U.S. Army Center for Health Promotion and Preventive Medicine

USACHPPM

A REVIEW OF THE LITERATURE ON ATTRITION FROM THE MILITARY SERVICES: RISK FACTORS FOR ATTRITION AND STRATEGIES TO REDUCE ATTRITION

USACHPPM REPORT NO. 12-HF-01Q9A-04

U.S. Army Center for Health Promotion and Preventive Medicine
Aberdeen Proving Ground, MD

Center for Accessions Research
Ft Knox, KY

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Readiness Thru Health

U.S. Army Center for Health Promotion and Preventive Medicine

The lineage of the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) can be traced back over 50 years. This organization began as the U.S. Army Industrial Hygiene Laboratory, established during the industrial buildup for World War II, under the direct supervision of the Army Surgeon General. Its original location was at the Johns Hopkins School of Hygiene and Public Health. Its mission was to conduct occupational health surveys and investigations within the Department of Defense's (DOD's) industrial production base. It was staffed with three personnel and had a limited annual operating budget of three thousand dollars.

Most recently, it became internationally known as the U.S. Army Environmental Hygiene Agency (AEHA). Its mission expanded to support worldwide preventive medicine programs of the Army, DOD, and other Federal agencies as directed by the Army Medical Command or the Office of The Surgeon General, through consultations, support services, investigations, on-site visits, and training.

On 1 August 1994, AEHA was redesignated the U.S. Army Center for Health Promotion and Preventive Medicine with a provisional status and a commanding general officer. On 1 October 1995, the nonprovisional status was approved with a mission of providing preventive medicine and health promotion leadership, direction, and services for America's Army.

The organization's quest has always been one of excellence and the provision of quality service. Today, its goal is to be an established world-class center of excellence for achieving and maintaining a fit, healthy, and ready force. To achieve that end, the CHPPM holds firmly to its values which are steeped in rich military heritage:

★ *Integrity is the foundation*
★ *Excellence is the standard*
★ *Customer satisfaction is the focus*
★ *Its people are the most valued resource*
★ *Continuous quality improvement is the pathway*

This organization stands on the threshold of even greater challenges and responsibilities. It has been reorganized and reengineered to support the Army of the future. The CHPPM now has three direct support activities located in Fort Meade, Maryland; Fort McPherson, Georgia; and Fitzsimons Army Medical Center, Aurora, Colorado; to provide responsive regional health promotion and preventive medicine support across the U.S. There are also two CHPPM overseas commands in Landstuhl, Germany and Camp Zama, Japan who contribute to the success of CHPPM's increasing global mission. As CHPPM moves into the 21st Century, new programs relating to fitness, health promotion, wellness, and disease surveillance are being added. As always, CHPPM stands firm in its commitment to Army readiness. It is an organization proud of its fine history, yet equally excited about its challenging future.

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13. ABSTRACT *(Maximum 200 words)*
Attrition is the failure of an enlisted service member to be retained in service within the first term of enlistment. This paper emphasizes health/fitness-related aspects of attrition but also covers demographic and psychosocial factors. Overall 3-year military attrition steadily rose from 26% in 1985 to 31% in 1995. Demographic and psychosocial risk factors for attrition include lower educational attainment, female gender, White ethnicity, lower Armed Forces Qualification Test scores, lower moral character (less conformance to laws, rules and regulations), moral waivers, pre-service job instability, and less time in the Delayed Entry Program. The age-attrition relationship appears to be bimodal with higher attrition when youngest, decreasing in 19-23 year olds, and rising again after that. Attrition for mental health reasons is associated with pre-service physical/sexual abuse, previous mental health counseling, previous treatment with medication, previous psychiatric hospitalization, low motivation, pessimism toward training, depression, lack of self-reliance, and referral to a mental health facility. Attrition is also higher among those waivered for hearing problems, skin disorders, back disorders, and prior knee injuries. Other health-related risk factors include pre-service injury, injuries during basic training, a history of prior cigarette smoking, low physical activity prior to service, greater body weight, higher body mass index and lower physical fitness. Strategies to reduce attrition include prescreening by biographical questionnaires, compensatory screening, individual behavioral health counseling, and realistic job previews. Senior leadership initiatives have a powerful effect on attrition. Attrition also appears to be reduced by increasing physical fitness prior to basic training, the Physical Training and Rehabilitation Program, and the Pre-Initial Entry Training Program (for National Guard).

