included and coded as smoking zero amount per day, and 2) with nonsmokers and former smokers excluded so that the effects of the quantity smoked could be examined among smokers only.

Table 2 presents descriptive statistics and analysis of variance results comparing raw PRT scores and the Navy's sex- and age-adjusted classification scores across the smoking status groups. Significant effects were found for both raw scores and classification scores for all the PRT components except the sit-reach flexibility test. Performance on the 1.5-mile run, sit-ups, and overall tests showed a decreasing linear trend between smoking and performance: current smokers performed the worst and those who had never smoked performed the best, with former smokers in the middle. Percent body fat showed a different pattern: those who had never smoked were the leanest and former smokers were the fattest, with current smokers in the middle. The footnotes in Table 2 summarize the statistically significant group differences based on post hoc Modified Least Significant Difference tests (SPSS, 1983).

These tests were followed up with another series of analyses which took age into account. Because physical fitness is known to decrease with age, these analyses were done to be sure that effects of smoking status were not spurious effects of age (i.e., smokers having lower fitness only because they tended to be older than nonsmokers). The ANOVA procedure in SPSS^{X} (SPSS, 1983) was used to compute analyses of covariance controlling for age and 2-way analyses of variance with smoking status as one factor and age, dichotomized as less than 30 years old versus 30 or more years old, as a second factor. As expected, age had significant effects on all four physical fitness measures. With age controlled, smoking status had significant effects on all the fitness measures except sit-reach flexibility. There was one significant age by smoking status interaction which indicated that the negative impact of smoking on 1.5-mile run performance was stronger for older men. These findings suggest that the significant effects of smoking status shown in Table 2 are not a spurious result of age.

Table 2

Physical Readiness Scores by Smoking Status

		Never Smoked	Former Smoker	Current Smoker	Total	F-Value	% Var.
Actual Scores							
1.5-Mile Run (minutes)	Mean	11.70	12.04	12.94[a]	12.47	36.2***	7.0
	S.D.	1.89	1.93	2.20	2.13		
Sit-Ups (No. in 2-minutes)	Mean	58.83[b]	54.03[b]	49.27[b]	53.13	35.7***	6.8
	S.D.	17.01	15.12	14.55	15.98		
Sit-Reach (inches)	Mean	2.98	3.08	2.69	2.86	1.4	0.3
	S.D.	3.34	2.79	3.04	3.08		
% Body Fat (percent)	Mean	14.22[c]	16.10	15.35	15.17	9.6***	1.9
	S.D.	4.52	5.12	4.96	4.91		
Navy Classification Ratings							
1.5-Mile Run	Mean	3.26	3.17	2.65[a]	2.94	32.8***	6.4
	S.D.	1.10	1.06	1.16	1.16		
Sit-Ups	Mean	2.92	2.74	2.46[b]	2.66	27.2***	5.3
	S.D.	0.85	0.83	0.87	0.88		
Sit-Reach	Mean	4.33	4.50	4.27	4.34	2.2	0.5
	S.D.	1.28	1.04	1.29	1.24		
% Body Fat	Mean	3.92[c]	3.27	3.54	3.60	10.1***	2.0
	S.D.	1.43	1.74	1.67	1.63		
Overall	Mean	2.33[d]	2.01	1.84	2.02	14.7***	3.3
	S.D.	1.17	1.17	1.14	1.17		

*** $p < .001$

[a] Current smokers ran significantly ($p < .01$) slower than former smokers and those who had never smoked; the latter two groups did not differ ($p > .05$).

[b] Current smokers did significantly ($p < .01$) fewer sit-ups than former smokers and those who had never smoked. Former smokers also did fewer ($p < .01$) sit-ups than those who had never smoked; however, they were not significantly ($p > .05$) different on the classification rating for sit-ups.

[c] Those who had never smoked were significantly ($p < .01$) leaner than current and former smokers; the latter two groups did not differ ($p > .05$).

[d] Those who had never smoked performed significantly ($p < .05$) better overall than current and former smokers; the latter two groups did not differ significantly ($p > .05$).

Table 3 shows the correlations between the raw PRT scores and the amount smoked per day. The first column of correlations included nonsmokers and former smokers coded as smoking zero amount per day, and the second column of correlations is based on smokers only. All correlations were significant at $p < .05$.

