SMOKING VERSUS NONSMOKING
AND
THE ARMY PHYSICAL FITNESS TEST

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree
MASTER OF MILITARY ART AND SCIENCE

by

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This study determines the difference in Army Physical Fitness Test (APFT) scores among smoking and nonsmoking students attending the Command and General Staff Officer's Course (CGSOC) 1990-1991.

This study examines APFT scores in three different events as well as total scores. The three events are push-ups, sit-ups, and a 2 mile run. Scores of current smokers, those who have recently quit smoking, and non-smokers are evaluated. This study contributes to the knowledge of smoking and its link to physical fitness in this limited population using the APFT scores as the unit of measurement. Physical fitness affects overall mental and physical health, and physical readiness. Decreased physical fitness infers decreased endurance on the battlefield and this may impact overall military readiness. This is an important area to evaluate because it may have an overall effect on the future leaders of the military. The results of this study may also help to predict the future health of the current forces and related health care costs.
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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)
This study determines the difference in Army Physical Fitness Test (APFT) scores among smoking and nonsmoking students attending the Command and General Staff Officer’s Course (CGSOC) 1990-1991.

This study examines APFT scores in three different events as well as total scores. The three events are push-ups, sit-ups and a 2 mile run. Scores of current smokers, those who have recently quit smoking, and non-smokers are evaluated. This study clearly shows a significant difference between APFT scores among smoking and nonsmoking students and implicates smoking as detrimental to physical fitness when using APFT scores as a measure of fitness.

This research project contributes to the knowledge of smoking and its link to physical fitness in this limited population using the APFT scores as the unit of measurement. Physical fitness affects overall mental and physical health, and physical readiness. Decreased physical fitness implies decreased endurance on the battlefield and this may impact overall military readiness. This is an important area to evaluate because it may have an overall effect on the future leaders of the military. The results of this study may also help to predict the future health of the current forces and related health care costs.
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CHAPTER I
INTRODUCTION

Smoking is responsible for more than one in every six deaths in the United States today. Smoking remains the single, greatest cause of preventable death in our society. Smoking students in the Command and General Staff Officer's Course (CGSOC) were the inspiration for conducting this study. The students are frequently noted standing outside the doors of Bell Hall during breaks and in between classes smoking cigarettes. If time and energy spent smoking were put into exercising and improving fitness, would their Army Physical Fitness Test (APFT) scores be higher? First, scores needed to be evaluated and compared to determine if smoker's scores were higher, lower, or the same as non-smokers.

The purpose of this study is to identify whether there is or is not a significant difference between APFT scores in smoking and nonsmoking students attending the CGSOC during 1990-1991. This chapter will discuss aspects associated with smoking in general, smoking in the Army, smoking and fitness, the "Fit to Win" program, and the current study.

General Aspects of Smoking

Smoking is a drug addiction. The Surgeon General's Report identified smoking as the most common cause of avoidable morbidity and premature death in the United States. This conclusion comes twenty-five years after the U.S. Surgeon General's first warning that cigarette smoking is a serious health hazard. The Centers for Disease Control (CDC) has reported that in 1988
alone, more than 434,000 Americans died from health problems caused by smoking. This is an increase of 11 percent since 1985.  
Iverson in 1987 noted that there have been more than 10 million deaths in this century alone that can be attributed to smoking. Each time a person smokes a cigarette, five minutes of life is lost. In addition, the mortality rate for adult cigarette smokers is double that of nonsmokers.

The health effects of smoking are devastating and account for thirty percent of all cancer deaths. In the United States, cigarette smoking is the major cause of cancer of the lung, larynx, oral cavity, and esophagus. In 1988, the CDC noted that there were 111,985 deaths from lung cancer. Smoking contributes to cancers involving the bladder, kidney, and pancreas. There were 30,850 deaths from these other smoking related cancers in 1988. Smoking is also the major risk factor of coronary heart disease, stroke, and peripheral vascular disease. Coronary heart disease alone results in almost 200,000 deaths per year and thousands of hospital visits. In addition to the ill health effects already mentioned, smoking in the United States contributes to the incidence of peptic ulcer disease, intrauterine growth retardation, and more than 5000 perinatal deaths each year. Smoking is responsible for most of the deaths from emphysema, chronic bronchitis, and fires.

Numerous studies have demonstrated that smokers have higher resting and exercise heart rates than non-smokers. This implies the heart has to work much harder to deliver oxygenated blood to vital organs and tissues. Goldberg noted in 1971 that cigarettes and the effects from smoking them can produce changes opposite to those seen with physical conditioning.
Lungs appear to suffer the most from cigarette smoking, but the cardiovascular system is also affected. Smokers have been found to have a significant increase over non-smokers of symptoms such as cough, shortness of breath, sputum production, and wheezing.\textsuperscript{15} Most of these symptoms are related to diseases, such as bronchitis and emphysema, that occur in the small airways of the lungs in smokers.

Smokers' rate of small airway dysfunction is much higher than non-smokers. This is shown by reduced vital capacity and forced expiratory flow rates in pulmonary function studies that compared smokers and non-smokers.\textsuperscript{16} Lung function is decreased progressively as the number of smoking pack-years increases.\textsuperscript{17} Researchers have also found abnormal lung function in adolescents and young adults who have just begun to smoke. This seems to suggest an immediate negative effect.\textsuperscript{18} Increased airway resistance and decreased expiratory flow rates have documented this immediate effect after smoking just one cigarette.\textsuperscript{19} Smoking jeopardizes the cardiopulmonary system anatomically and physiologically.