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Table of Contents

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Executive Summary

A Review of the Literature on Attrition from the Military Services: Risk Factors for Attrition and Strategies to Reduce Attrition

USACHPPM Report Number 12-HF-01Q9A-04

1. INTRODUCTION. The Center for Accessions Research (CAR) requested that the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM) review the literature on military attrition. For the purposes of this paper, attrition was defined as the failure of an enlisted service member to be retained in service during their contracted first term of enlistment. This manuscript reviews a wide range of factors influencing attrition but the primary interest is in health-related factors.

2. PATTERN OF ATTRITION OVER TIME AND REASONS FOR ATTRITION. Overall 3-year military attrition steadily rose from 26% in 1985 to 31% in 1995. About 1/3 of attrition occurred in the first 6 months of service, about ½ within the first year, and the remainder in the subsequent 2 year period. Separations within the first 6 months of service were associated with performance problems (34%), medical/physical problems (26%), erroneous or fraudulent enlistments (23%), and other reasons (17% including misconduct, excessive body weight or body fat, character or behavioral disorders, alcoholism, drug abuse and homosexuality). Separations within 7 to 48 months were associated with misconduct (34%), physical problems (15%), drug use (10%), performance problems (8%), and character or behavioral disorders (7%).

3. RISK FACTORS FOR ATTRITION. The largest volume of research has centered on demographic and psychosocial factors probably because of the large amount of personal information contained in readily available databases.

a. Demographic Factors. Individuals without a high school diploma are about twice as likely to attrite in their first term compared to those that do have a diploma. Other demographic risk factors include female gender, and White ethnicity/race. With regard to age, attrition seems to be highest for 17 or 18 year olds, decreases for 19-23 year olds, and then increases again beyond about age 24. There is conflicting data on marital status although most studies suggest higher attrition risk among married individuals.

b. Psychosocial Risk Factors. Psychosocial risk factors include lower Armed Forces Qualification Test (AFQT) scores, moral character (less pre-service conformance to laws, rules and regulations), moral waivers (enlistments granted to individuals who have minor or major legal offenses and/or pre-service illegal drug/alcohol use), pre-service job instability (unemployment when enlisted, many job changes), and less time in the Delayed Entry Program (DEP).

(1) With regard to moral character, attrition is associated with self-reported past expulsions or suspensions from school, times late for school, rebelliousness, self-reports of being charged with or suspected of a crime, traffic violations, fighting while intoxicated, and being arrested for a crime. Recruits with demonstrated felony convictions, felony arrests or non-felony convictions or arrests are more likely to receive an unsuitability/adverse discharge than those without such a history.

(2) Satisfaction with military jobs does not appear to affect 6-month attrition or attrition from basic or advanced training, possibly because trainees have not actually worked in their specialties in an operational unit. Once an individual is in an operational unit, job satisfaction does appear to be related to attrition but is more related to the organization climate and the characteristics of the job (sense of control, variety, and meaningfulness).

c. Mental Health-Related Factors. A number of studies have examined risk factors for mental health-related attrition in basic training and advanced training personnel. A history of pre-service physical or sexual abuse is a consistently demonstrated risk factor for mental health-related attrition. Previous mental health counseling, previous treatment with medication and previous psychiatric hospitalization are associated with higher attrition risk. Using questionnaires, items relating to low motivation, pessimism toward training, depression, and lack of self-reliance are associated with higher risk of attrition. About 2/3 of individuals referred to a mental health facility during basic training attrite within the first term. Within 6 months after a mental-health related hospitalization, 61% of those hospitalized attrite.

d. General Health Factors.