Table 3

Correlations between PRT Scores and Amount Smoked Per Day

PRT Measure	Total Group[a]		Smokers Only[b]	
	r	prob.	r	prob.
1.5-Mile Run	.32	.001	.25	.001
Sit-Ups	-.29	.001	-.23	.001
Sit-Reach	-.11	.001	-.15	.001
% Body Fat	.06	.022	.09	.029

[a] Group size varied from n = 902-980 because of missing PRT data.
[b] Group size varied from n = 443-475 because of missing PRT data.

Figures 1-4 are graphic representations of the association between smoking and PRT performance. Because age had a significant effect on PRT performance, results for those less than 30 years old and those 30 or more years old are presented separately. Figures 1 and 2 clearly show inverse linear associations between smoking and performing well on both the 1.5-mile run and sit-up tests. These trends are evident in both age groups even though the relationship between smoking and run performance is stronger for older men. Figure 3 indicates that there is not a simple monotonic association between smoking and sit-reach flexibility; however, heavier (over 20 cigarettes a day) smokers tended to be less flexible than light (20 or less cigarettes a day) smokers in both age groups. Figure 4 shows that there is also not a simple association between smoking and percent body fat. However, among men under 30 years of age, those who had never smoked were significantly leaner than both former smokers and current smokers. Among those 30 or more years of age, there were no significant group differences, although there was a trend ($p < .10$) for former smokers to have higher percent body fat than those who had never smoked and current smokers.