Along with the devastating health effects of smoking, another aspect of smoking that is documented, as well as morbidity and mortality, is the cost to society of cigarette smoking. The cost of smoking is phenomenal in terms of higher health care costs, lost productivity, and increased absenteeism.\textsuperscript{20} A forty-five percent higher rate of job absenteeism in the United States was noted among smokers as compared to non-smokers. Yearly, the cost of this absenteeism is a productivity loss of 43 billion dollars.\textsuperscript{21} In 1985, the cost of health care associated with smoking related illnesses was over 16 billion dollars.\textsuperscript{22}
Although smoking prevalence in the United States is declining, at least in the male population, there are still over 50 million adults who smoke.\textsuperscript{23} The recent decline of smoking may have a positive effect on the associated higher health care costs. In 1965, 40 percent of Americans smoked. That was the year the Surgeon General issued his warning against smoking. From 1985 to 1988, the number of Americans who smoked declined from 30 to 29 percent. Because it may take up to 20 years to develop cancer from smoking, society is now paying for the damage that occurred 20 to 30 years ago when larger numbers of people smoked.\textsuperscript{24}

One can compare a burning cigarette with a chemical factory that produces over 4000 compounds.\textsuperscript{25} Nicotine and carbon monoxide are the predominant compounds. These compounds hinder oxygen delivery and uptake; this impairs endurance and training response.

**Smoking in the Military**

It is widely held that cigarette smoking adversely affects the health and welfare of society. The military cannot escape the effects of smoking any more than society as a whole can escape them. The military, and the Army in particular, has a significant problem with smoking rates being almost twice that of the civilian sector. Approximately 28 percent of the American population smoke now. This rate is 40 percent among Army personnel. Department of Defense statistics indicate that the percentage of Army personnel who smoke is higher than any other branch of the military.\textsuperscript{26}

Health care costs may be higher as well. In 1984, the military health care system spent 210 million dollars on smoking related illnesses.\textsuperscript{27} Thirteen
thousand, five hundred man-days are lost annually in the U.S. Navy due to smoking-related illnesses. Upper respiratory infections related to smoking have caused the military significant losses not only in time and money, but also in terms of time lost from work.

The Army still has numerous areas where non-smokers are exposed to smoke from smokers. The CDC reported that in 1988, 3,825 nonsmokers in the United States died from lung cancer caused by passive smoking which is another’s smoke. Though smoking areas in Army buildings are to be designated areas, they are often in offices or areas in close proximity to several other offices and areas where there are non-smokers. Most U.S. Army Hospitals, however, have enforced no smoking policies inside the hospitals and those who smoke must go outside if they want to smoke. It is accurate to summarize that smokers affect the military as well as society.

Finally, if one puts aside the health, endurance, and general physical fitness concerns associated with smoking in the military, there are also direct effects of smoking on the battlefield. Discarded cigarette butts and matches may lead the enemy to a smoking soldier. Even though smokers may take precautions, they also get tired and make mistakes. Cigarettes smell and so does a soldier who smokes as well as his gear. Smokers often have chronic coughs. Also, there is the potential of starting a fire with a cigarette butt.

These smells and sounds could alert the enemy to a soldier’s location. A captain on a Japanese destroyer spotted a light across the water during a patrol at night in World War II in the South Pacific. It was an American sailor smoking on the conning tower of a surfaced submarine. The Japanese gunners aimed at the glowing cigarette and sank the submarine. After this incident, the
Japanese officer threw his own cigarettes into the sea and vowed never to smoke again. An Army nurse in her memoirs told about U.S. troops that were warned in World War II that on a dark night a lighted cigarette was visible for miles at sea and thousands of feet into the air.31

In addition, smoking also appears to interfere with perceptual and motor skills such as reaction time, visual acuity, and time perception.32 Alterations in these skills on the battlefield could have devastating effects. Ill effects can occur in soldiers addicted to nicotine when smoking is not possible. Side effects of nicotine withdrawal include irritability and nervousness.33 These side effects can affect concentration and performance on the battlefield and thus can be devastating.

**Smoking and Fitness**

One particular area that deserves extra attention in the military is the effects of smoking on fitness. Physical fitness is essential for combat readiness. It is important to know if there is a link between smoking and fitness. Chronic diseases such as coronary heart disease, emphysema, bronchitis, and lung cancer have already been noted as smoking's adverse health effects. Many studies have documented the long-term consequences of smoking, along with the effects of second hand smoke, but there has been very little research to evaluate if there is a difference in physical fitness among smokers and nonsmokers. The acute effects of a smoking habit on physical fitness in military populations are not known. The population attending the CGSOC is particularly interesting and important to study as this population will probably become the future leaders of the Army. They should be the most physically fit soldiers and
role models to others in the Army. Determining the difference between smoking and nonsmoking students' APFT scores may demonstrate if a link exists between fitness and smoking.

The Army Physical Fitness Test

In 1985, the Army instituted a physical fitness program. Army leaders were beginning to put more emphasis on physical fitness. The military, particularly the Army, strongly emphasizes the physical fitness test which is given to each soldier twice a year to try to insure minimal physical fitness. Levels of fitness are measured by different events in this test. This is a base level of physical conditioning essential for every soldier in the Army, regardless of sex, specific specialty, or duty assignment. It also helps commanders assess general fitness of their units.

The APFT is a performance test made up of push-ups and sit-ups that are meant to evaluate muscular strength and endurance. Another component is a two mile run that is timed, which is meant to measure cardiorespiratory endurance. The APFT is standardized and objective and evaluates the basic components of physical fitness and a soldier's ability to perform physically.