(1) Attrition is higher for those receiving a medical waiver of any type. Examining individual types of waivers shows that attrition is higher for those waivered for a hearing problem, a skin/cellular tissue disorder, depression, back disorders (Army only) and prior knee injury (Army only). Attrition tended to be lower for those receiving an asthma waiver. There are no differences in attrition between those waivered and not waivered for attention deficit/hyperactivity disorder.

(2) The influence of prior drug and alcohol use on attrition are conflicting possibly because various studies define drug and alcohol use/abuse differently. Heavy pre-service alcohol use does appear to increase attrition. A history of prior cigarette smoking is associated with higher attrition in basic training; a dose-response relationship can be demonstrated such that as the number of packs/day increases, attrition increases.

(3) Pre-service injury or injuries during basic training increase the likelihood of attrition. Individuals hospitalized for an injury within the first 3 months of service are about twice as likely to be discharged as those not hospitalized.

e. Physical Activity and Physical Fitness. The literature is unanimous in demonstrating low physical activity prior to service is associated with higher discharge rates in basic training. Most studies also indicate that greater body weight, higher body mass index, or less fat free mass is associated with higher attrition. Low aerobic fitness or low muscle strength is also associated with attrition in most studies but there is conflicting information. Many studies not showing a relationship between attrition and aerobic fitness have used inappropriate statistical procedures and/or used heart rate to predict aerobic capacity. Heart rate can be elevated by stress, especially in new situations, and this questions the validity of this measure in a basic training setting. It may be more appropriate to use performance tests of fitness (e.g., 1-mile run or push-ups) because individuals who achieve high scores on performance tests of fitness may demonstrate both higher physical capacity and higher motivation.

f. Other Risk Factors.

(1) Different military occupational specialties (MOS) or different groupings of MOS have different attrition rates. For the Air Force, attrition by MOS ranged from 4% to 84%. It is difficult to make broad generalizations about MOS and attrition because different studies categorize MOS differently and there are differences in jobs across the services. Physical hazards, environmental conditions, enlistment bonuses, and the potential for employment outside the military are latent factors that may influence attrition differences among MOS. Women in less traditional military occupational specialties (MOS) are more likely to attrite than women in more traditional MOS.

(2) Attrition is lowest in the Air Force. Attrition rates for the Army, Navy and Marines shift depending on the year examined. Differential attrition rates among services may reflect different policies, different leadership styles within services and/or the more physically demanding nature of some jobs.

4. STRATEGIES TO REDUCE ATTRITION. Two major categories of attrition-reduction strategies include 1) interventions that prescreen individuals before

they enter service and 2) providing special assistance or incentives to service members who are already in service.

a. Biographical Questionnaires.

(1) Biographical questionnaires (biodata) include questions regarding demographics, self-history, attitudes, behaviors, and other factors. Questionnaire responses are empirically linked to attrition. The criterion-related validity of biodata questionnaires for predicting attrition is about 0.3. There are numerous concerns with the use of biodata questionnaires including scoring techniques, changes in validity over time and across samples, reliability issues, and problems relating to coaching and faking. Instruments tested or implemented in operational settings included the Air Force History Opinion Inventory, the Navy Recruiting Background Questionnaire, the Army Military Applicant Profile, and the Department of Defense (DOD) Educational and Biographical Information Survey. A 1982 General Accounting Office (GAO) report supported the validity of biodata instruments and recommended the services consolidate their biodata instruments for cost savings and efficiency. The Armed Services Applicant Profile (ASAP) was tested and validated as a consolidated instrument. In 1989, a DOD committee postponed use of the ASAP and DOD eventually declined operational implementation because of concerns with the limitations mentioned above.