Figure 1

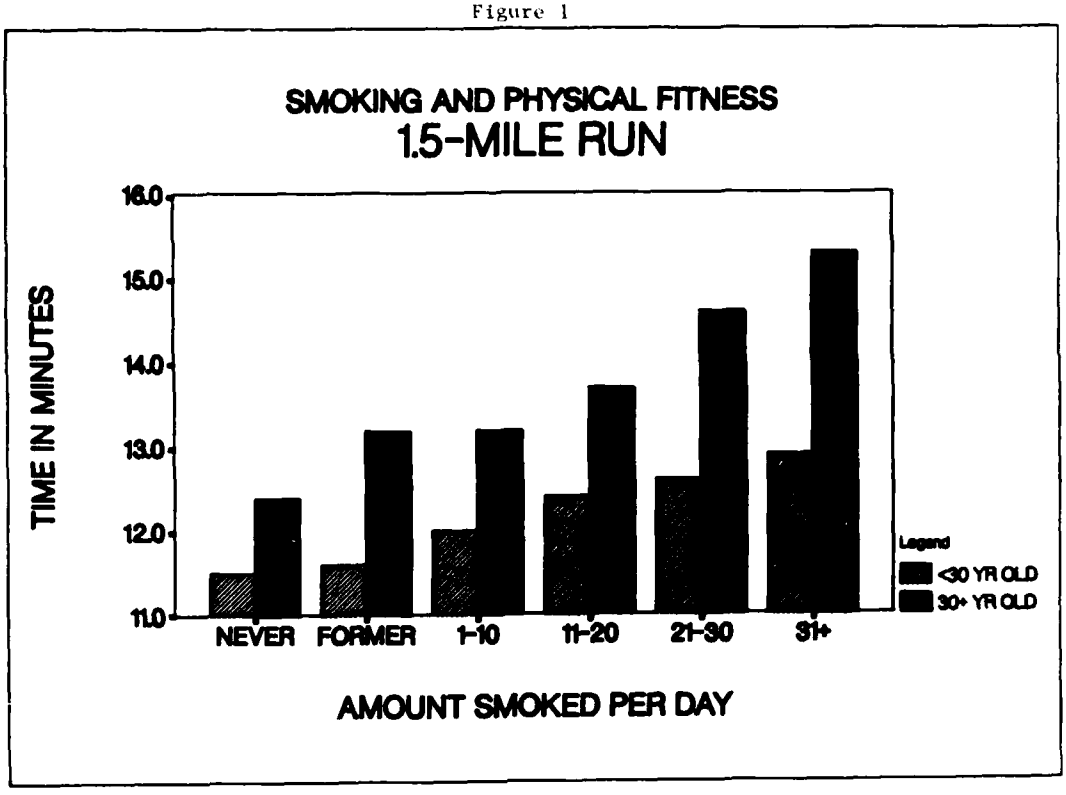


Figure 2

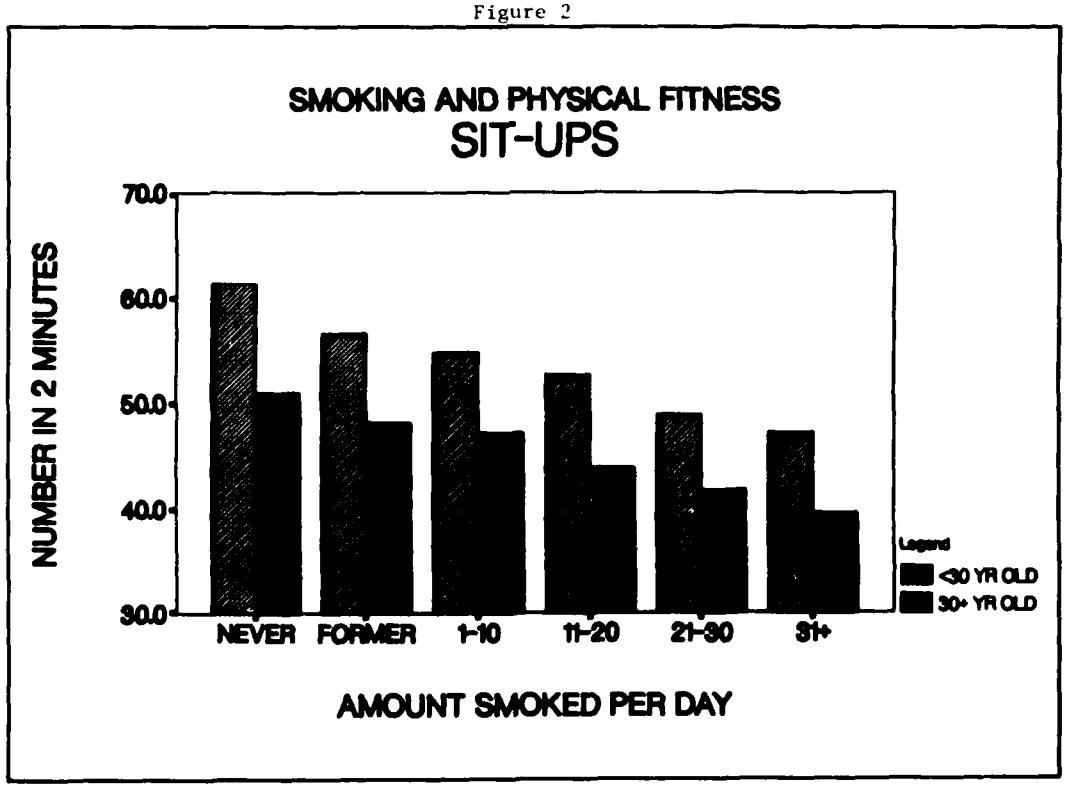


Figure 3

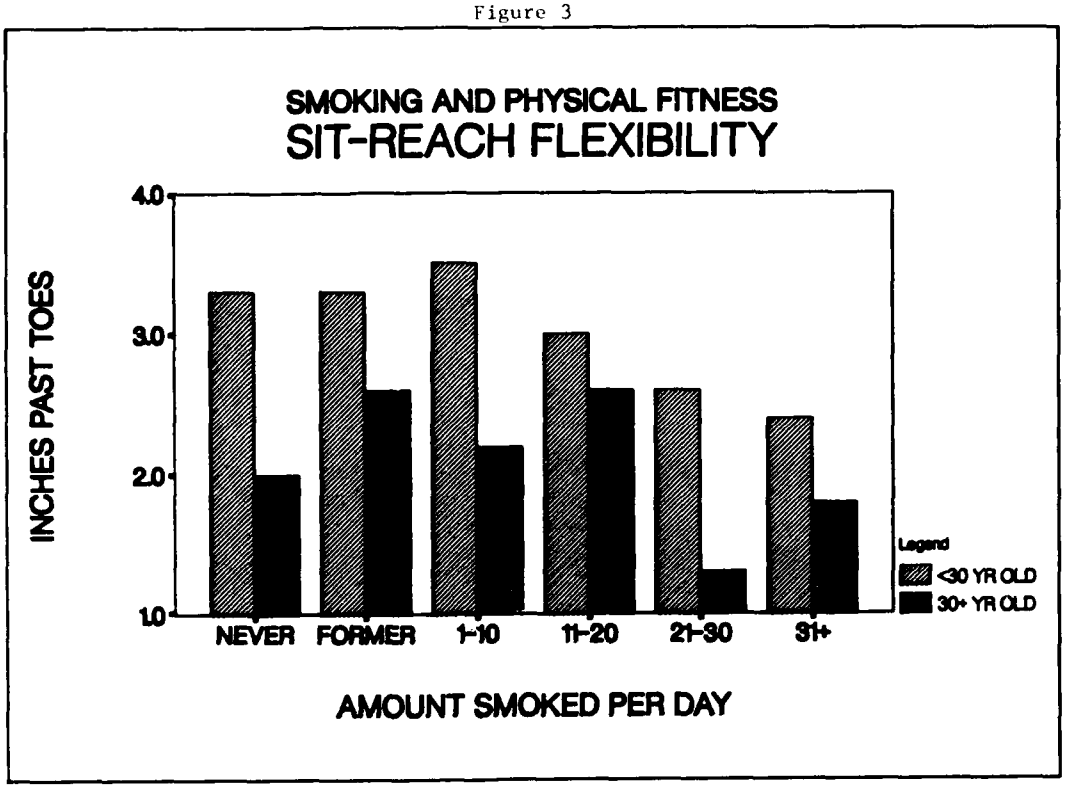
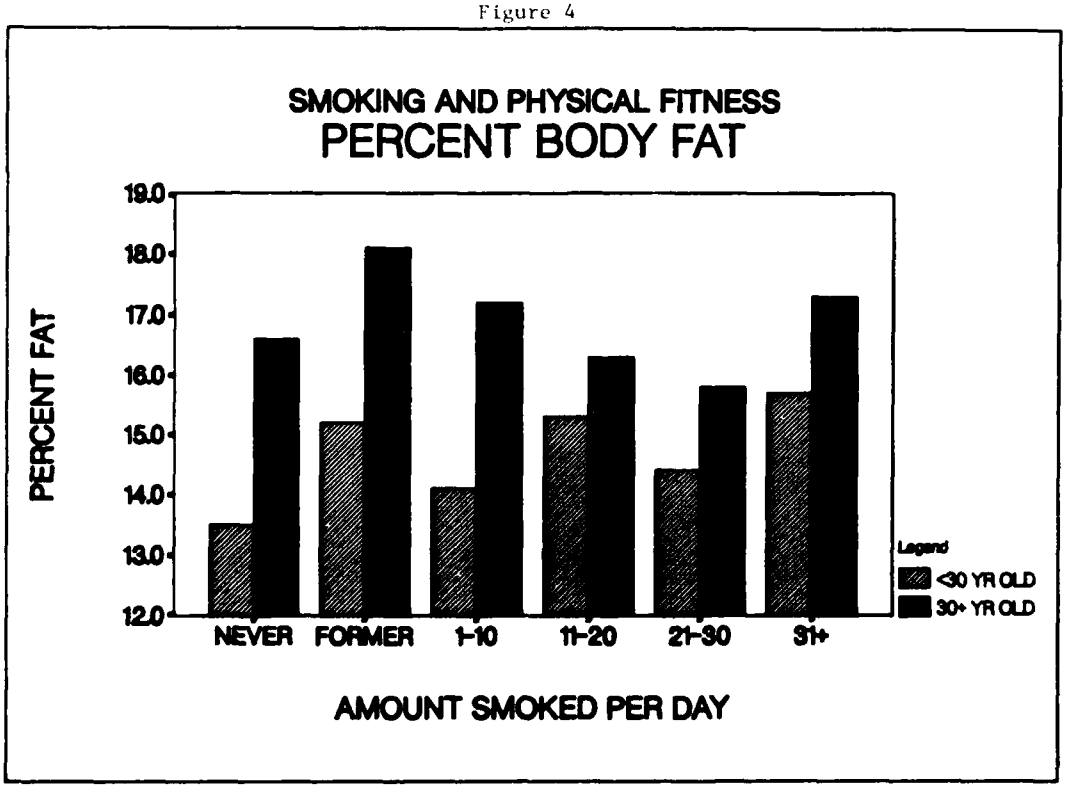


Figure 4



Discussion

This study examined the prevalence of smoking and the impact of smoking on physical fitness in a large group of Navy men stationed aboard ships in the San Diego area. The percentage of these men who smoked (50%) was substantially higher than a comparable estimate for men in the U.S. population (39%). Navy smokers were likely to be non-Black enlisted personnel with lower education who had been in the Navy longer and tended to be older. Findings also clearly indicated that smoking adversely affected physical fitness among these shipboard personnel. This adverse impact was most notable for the measures of cardiorespiratory endurance (1.5-mile run performance) and muscular endurance (sit-ups test). Among men under 30 years of age, those who had never smoked were also leaner than former smokers and current smokers. Smoking status did not have a significant effect on the flexibility test; however, considering smokers only, heavier (more than 20 cigarettes a day) smokers tended to be less flexible than lighter (20 or less cigarettes a day) smokers.