The APFT uses strict criteria Army wide. The standards that are expected of soldiers are statistically derived and can be correlated with maximal oxygen consumption. This supports its use as a measure of physical fitness. A raw score is obtained in each event and is then converted to a point score based on a scoring table for each event. A point system from zero to 100 has been standardized and adjusted for age and sex differences is used. All soldiers must attain a score of at least 60 points in each of the three events and attain an
overall score of at least 180 to pass and meet the minimum standards of the APFT. The maximum attainable score is 300 points. One must assume that students in CGSOC will do the best they can on this test, though the baseline requirement is only to pass, and little recognition is given for surpassing 180 points. Some units insure soldiers receive a physical fitness badge for scores over 275, however, this is a very inconsistent policy.

Selected soldiers at different points in their career are specially trained to help other soldiers improve their level of fitness. This is in hope that soldiers would become more physically fit and increase their endurance. Strength and endurance are physical qualities desirable in fighting men and women. These qualities should increase with improved physical training. Physically fit soldiers have a greater resistance to illness and disease and recover faster when injured than soldiers who are unfit. They also seem to have greater levels of self confidence, mental toughness, and motivation. Therefore, fit soldiers may cope better with stress and fear of combat and may perform at increased capacities.36 As stated in Army's Field Manual 100-5, "well trained, physically fit soldiers in cohesive units retain the qualities of tenacity and aggressiveness longer than those which are not." 37

Aerobic capacity is the best single indicator of physical fitness. This is the ability of the cardiopulmonary system to efficiently deliver oxygen to working muscles.36 Aerobic capacity is measured as maximal oxygen uptake in the laboratory. The physiological symbol for maximal oxygen uptake is $VO_2 \text{ max}$. This refers to the amount of oxygen blood cells can carry to tissues, muscles, and organs. Blood has to have enough oxygen to feed muscles in order for them to work efficiently. Smokers have a lower $VO_2 \text{ max}$ and the heart has to
work harder to deliver enough oxygenated blood to insure nourishment to tissues and organs. VO$_2$ max is seen as the "gold standard" for cardiopulmonary fitness in military and civilian circles alike. Because performance on the APFT is closely associated with VO$_2$ max, the APFT score provides a reliable measure of physical fitness.$^{39}$

"Fit to Win"

Over the last several years, the Army has been highlighting efforts in research and development concerning areas in physical fitness. The Secretary of the Army designated 1982 as the Year of Physical Fitness. At this time, the Army Physical Fitness Research Institute was formed at Carlisle Barracks, Pennsylvania. There was much effort put into improving the physical fitness of soldiers. This was seen as a way to increase soldier's ability to successfully sustain operations on a modern and highly intense battlefield.

In 1986, the Department of Defense and the Department of the Army established a set of guidelines that were meant to promote healthier life styles and improve fitness.$^{40}$ This program is called "Fit To Win" and the goals of this program are to improve the quality of life and health for all soldiers while at the same time improving combat readiness. "Fit to Win" has become the Army's slogan.

Smoking cessation is a big part of the "Fit to Win" program. This program was meant to help the Army meet the overall goals of maximum combat readiness, efficiency, and work performance. Cigarette smoking is detrimental to health and productivity and is inconsistent with these goals of the Army. If a significant difference is found in APFT scores between smokers and
nonsmokers, this data would provide evidence of a need for increased health education efforts and for more and better smoking cessation programs in the Army.

In the Army's "Fit to Win" program, a Health Risk Appraisal is included as part of the assessment. This consists of a cholesterol, blood pressure and blood sugar evaluation, and administration of a detailed questionnaire asking for smoking information. The smoking related questions have been tested and are valid and reliable. Therefore, they were used to collect smoking data for this study.

The Research Question

This study answers the question, "Is there a difference in APFT scores among smoking and non-smoking students attending the Command and General Staff Officer Course (CGSOC) A.Y. 90-91?" The subordinate questions deal with whether there is a difference between smokers and non-smokers in each event in the APFT— the number of push-ups and sit-ups a student can do, and the completion time of the two mile run.

This study on APFT scores in CGSOC students will reveal if there is a difference between smokers and non-smokers APFT scores. If a decreased level of physical fitness is found in smokers, this infers decreased endurance on the battlefield.

The assumptions made concerning this study were:

a. The questionnaire used to collect the data is valid and reliable.
b. Access will be provided to APFT score cards.
c. Students will be honest with self-reporting smoking behavior.
d. Students will do their best on the APFT.

The following are definitions of terms used for this study:

a. Smokers - students who currently smoke or who quit smoking during the last six months.

b. Nonsmokers - students who do not smoke or who quit smoking more than six months ago.

c. Physical fitness - a state of overall physical well-being

d. APFT - a standardized test administered to all U.S. Army personnel twice a year to measure fitness. Scores are adjusted for age and sex.

There are certain limitations and delimitations associated with this study. The limitations are:

a. Students may under-report their smoking habits

b. When using self-reported survey data, there is a possibility for bias.

c. The survey will not be anonymous but will be confidential.

d. People interested in health will participate and others may not; therefore, there may be a selection bias.

e. Previous exercise history may affect results.

The delimitations are:

a. This study will not include a historical average of APFT scores.

b. This study will not include APFT scores other than scores from the test in October, 1990.
c. This study will only include active duty U.S. Army officers attending the CGSOC regular course.

d. This study will not include use of smokeless tobacco or cigar smoking.

e. This study will not include students with profiles.

f. This study will not include students taking alternate physical fitness tests.

Once this study identifies whether or not there is a link between smoking and APFT scores, results could be used to estimate physical readiness and fitness as measured by the APFT scores in a select group of officers. It is reasonable for one to assume that the more physically fit soldiers are, the easier they will find it to conserve their fighting strength. Since physical fitness affects overall mental and physical health, and physical readiness, this study contributes to the knowledge of if and how smoking is linked to physical fitness in this limited population, with APFT scores being the measure of fitness used.

Perhaps the results of this study may lead to policy changes within the military, specifically the Army. The post exchanges and commissaries deal heavily in cigarette sales. Elimination of cigarette sales in post concessions would carry with it a very strong message about the opinion of military leadership towards smoking.