(2) Some biodata instruments contain more items relating to individual dispositions and self-perception and may be termed temperament surveys. The Assessment of Background and Life Experiences (ABLE) was developed as an instrument of this type but it was not operationally adopted because of concerns with coaching and faking. Efforts to create a faking- resistant questionnaire resulted in the Assessment of Individual Motivation (AIM) which is currently undergoing operational testing.

(3) Other biodata instruments that have been related to attrition in the peer-reviewed medical literature in the last 5 years include the Biographical Evaluation and Screening of Troops (BEST) questionnaire and the Sailor Health Inventory Program (SHIP) questionnaire. Studies show that items related to demographic, medical/physical and psychosocial factors have some ability to predict attrition and quantify risk of attrition.

c. Compensatory Screening. Compensatory screening involves mathematical models that counterbalance personal characteristics that increase attrition with personal characteristics that favor retention in service. Verifiable personal characteristics are used. Instruments adopted have included the Odds for Effectiveness (OFE), Success Chances for Recruits Entering the Navy (SCREEN), Compensatory Screening Model (CSM) and the High Performance Predictor Profile (HP3). Criterion-related validities for predicting attrition are as high as 0.20.

d. Psychiatric Screening. At the beginning of WWII, the U.S. Navy performed a 2- to 3-minute psychiatric screen of new Naval and Marine recruits. The validity of the clinical prediction from this screen was no greater than prediction from educational level, age, or aptitude.

e. Psychological Counseling and Stress Management Training. Intensive one-on-one sessions with behavioral specialists may reduce attrition in early military training. However, stress management classes involving large groups of basic trainees at high risk for attrition do not appear to be effective.

f. Realistic Job Previews. Realistic job previews (RJP) are films that are designed to provide recruits a balanced picture of the positive and/or negative aspects of the military training and operations. Some RJP provide trainees with information on how to react to specific training experiences. Most civilian and military studies show RJPs are associated with reduced attrition but further work is needed in this area.

g. Incentives To Remain in Service. Participation in tuition assistance within the first year of enlistment reduced 2-year attrition by about 5%. Studies on enlistment bonuses are conflicting.

h. Leadership Policy, Attitudes, and Beliefs. These factors affect attrition since leaders either make the final separation decisions or influence those decisions. Limited data on senior leadership initiatives have shown that they can double attrition or lower attrition by half compared to baseline attrition. When basic training attrition was reduced by senior leadership initiatives, later attrition was not different or was actually lower than baseline levels.

j. Service Member Remedial Programs. These are courses/programs put in place to assist service members in solving specific problems. Although there are numerous programs, only a few have been evaluated.

(1) Fitness- and Injury-Related Programs. The Fitness Assessment Program (FAP) evaluates the fitness of recruits on entry to basic training and provides a special physical training program for those of low fitness before they enter basic training. The FAP has been shown to reduce basic training attrition. The Army Physical Fitness Test Enhancement Program (APFTEP) provides soldiers who fail the final Army Physical Fitness Test (APFT) with a physical training program to assist them in passing the test. Trainees who entered the APFTEP had slightly lower overall basic training graduation and higher 1-year attrition than those who did not have to enter the program because they passed the final APFT. However, the APFTEP did retain a large number of soldiers who would otherwise been discharged for APFT failure. The Physical Training and Rehabilitation Program (PTRP) provides supervised training and rehabilitation for trainees severely injured in basic training. Trainees who successfully complete the PTRP had graduation rates and 2-year attrition similar to basic training

graduates who were not injured to the extent they had to enter the PTRP. The Marine Sports Medicine and Rehabilitation Therapy (SMART) Center is for the conservative treatment of non-surgical musculoskeletal complaints and is designed to care for Marines as athletes (rather than patients) to rapidly treat and/or rehabilitate them so they can return to duty. Preliminary data suggested a large reduction in medical attrition.