If these findings generalize to the Navy at large, they have important implications because they show that smoking is working in direct opposition to the Navy's health and fitness goals. Health and physical fitness is a major concern because of the need to maintain a combat ready force (OPNAVINST 6110.1B). In fact, several Navy directives and large-scale programs are geared specifically toward developing and maintaining a force with high levels of health and physical readiness, and anti-smoking efforts are part of these initiatives (SECNAVINST 6100.5; CNO MEMO, 25 FEB 86). The findings presented here underscore the importance of these efforts.

Smoking among Navy personnel should be a cause of concern not only because of its adverse impact on physical fitness, but also because smokers are in general more costly to employers than nonsmokers. These costs include higher health care costs, lost productivity, and increased absenteeism (Kristen, 1983). Smokers have been found to have increased illness and morbidity as well as premature death (Kristen, 1983; Weis, 1981). Because of the increased costs, decreased productivity, and decreased health and physical fitness related to smoking, the Navy should be especially concerned about having smoking rates which are substantially higher than the U.S. population at large.

Recommendations and Future Research

Based on findings from this study, we recommend that the Navy's anti-smoking efforts focus heavily on prevention. Overall, those who had never smoked were more physically fit than both current smokers and former smokers. Men who had never smoked tended to be leaner, could do more sit-ups, and scored higher on the overall PRT classification rating than current smokers and former smokers.

Efforts to get smokers to stop smoking are also strongly recommended to improve physical fitness. Getting people to stop smoking should improve both cardiorespiratory endurance and muscular endurance, as former smokers performed better on the 1.5-mile run and sit-up tests than current smokers.

Because preventing people from ever starting to smoke appears to be the best way to avoid the smoking "costs" to physical fitness and health, future research should determine why the Navy has such high rates of smoking. For example, does the Navy attract smokers through its enlistment procedures or do people start smoking after they join the Navy because of environmental pressures in work or social settings? If a higher percentage of smokers are being attracted to the Navy, recruiting information and procedures might be modified to ensure that potential recruits know that the Navy is strongly anti-smoking and pro-fitness and health. If people are starting to smoke after they join the Navy, research needs to identify relevant environmental, social, and psychological factors which encourage smoking behavior. Interventions can then be developed to modify these factors. Successful interventions, regardless of whether they are aimed at preventing the onset of smoking or at getting people to stop, will help the Navy reach its goals for maintaining a healthy and fit force.

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The purpose of this study was to examine smoking prevalence in a large group of Navy men and to assess the impact of smoking on their physical fitness. Self-reported demographic and smoking information was provided by 1,357 Navy men stationed aboard ships in the San Diego area. Physical fitness was measured as performance on the Navy's annual physical readiness test which includes a 1.5-mile run/walk, 2-minute sit-ups test, sit-reach flexibility test, and percent body fat assessment. Self-reported smoking status indicated that 49.8% were current smokers, 20.3% were former smokers, and 29.9% had never smoked. Smokers were more likely to be non-Black enlisted personnel with lower education who had been in the Navy longer and tended to be older. Smoking also had a clear negative impact on physical fitness, most notably on cardiorespiratory endurance (1.5-mile run performance) and muscular endurance (sit-ups test). Study results suggest that the Navy's anti-smoking efforts should focus heavily on prevention. Men who had never smoked were
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leaner, could do more sit-ups, and scored higher on the overall physical fitness rating than current smokers and former smokers. Strong efforts to get people to stop smoking should also improve cardiorespiratory and muscular endurance as former smokers performed better on the 1.5-mile run and sit-ups tests than current smokers. Future research should focus on why smoking rates in the Navy are so high. Identification of factors associated with smoking would provide useful information for developing interventions to lower smoking rates. Successful interventions are vitally needed to help the Navy reach its goals for maintaining a healthy and fit force.