Limitation of smoking during duty hours and smoking cessation inside all Army buildings, such as Army hospitals have done, would also be a step in the right direction. Special incentives could be offered for not smoking. These could be in the form of monetary compensation or extra days off. The possibility of forfeiture of health benefits for smoking related diseases should be seriously considered. Increasing number and locations, that is, availability of smoking
cessation programs and support of on-going educational programs on smoking hazards should be mandatory on all Army posts.

The results of this study will be forwarded to the Army Surgeon General and be presented at future research meetings held by the medical as well as military communities. This is in hope of having cigarettes removed from post concessions and to force the issue of health education. The results of this study will also be submitted to a professional journal for publication.

This study lends support to the federal-work-site smoking ban proposed by the Department of Health and Human Services and endorsed by Defense Department officials. This would also protect nonsmokers from the dangers of second hand smoke.

In summary, the probability of chronic health problems may be predicted if the smoking behavior among soldiers remains unchanged. Smoking is detrimental to good health and productivity and adverse effects from smoking are most likely cumulative. This has an overall effect on future leaders of the Army as well as the total military. One of the basic goals of the Army today is to heighten combat readiness, and to increase efficiency and work performance. Physical fitness is fundamental for combat readiness and smoking is not compatible with this goal.
ENDNOTES


2 Ibid., 20.


9 Ibid.


Bahrke, Baur, Poland, and Connors in 1988 examined the relationship of cigarette smoking and performance on the U.S. Army Physical Fitness Test. Soldiers who smoked performed fewer push-ups and fewer sit-ups. The average two-mile run time for smokers was slower than for non-smokers, however, the difference was not statistically significant. Statistical comparisons were made with one way analysis of variance. They also summarized that as the number of cigarettes smoked per day increased, repetitions of push-ups and sit-ups decreased. No significant changes were found for the two-mile run time. These studies were done on 147 soldiers attending a four week training course and the authors concluded that soldiers who smoke had significantly reduced physical readiness.

In 1986, Jensen looked at the relationship between cigarette smoking and physical fitness as measured by the Army Physical Fitness Test. Jensen looked at scores of 54 enlisted medical company personnel. Data analysis with a one-tailed t test revealed a statistically significant difference between smokers and non-smokers in all APFT scores except the push-up event. Along with these conclusions, this study also identified the need for further research in this area.

Miser in 1987 conducted a study on 192 male soldiers in a Field Artillery unit at Fort Sill, Oklahoma. He obtained a smoking history during routine physical examinations and analyzed scores for two sequential Army Physical Fitness Tests. There were 109 smokers and 83 non-smokers included in this
study. He supported the findings noted previously of Jensen and Bahrke et al. and concluded that non-smokers are more physically fit than smokers as measured by performance on the APFT. All participants in this study were from the same unit that exercised together regularly. This ensured a baseline uniform level of training. He analyzed two sequential APFTs over one year to eliminate the possibility of substandard or extraordinary performance by individuals. This study also showed that the performance on the APFT decreased as the amount smoked per day and the duration increased. These results demonstrated an inverse relationship between smoking and APFT performance. Of additional interest, Miser also noted that there were four soldiers who failed the APFT and all were smokers. At the same time, there were three soldiers who earned the maximum score on the APFT and all three were non-smokers.³

Conway and Cronin in 1986 did a study on 1,357 men stationed aboard ships in the San Diego area to examine smoking prevalence and to assess the impact of smoking on their physical fitness. Most smokers in this group were non-black enlisted personnel with lower education levels than average. Smoking was clearly associated with poorer physical fitness, most notably on cardiorespiratory endurance (1.5 mile run performance) and muscular endurance (sit-ups). Men who had never smoked scored higher than current and former smokers. Former smokers performed better on the 1.5 mile run and sit-ups than current smokers. The researchers computed analyses of variance and Pearson product-moment correlation coefficients to examine the degree of association between the physical readiness test and performance and smoking.⁴
In 1988, Marti, et.al, in a study using Swiss data, suggested that smoking exerts a direct, biologically mediated, deleterious effect on endurance capacity. He concluded that the distance covered in a 12 minute endurance run was inversely related to daily cigarette consumption and years of smoking. This association was present even among light smokers who had been smoking less than 2 years when they were compared with non-smokers.6

Kristen (1983)8 once again documented that smokers have increased illness and morbidity as well as premature death. If smoking is decreased and fitness increased, one would expect to see a decrease in premature death.

Goldbarg, et. al, in 1971 noted that smoking only one cigarette lowered cardiac stroke volume in young men. Because of this, the author concluded: "since the major hemodynamic effect of physical training is to increase stroke volume over pre-training levels, cigarettes can thus be said to produce changes opposite in direction to those of physical conditioning."7

Niewoehner, et. al, in 1974 showed a relationship between smoking and pathologic changes in the peripheral airways.8 He identified the characteristic pulmonary lesion in young smokers to be respiratory bronchiolitis. This finding was confirmed by Berend, et. al, in 1979. He showed the relationship between small airway obstruction on pulmonary function tests with morphologic abnormalities from lung resections.9

Dockery, et. al, in 1981 showed that smoking has both an immediate and chronic effect on lung function in a study with a sample of over 8000 people.10

Krumholz compared oxygen debt in smokers to nonsmokers in 1964. He looked at smokers and non-smokers after five minutes of exercise and noted
a greater accumulation of oxygen debt in smokers.\textsuperscript{11} Other later studies have confirmed that smoking impairs VO\textsubscript{2} max.\textsuperscript{12}

Although the next few studies are not directly related to the relationship between the Army Physical Fitness Test scores and smoking, they are still of interest to this study.