(2) Academic/Cognitive-Related Programs - The Functional Academic Skills Training Program (FAST) is a voluntary program delivered by accredited civilian institutions in a typical classroom lecture setting at Army Education Centers. FAST graduates were one-tenth as likely to attrite compared to a comparison group. Individuals enrolled in the English-as-a-Second-Language program are about half as likely to attrite as a comparison group.

j. Injuries and Attrition. There are several methods or approaches to reducing injuries in military populations. Reducing the amount of running in recruit training considerably reduces injuries with little or no effect on improvements in aerobic fitness. The common practice of stretching prior to exercise does not appear to influence injury rates. Special sock systems reduce the likelihood of foot blisters. Ankle braces reduce ankle injuries during airborne operations. Promising injury-reduction strategies that require further investigation include the use of antiperspirants to reduce foot blisters, the use of special insoles in footwear, and matching running footwear to individual foot characteristics.

k. Pennsylvania Pre-Initial Entry Training Program. Designed for the National Guard, this program was a 4-day, pre-basic training course that covered basic training topics, physical fitness training and mechanical training on the M-16 and 45-caliber pistol. It emphasized identifying pre-existing and disqualifying legal and physical problems. Attrition rates for the Pennsylvania National Guard decreased from 30% to 4% after the program was initiated.

5. SUMMARY AND CONCLUSIONS.

a. There has been a considerable amount of research done on the association of demographic and psychosocial factors with attrition. Less work has been done on health- and fitness-related factors but available information suggests that many of these factors result in higher attrition risk than the demographic and psychosocial factors. Demographic and psychosocial risk factors increasing attrition risk by a factor between about 1.1 to 2.0 include lower educational level, female gender, white ethnicity, lower AFQT scores, less pre-service conformance with laws, rules, and regulations (moral character), moral waivers, factors relating to prior job history, and less time in the DEP. Health-related factors increasing risk of attrition risk by about the same amount include enlistment medical waivers, heavy pre-service alcohol use, pre-service injury, injuries in basic training, lower pre-service physical activity, higher body weight

on entry to service, and pre-service mental health history. Heath- and fitness-related risk factors that appear double, triple or increase attrition risk even more include pre-service physical/sexual abuse, heavy pre-service cigarette smoking, referral to a mental health facility in basic training, a mental-health hospitalization early in service, and low physical fitness on entry to service.

b. Much of the demographic and psychosocial risk factor information has been successfully exploited to reduce attrition through the use of biographical questionnaires and compensatory screening that successfully identify individuals likely to attrite but at the risk of also screening out a number of individuals likely to succeed (false positives). Other successful attrition-reducing strategies for basic training include one-on-one behavioral counseling sessions, RJP, the FAP, the PTRP and Pre-Initial Entry Training Program (for National Guard). One of the most powerful strategies influencing attrition appears to be senior leadership initiatives. Limited data suggests that senior leadership initiatives can double attrition or lower it by half in basic and/or advanced training; this reduction does not influence later attrition although some studies suggest it may further lower later attrition. Soldiers that voluntarily take advantage of the tuition assistance program, the FAST program, and the ESL program have lower attrition but individuals enrolled in these programs may just be the more motivated service members.

c. What is missing from the literature is a comprehensive study that examines a large number of risk factors in a single investigation so their interaction and relative importance can be determined. It is possible that a number of these factors interact in ways that decrease (due to multicollinearlity) or increase (due to synergistic effects) their influence on attrition risk.

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A Review of the Literature on Attrition from the Military Services: Risk Factors for Attrition and Strategies to Reduce Attrition

USACHPPM Report Number 12-HF-01Q9A-04

1. REFERENCES. Appendix A contains the references used in this paper.

2. INTRODUCTION. Attrition has been defined as the failure of a service member to meet his or her contractual enlistment obligation ([Laurence, 1996 #1980). A more practical definition might be the failure of a service member to be retained in service during their contracted period. There are many points in a service member's military career when attrition can occur. After signing a service contract the potential recruit may be lost because he cannot obtain a contractual choice such as the desired military occupational specialty (MOS) or station of his choice. He or she can be disqualified in the Military Entrance Processing Station (MEPS) for a mental or physical problem. The recruit may decide not to join the military while awaiting a training slot in a Delayed Entry Program (DEP). Once the trainee begins basic training, he or she may encounter a number of challenges that may result in attrition. These might include psychological problems in adjusting to military life, inadequate performance on critical military tasks, or serious injury. Similar problems may manifest once the military member enters an operational unit leading to later attrition.