The prevalence of smoking among military personnel exceeds the rates established for the general population. Studies done from 1980 to 1985 estimated that approximately half of all military personnel are smokers.\textsuperscript{13} With our knowledge about the effects of physical fitness on overall mental and physical health, it is important to know if smoking is related to physical fitness and thereby physical readiness. Smoking is a behavior that can be changed. If a significant difference in APFT scores is found between smoking and nonsmoking students attending the CGSOC, it would provide additional rationale to emphasize health education efforts and to focus preventive health care on providing smoking cessation programs to change this behavior.

Cronin and Conway (1987) stated that effective smoking prevention and cessation programs should decrease health care costs, increase productivity, increase physical fitness, and produce a healthier and fitter force.\textsuperscript{14} These are the basic reasons the Army's "Fit to Win" program was initiated.\textsuperscript{15}

Literature that examines physical fitness measurements and smoking is limited. The effects of cigarette smoking on physical fitness in the U.S. Army CGSOC students has not been studied. CGSOC students, as future leaders of the military, are an ideal group to assess. If a significant difference in APFT scores is found between students who smoke and students who do not smoke, this study may help medical professionals direct health education and health
promotion efforts in the right direction. This study also contributes valuable information to the current literature. If premature death can be prevented and therefore keep the Army's leaders effective for a longer period of time, other soldiers would be able to benefit from the leader's military education and experience. In addition, if health care costs can be decreased, it would well be worth putting money and effort into health education, and health promotion, particularly smoking cessation programs.
ENDNOTES


CHAPTER III
METHODOLOGY

It has already been noted that in the Army's "Fit to Win" program, a Health Risk Appraisal is included as part of the assessment. This consists of a cholesterol, blood pressure and blood sugar measurement, and administration of a detailed questionnaire regarding various health related practices including information on smoking. One of the assumptions made during this study was that the questions were tested before the questionnaire was put into use Army wide and that they are valid and reliable. Therefore, the questions pertaining to smoking from this questionnaire were used for the purposes of collecting data for this study.

Each Army CGSOC student was requested to complete a short, seven item questionnaire requesting demographic data and a history of smoking and exercise habits. Included with the questionnaire was an information letter explaining the study and requesting participation and written permission to verify APFT scores. The questionnaire and letter included are at Appendix A. Students were asked to return the questionnaires even if they chose not to participate. They were given the opportunity to state a reason why they chose not to participate, if that were the case. All CGSOC students were given questionnaires; however, only data from U.S. Army students taking the regular APFT test was used for the data analysis.

After the first questionnaires were distributed, 729 were returned within two weeks. One month after the original distribution, a second follow up
distribution was done through section leaders to attempt to increase the response rate. This request is attached as Appendix B. Sixty-six additional questionnaires were returned within one week. Total response rate was almost 80 percent of the approximately 1000 students eligible to participate.

A memorandum and a data collection form were distributed to all Academic Counselors and Evaluators requesting APFT scores of the students who returned the questionnaires to allow access to the APFT scores. The memorandum and data collection form is attached at Appendix C. Forty-two out of eighty of the advisers returned the information requested within two weeks, however, occasional event scores were not included with returned data. A second request (Appendix D) was distributed one month after the original and 20 additional forms were returned within two weeks. Although a third request was distributed two weeks later, the researcher collected the data on APFT scores for the remaining students. Because one advisor was not able to be contacted for APFT results, these students were deleted from the study.

Statview,¹ a statistical package made for the Macintosh computer was used to analyze the data for this study.
ENDNOTES

CHAPTER IV
DATA ANALYSIS

It is important to comment here on the original intent of this research. This study had hoped to show a relationship between smoking and APFT scores. Initially, Pearson’s correlation coefficient was performed. The data collected was not definitive enough to do correlation testing. Pearson’s correlation coefficient demands continuous data for both variables. An unsuccessful attempt was made to score amount of smoking in a way to make the data continuous. Since this could not be done, Pearson’s correlation was not the appropriate test to use. Therefore, this research was unable to show a relationship between smoking and APFT scores.

Instead, the research question was revised to examine the difference in APFT scores among smoking and nonsmoking students attending CGSOC in 1990-91 and a two tailed t-test was performed. In future studies, this obstacle could be overcome by asking respondents exactly how many cigarettes they smoked every day and years they have smoked. This would provide a continuum of smoking scores.

The t-test is used to compare the means of two groups. The unpaired t-test compares the means of two independent samples. A two-tailed t-test was chosen because it is sensitive to significant differences in either direction. The direction of the difference between the populations is unknown, therefore a two-tailed test is the appropriate test to use. In an unpaired two-tailed t-test of two population means, it must be assumed that the population variances are equal. Fortunately, the test is not overly sensitive to small
differences between the population variances. Since the sample variances in this study are similar, it can be assumed that the population variances are approximately equal. The assumption must also be made that the APFT scores are normally distributed. Since the researcher could not assume the direction of difference between populations and is concerned about a difference in both directions, it is appropriate to use a two-tailed test.

The data collected was separated by Army branches according to whether they were combat, combat support, and combat service support. Combat branches included: Infantry, Field Artillery, Armor, Aviation, and Special Forces. Combat Support included: Air Defense, Engineers, Signal, Chemical, Military Intelligence, Military Police, and Ordnance. Combat Service Support included: Transportation, Quartermaster, Judge Advocate General, Chaplains, Adjutant General, Finance, and all Army Medical Department Corps.

The raw data is included in the study at Appendix E. Names have been removed from the data set. The data from the questionnaire (Appendix A) was coded into the computer program as follows:

Question number 1: Choice number 1 was assigned a 3, number 2 was assigned 1.5, and number 3 was assigned a 0.

Question number 2: Choice number 1 was assigned a 3, number 2 was assigned 1.5, and number 3 was assigned a 0.