In the voluminous literature on attrition, the most common career points that have been examined include basic training and the "first-term". First-term attrition can be defined as a service member's separation from service before completion of his or her first contractual agreement. Other common points that have been examined include 6-months and 1, 2, 3, or 4 years. Other time points are not uncommon (e.g., 30 months, 35 months).

The Center for Accessions Research (CAR) requested that the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM) review the literature on military attrition as part of a project to determine whether or not attrition can be reduced by pre-accession physical fitness screening. The attrition review was requested to assist in understanding factors that might influence attrition in the larger context.

The purpose of this paper is to review the published literature on attrition emphasizing demographic, cognitive/psychosocial, medical, and fitness-related factors. Demographic and psychosocial factors have been covered in previous reviews (160,177) but the current review updates and further analyzes these factors. This paper is organized to first determine the size of the attrition problem, second, to examine risk factors for attrition, and finally, to examine strategies that reduce attrition.

a. Limitations to the Review. This review is limited to attrition studies that have involved enlisted military personnel in any of the three services (Army, Navy, Air Force) including Marines. Civilian literature is sometimes cited to reinforce a point. The review is focused on attrition within the first-term and does not consider retention/attrition beyond the first-term except in a few cases were studies have included this as part of their criteria for evaluating first-term attrition (e.g., a criterion involving first-term retention plus eligibility for reenlistment). Only studies available in the published medical literature or studies/reports available at the Defense Technical Information Center (DTIC) were reviewed. In the case of a few key studies, requests to specific organizations or individuals were pursued. This cannot be considered a comprehensive review of the topic of attrition because some subject areas could not be exhaustively researched. However, this report does serve as a starting point for a more comprehensive review of specific attrition topics covered.

b. Special Considerations. Where the data is relatively consistent, a large number of studies are grouped together. Where data is conflicting, attempts are made to resolve discrepancies where possible and studies are discussed in more detail. More detailed presentations of studies are made in many cases because many studies are unique in methods, findings, or insights. In some cases, authors presented data that could be further analyzed to determine the magnitude of a relationship or size of the differences between groups. When these "secondary analyses" were performed, they are specified in the report. Where individual authors have hypothesized about possible reasons for particular associations or where it is possible for the present authors to speculate, this is included in the report.

c. Definitions. The initial training period where individuals learn the common skills for a particular service is called Basic Combat Training in the Army and Basic Military Training in the Air Force. In this review, the term "basic training" will be used to refer to this common period for all services. The period after basic training is called Advanced Individual Training in the Army and Technical training in the Air Force. For the purposes of this paper this period will be referred to as Advanced Training. When individuals leave Advanced Training they will enter what will be referred to as an operational unit. Service members in the Army, Navy, Marines and Air Force are referred to as Soldiers, Sailors, Marines, and Airmen, respectively.

3. PATTERN OF ATTRITION OVER TIME & REASONS FOR ATTRITION

Table 1 shows cumulative first-term enlisted attrition assembled by the General Accounting Office (GAO) based on analysis of data from the Defense Manpower Data Center (DMDC). It is apparent that at all career points examined, attrition is rising over the 10 year period of time. This attrition should be viewed in the context of total attrition from civilian jobs in the U.S. Individuals entering the Army tend to be relatively young with 70-76% of recruits falling into the 17-21 year old age category (137,143). Civilian literature indicates that 29% of 16-19 year olds and 22% of 20-24 year olds hold jobs for less than a year (42). Ten years after entry into the job market young men (18 years or younger) have held an average of 7 jobs and only 20% will have held a single job for this time period (248).