Question number 3: Eliminated from the data set - irrelevant to the study.

Question number 4: Choice number 1 was assigned a 3, number 2 was assigned a 2, number 3 was assigned a 1, and number 4 was assigned a 0.
Question number 5: Choice number 1 was assigned a 0, number 2 was assigned 0.5, number 3 was assigned a 1, number 4 was assigned a 1.5, and number 5 was assigned a 2.

Question number 6: Choice number 1 was assigned a 0, number 2 was assigned 1, number 3 was assigned a 3, number 4 was assigned a 7.5, and number 5 was assigned a 10.

Question number 7: Assigned yes or no.

Most respondents in this study were male, 32 to 36 years old, Caucasian, and in combat arms branches of the Army. This is reflected below in Table 1:

Table 1. Demographics of Study Respondents.

<table>
<thead>
<tr>
<th>Demographic Characteristic</th>
<th>Number of Respondents (N)</th>
<th>Percent of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Mean = 36.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32 to 36</td>
<td>489</td>
<td>66.34</td>
</tr>
<tr>
<td>37 to 41</td>
<td>206</td>
<td>29.42</td>
</tr>
<tr>
<td>42 to 46</td>
<td>29</td>
<td>4.10</td>
</tr>
<tr>
<td>47 to 51</td>
<td>1</td>
<td>0.14</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>666</td>
<td>93.67</td>
</tr>
<tr>
<td>Female</td>
<td>45</td>
<td>6.33</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>612</td>
<td>85.96</td>
</tr>
<tr>
<td>Black</td>
<td>65</td>
<td>9.13</td>
</tr>
<tr>
<td>Hispanic</td>
<td>8</td>
<td>1.12</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>0.56</td>
</tr>
<tr>
<td>Unspecified</td>
<td>23</td>
<td>3.23</td>
</tr>
<tr>
<td>Branch Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combat</td>
<td>334</td>
<td>46.91</td>
</tr>
<tr>
<td>Combat Support</td>
<td>219</td>
<td>30.76</td>
</tr>
<tr>
<td>Combat Service Support</td>
<td>159</td>
<td>22.33</td>
</tr>
</tbody>
</table>
Seventy four percent of study respondents never smoked. Most respondents that reported smoking, smoke less than one pack per day and only one person smoked two packs per day. Of the respondents who do smoke, almost 80 percent verbalized a desire to quit smoking. This data is included in Table 2:

Table 2. Smoking History of Study Respondents.

<table>
<thead>
<tr>
<th>Historical Characteristic</th>
<th>Number of Respondents (N)</th>
<th>Percent of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Smoking History</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never Smoked</td>
<td>526</td>
<td>73.98</td>
</tr>
<tr>
<td>Quit over 6 Months Ago</td>
<td>138</td>
<td>19.41</td>
</tr>
<tr>
<td>Quit less than 6 Months Ago</td>
<td>5</td>
<td>0.70</td>
</tr>
<tr>
<td>Current Smoker</td>
<td>42</td>
<td>5.91</td>
</tr>
<tr>
<td><strong>Smoker's Desire to Quit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wants to Quit</td>
<td>33</td>
<td>78.57</td>
</tr>
<tr>
<td>Does not Want to Quit</td>
<td>9</td>
<td>21.43</td>
</tr>
<tr>
<td><strong>Cigarettes per Day</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero</td>
<td>669</td>
<td>94.09</td>
</tr>
<tr>
<td>Less than Ten</td>
<td>15</td>
<td>2.11</td>
</tr>
<tr>
<td>Ten to Twenty</td>
<td>16</td>
<td>2.25</td>
</tr>
<tr>
<td>Twenty to Forty</td>
<td>10</td>
<td>1.41</td>
</tr>
<tr>
<td>Forty or More</td>
<td>1</td>
<td>0.14</td>
</tr>
</tbody>
</table>

The average APFT score for all study respondents was 268. The minimum score was 187 points and the maximum score was 300 points with a range of 113 points. The mean number of repetitions performed for push-ups was 60, sit-ups was 67, and the time for the 2 mile run was almost 15 minutes. Table 3 on the following page summarizes the APFT data for the sample:
Table 3. APFT Scores: All Respondents.

<table>
<thead>
<tr>
<th>APFT Event</th>
<th>Mean Score</th>
<th>Std. Dev.</th>
<th>Std. Error</th>
<th>Number (N)</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Score (Points)</td>
<td>267.99</td>
<td>29.23</td>
<td>1.164</td>
<td>675</td>
<td>187</td>
<td>300</td>
<td>113</td>
</tr>
<tr>
<td>Push-Ups (Count)</td>
<td>59.99</td>
<td>18.25</td>
<td>0.623</td>
<td>680</td>
<td>14</td>
<td>144</td>
<td>130</td>
</tr>
<tr>
<td>Sit-Ups (Count)</td>
<td>67.35</td>
<td>14.78</td>
<td>0.566</td>
<td>681</td>
<td>27</td>
<td>122</td>
<td>95</td>
</tr>
<tr>
<td>2-Mile Run (Mins.)</td>
<td>14.94</td>
<td>1.74</td>
<td>0.067</td>
<td>677</td>
<td>11.27</td>
<td>22.42</td>
<td>11.15</td>
</tr>
</tbody>
</table>

When comparing smokers versus nonsmokers using an unpaired two-tailed t test, overall mean score for smokers was 247.80 and nonsmokers was 269.47. P value was 0.0001. A significant difference (P < 0.05) was noted in all other events as shown in Table 4 on the next page. The difference in the means showed a decrease in performance for each APFT event in the smoking group.
Table 4. Analysis of APFT Scores in Smokers (Current and Recent) versus Nonsmokers using Unpaired two-tailed T-Test.

<table>
<thead>
<tr>
<th>APFT Event</th>
<th>Smoking Status (N)</th>
<th>Mean Score +/- St. Dev.</th>
<th>Unpaired T-Statistic</th>
<th>P-Value (2-tail)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall APFT Score</td>
<td>Nonmoker (629)</td>
<td>269.47 +/- 26.67</td>
<td>4.937</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>Smoker (46)</td>
<td>247.80 +/- 22.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push-Ups</td>
<td>Nonmoker (634)</td>
<td>60.44 +/- 16.26</td>
<td>2.714</td>
<td>0.0068</td>
</tr>
<tr>
<td></td>
<td>Smoker (46)</td>
<td>53.74 +/- 14.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sit-Ups</td>
<td>Nonmoker (635)</td>
<td>68.14 +/- 14.48</td>
<td>5.298</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>Smoker (46)</td>
<td>56.41 +/- 14.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Mile Run Time</td>
<td>Nonmoker (631)</td>
<td>14.87 +/- 1.73</td>
<td>-3.512</td>
<td>0.0005</td>
</tr>
<tr>
<td></td>
<td>Smoker (46)</td>
<td>15.80 +/- 1.71</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

There were a total of 712 participants in this study. Forty-two were smokers; however 5 had quit smoking during the previous six months and were therefore, counted as smokers for a total of 47 smokers or 6 percent. There were 665 non-smokers or 94 percent of the respondents.

To verify that the low number of smokers who chose to participate were representative of the CGSOC class of 90-91, the researcher collected data from the Health Risk Appraisal that had been done on all students attending CGSOC 90-91. According to this data, 93 percent of students attending CGSOC do not smoke; 7 percent do. Since the response rate of smokers is between 6 and 7 percent, the study is representative of smokers in the current class. Though this rate is much lower than the overall Army rate of smokers, it is probably because this is a highly educated, total officer population who are interested in their health. Also, they may be aware of the social stigma that is attached to smokers today. Most likely, the smokers that chose not to participate had lower scores than those who agreed to participate. It is suspected that if the smokers had high APFT scores, they would probably have chosen to participate. It seems probable that if the non-participant smokers would have participated, the difference between means would be even more significant.

When mean APFT scores were compared, smokers had scores that were statistically significantly (P < 0.05) lower compared to scores of non-smokers (247 vs 269). Smokers scored significantly lower that non-smokers in all individual events as well. (Table 4).

33
The results of this study show a significant difference between smokers and nonsmokers' APFT scores in the students who chose to participate. This suggests that cigarette smoking is detrimental to physical fitness as validated by the smokers' lower scores in all events in the APFT when compared to scores of non-smokers.

A recommendation for further research is to repeat this study in the same population or another population. It would be valuable to collect scores from the second record test of students and use these scores in the study as well. It would also be very valuable to look at the effect duration and amount of smoking have on APFT scores and to use a group where exercise could be controlled. For example, a study of soldiers in a basic training unit or soldiers attending airborne school. It would also be interesting to look at the relationship between smokeless tobacco and APFT scores as well as academic status of smokers versus nonsmokers. Students in school may not maintain their normal smoking behaviors, but it would be interesting to look at overall scores on the Health Risk Appraisal of smokers and nonsmokers for smoking overall behavior scores.

There is literature to support the many dangers of second hand smoke. It would be valuable to look at APFT scores of students who have wives that smoke.

Smoking cessation efforts would be valued in this population as evidenced by smokers' 80 percent positive response rate when asked if they wanted to quit. Studies were noted earlier that showed that lung function and VO$_2$ max quickly improves after smoking cessation (see literature review). The results of this study can be used to encourage the Army to make policy changes.
concerning smoking and to increase smoking cessation efforts, health education efforts, and to show smokers that smoking does have a negative effect on their physical performance when using the APFT as a measurement tool. The potential for further research in this area is unlimited.

In summary, this clearly shows a significant difference between APFT scores among smoking and nonsmoking students in the CGSOC 1990-91 class. This study implicates smoking as detrimental to physical fitness when using APFT scores as a measure of fitness.
MEMORANDUM FOR: ALL CGSOC STUDENTS

SUBJECT: INFORMATION LETTER - PARTICIPATION IN A STUDY

1. I would like your help in obtaining data for my research project for the MMAS program. My research question is "What is the relationship between smoking and the Army Physical Fitness Test (APFT) scores of U.S. Army students, A.Y. 90-91, in the Command and General Staff Officer Course (CGSOC)"?

2. In order to do this, I need to know if you smoke, how much you smoke, and how long you have smoked. I also need to know if you have ever smoked in the past, if you quit and when, or if you have never been a smoker. The data obtained from this questionnaire will remain completely confidential and will have no effect on you. All data will be presented in summary format only. It is extremely important that the data you supply be accurate.

3. The APFT score must be verified from the APFT score card because most scores are not totaled at the time of the PT test. Once the smoking history has been tied to a verified APFT score, the names will be discarded from the data set. The attached questionnaire should take less than five minutes to complete. Please complete the questionnaire and return both this information letter and the questionnaire to your survey representative.

4. Please sign below and return this questionnaire to your survey representative even if you do not wish to participate. Results of this study will be presented in May for all interested personnel when the thesis is completed. Thank you in advance for your assistance.

Joan P. Eitzen
MAJ, AN
10D

I understand that participation in this study is voluntary and I will /will not (cross out one that does not apply) allow the researcher to verify my PT scores from the APFT score card.

(Signature)

NAME (printed) ___________________________ Section _________

If you have chosen not to participate and are willing to share your reasons for not participating, please use the space below.
Appendix A - QUESTIONNAIRE

This questionnaire is for Army personnel only  
Survey Control Number 9136-004

Name ___________________  Section ________  Group ________
Branch ______  Age_____  Sex_____  Race ________

Please circle the number of the correct answer.