Table 1. Cumulative First-Term Enlisted Attrition (From Reference 75)

Year	Career Points				
	0 to 6 Months	7 to 12 Months	13 to 24 Months	25 to 36 Months	37 to 48 Months
1985	10.0	13.2	20.7	26.3	29.8
1986	11.1	14.4	21.5	27.4	31.4
1987	10.0	13.3	20.4	26.2	30.5
1988	10.5	13.9	20.8	26.6	31.4
1989	10.4	14.5	21.8	28.1	33.9
1990	10.4	14.3	21.4	28.7	34.2
1991	11.1	14.7	22.3	28.6	33.6
1992	11.4	14.8	22.1	28.2	33.2
1993	13.6	17.4	24.8	30.9	35.9
1994	13.5	17.6	24.7	31.2	36.9
1995	13.9	17.7	25.1	31.2	36.8

Table 1 shows that most first-term attrition occurs during the early part of service, especially during basic and advanced training. When looked at as a whole, about 1/3 of attrition occurs in the first 6 months (25,67,70,75,127), about ½ within the first year (70 ,75,156), and the remainder in the subsequent 2 year period (61,70). One study examining attrition for adverse reasons showed that about ½ of female attrition for adverse reasons occurred in the first 6 months (127).

Klein et al. (127) reviewed discharge packets for a stratified random sample of military members from all services who separated from service for adverse reasons. They found that mental health problems like emotional instability and failure to adapt to the military were more likely to surface early and more likely in women than in men. Mental health problems tended to decrease with longer times in service. Training-related reasons for discharge were more prevalent early in service while drug/alcohol problems tended to surface later in service as a reason for separation. This may simply relate to the fact that early in service (basic and advanced training) there is limited access to alcohol and drugs. Major and minor offenses were also more likely to emerge as reasons for discharge later in service. Over half of discharged recruits had more than 2 identifiable reasons for separating with a modal number of 3.

A GAO investigation using Fiscal Year (FY) 1998 data from the Defense Manpower Data Center (75) found that separations within the first 6 months of service occurred for 4 major reasons. Performance problems accounted for 34% of separations and included inability to adapt to the military, loss of motivation, and failure to pass mandatory training evaluations such as the physical fitness tests. Medical/physical problems accounted for 26% and included medical conditions that existed prior to service or medical problems that developed in training. Erroneous or fraudulent enlistments accounted for 23% of separations and these included detection of disqualifying conditions that were not found earlier or applicant's deliberately withholding disqualifying information. Other reasons accounted for 17% of separations and included such disqualifications as misconduct, excessive body weight or body fat, character or behavioral disorders, alcoholism, drug abuse, and homosexuality. The GAO report (75) indicated that separations after 6 months (7 to 48 months) are more related to discipline, performance, and medical problems. In using FY 1995 data, they found that 7 to 48-month attrition was associated with misconduct (34%), physical problems (15%), drug use (10%), performance problems (8%), and character or behavioral disorders (7%).

4. RISK FACTORS FOR ATTRITION

Many factors that increase the likelihood of attrition have been examined. By far, the largest volume of research has centered on demographic and psychosocial factors. This is probably because of the large amount of personal information of this type that is contained in readily available databases like those of the DMDC.

a. Demographic Factors

(1) Educational Attainment

Perhaps the factor that is most commonly associated with early attrition is low educational attainment (14,19,36,42,43,60,61,64,67,70,72,91,92,106, 111,114,121,133,145,150,153,155,157,158,163,167,172,173,176,196,197,199, 200,220,236,247,252,253,262,268). A classic study of Air Force recruits (69) demonstrated that individuals possessing a high school diploma were much less likely to be discharged for unsuitability than those without a high school diploma. Subsequent work showed that those without a high school diploma were about twice as likely to attrite in their first term as those that do have a diploma (about 50% vs. 25%) (61,70,176,268). The difference between graduates and non-graduates strongly persists even after controlling for race, gender, and service (70).