1. How often do you do at least 20 minutes of non-stop aerobic activity (vigorous exercise that greatly increases your breathing and heart rate such as running, fast walking, biking, swimming, rowing, etc)?
   (1) 3 or more times a week
   (2) 1 or 2 times a week
   (3) rarely or never

2. How often do you do exercises that improve muscle strength, such as pushups, situps, weight lifting, a Nautilus/Universal workout, resistance training, etc?
   (1) 3 or more times a week
   (2) 1 or 2 times a week
   (3) rarely or never

3. Do you have a physical condition that limits or prevents you from exercising?
   (1) Yes  (2) No

4. Do you smoke cigarettes now?
   (1) Yes  (2) No, “I quit in the last 6 months”
   (3) No, “I quit over 6 months ago”  (4) No, “I never smoked”

5. How much do you smoke now?
   (1) “I don’t smoke”  (2) less than a half-pack a day
   (3) one-half to one pack a day  (4) one to two packs a day
   (5) two or more packs a day

6. How long have you smoked?
   (1) “I don’t smoke”  (2) less than 1 year
   (3) 2 to 4 years  (4) 5 to 10 years
   (5) more than 10 years

7. Do you want to stop smoking?
   (1) “I don’t smoke”  (2) “I would like to quit now”
   (3) “I would like to quit someday”  (4) “I don’t want to stop smoking”
MEMORANDUM FOR: SECTION LEADERS

SUBJECT: MMAS RESEARCH STUDY

1. I would like your help with increasing the response rate to the questionnaire I recently sent out to all CGSOC students. This data is necessary for my research project for the MMAS program. My research question is "What is the relationship between smoking and the Army Physical Fitness Test (APFT) scores of U.S. Army students, A.Y. 90-91, in the Command and General Staff Officer Course (CGSOC)?"

2. Participation in this study is voluntary, however I have had only 40 smokers respond. This data will only be presented in summary format and once scores are verified, I will discard names from the data. Results will not be seen anywhere in anyones record.

3. Would you please ask the students in your section if they would be willing to fill out this questionnaire now if they did not do so before? If they filled it out the first time, they cannot fill it out again. I really need their help in making this study a worthwhile effort to obtain my MMAS. If students choose not to participate, I would like them to fill out a questionnaire as well and sign it stating they will not give me the permission I need and possibly a reason why they have chosen not to participate. This will still increase my response rate. Please return the questionnaires to:

   MAJ Joan Eltzen
   Section 10 D

4. Feel free to contact me if you would like more information or if you need more questionnaires. Thank you in advance for your cooperation and assistance.

   Joan P. Eltzen
   MAJ, AN
MEMORANDUM TO ACADEMIC COUNSELORS AND EVALUATORS

ATZL-SWG

10 February, 1991

MEMORANDUM FOR: ACADEMIC COUNSELORS AND EVALUATORS

SUBJECT: MMAS RESEARCH STUDY

1. I would like your help in verifying Army Physical Fitness Test (APFT) scores from the October physical fitness test. This data is necessary for my research project for the MMAS program. My research question is "What is the relationship between smoking and the Army Physical Fitness Test (APFT) scores of U.S. Army students, A.Y. 90-91, in the Command and General Staff Officer Course (CGSOC)?"

2. Participation in this study is voluntary and students have given me written permission to verify their PT scores from the APFT score cards. Once scores are verified, I will discard names from the data.

3. Please provide requested information on the back of this memo for the students listed (U.S. Army students only taking the regular APFT test) and return to:

   MAJ Joan Eitzen
   Section 10 D

   Only students who have chosen to participate are listed.

4. Feel free to contact me if you would like more information. Thank you in advance for your cooperation and assistance.

   Joan P. Eitzen
   MAJ, AN
## Appendix C - DATA COLLECTION FORM

**ACE ___________________  Section _______  Group _______**

<table>
<thead>
<tr>
<th>Student's Name</th>
<th>Sit-ups</th>
<th>Push-ups</th>
<th>2 mile run</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># score</td>
<td># score</td>
<td># score</td>
<td># score</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
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<tr>
<td>2.</td>
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<td>20.</td>
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</tbody>
</table>
MEMORANDUM FOR: ACADEMIC COUNSELORS AND EVALUATORS

SUBJECT: MMAS RESEARCH STUDY - FOLLOW-UP REQUEST

1. This memorandum is in follow-up to my request for your help in verifying Army Physical Fitness Test (APFT) scores from the October physical fitness test (memorandum dated 20 February, 1991). This data is necessary for my research project for the MMAS program. My research question is "What is the relationship between smoking and the Army Physical Fitness Test (APFT) scores of U.S. Army students, A.Y. 90-91, in the Command and General Staff Officer Course (CGSOC)?"

2. Participation in this study is voluntary and students have given me written permission to verify their PT scores from the APFT score cards. Once scores are verified, I will discard names from the data.

3. If you have misplaced the original memorandum with the names of the students' scores I need, please leave me a note in my box in 10D. I am currently on emergency leave and will provide you with another copy upon my return.

4. Thank you very much for your cooperation.

MAJ Joan Eitzen
Section 10 D
Appendix D - DATA COLLECTION FORM

ACE ____________________________  Section ______  Group ______

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<th>Student's Name</th>
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Appendix E - RAW DATA

The raw data for this study is included in the following fifteen pages (44-58).
BIBLIOGRAPHY


INITIAL DISTRIBUTION LIST

1. Combined Arms Research Library
   U.S. Army Command and General Staff College
   Fort Leavenworth, Kansas 66027-6900

2. Defense Technical Information Center
   Cameron Station
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