Laurence (157) traces the history of educational standards and military selection from the original Flyer study (69) through the early 1990s. Prior to about 1975, no distinction was made between those that had a high school

diploma and those with alternate high school educational credentials. However, research in the 1960s and 1970s indicated that not all academic credentials were equally related to attrition (157). Other academic credentials included Certificates of Attendance, Certificates of Competency, home study certificates, non-state accredited diplomas, adult education diplomas, and other types of certificates. The difference among credentials with regard to attrition is illustrated by the General Education Development (GED) certificate. Those with GEDs have been found to have attrition rates about twice as great as those with high school diplomas (61,133,157,158,176). GED holders thus had likelihoods of success similar to non-graduates (158). The difference in attrition between GED holders and high school diploma graduates was independent of AFQT score, gender, age, race, or MOS category, and was consistent across services (61,176). In multivariate discriminate function analysis, demographics (age, AFQT, race), work history, socioeconomic factors, MOS matching and satisfaction, and socioeconomic factors did not diminish the size of the effect of high school graduation on 6-month attrition (25). However, one study (133) showed that physical fitness on entry to service and injuries in training were stronger predictors of discharge in basic training suggesting that the GED may be serving as a marker for other factors.

Currently, educational credentials are placed in three tiers, partially based on research accumulated over the last 50 years. TIER 1 consists of traditional high school graduates, alternative/continuation high school graduates, those with one semester of college (without high school diploma), or those with an adult high-school diploma graduate. TIER 2 consists of test-based equivalency diploma graduate (i.e., GED), high school certificate of attendance, alternative/continuation/ correspondence high school, and home study diploma. TIER 3 includes individuals who are non-high school graduates (no high school diploma or alternative educational credential). The services also include in TIER 1 associate degrees and higher (baccalaureate, master, nursing degrees, etc.) (155). These tiered educational categories have been shown to be systematically related to Marine basic training attrition and first-term attrition with TIER 1 having the lowest attrition and TIER 3 the highest (98). Laurence and Ramsberger (155) performed a detailed analysis of 2-year attrition in a 1988 to 1993 cohort across all the services. This analysis indicates that those with one semester of college and those with an adult education diploma have attrition similar to others in TIER 2. One semester of college with no high school diploma may reveal a continuation of the pattern of dropping out of school (155). Laurence and Ramsberger (155) also highlighted problems in the coding of educational categories in military databases.

Hypotheses about why the high school diploma is such a powerful predictor of attrition centers on the similarities between the high school and military environments. Those who achieve high school diplomas demonstrate some degree of perseverance, and cooperation with instructors and peers, and an ability to conform to rules and regulations. This achievement may

demonstrate some degree of maturity, ambition, and goal orientation. It is possible that individuals without high school diplomas have problems completing their education in formal environments where maturity, persistence, conformance, and adaptation to rules and regulations are required. The highly structured setting of basic training and the focus on task performance may be a difficult environment for dropouts (58,157,160). Providing some support for this idea, McCraw and Bearden (174) found that what distinguished Air Force recruits who were and were not discharged were psychological measures related to persistence and achievement in environments where conformance was a positive behavior. Laurence (158) noted that GED holders have not been successful in the structured and disciplined classroom environment with its rules, regulations, and cooperative necessities; GED holders may have similar problems in the structured and disciplined military environment.

(2) Gender

Women are more likely to leave the service early than are men (20,36,60, 67,70,92,133,150,220,244,247,252,268). Female attrition rates are 1.1 to 1.8 times higher than male rates depending on the study and service (20,36,60, 67,133,150,220,228,244,252,268).

Several factors about female attrition are significant. Women are typically separated for family and administrative reasons, primarily pregnancy, while men more often have attrition for adverse reasons such as alcohol/drugs, infractions, and failure to meet minimum behavioral or performance criteria (20,68,70,72,92, 220,228,244). One study of Soldiers found that when pregnancy cases were eliminated from the analysis the first-term attrition rate for men and women were identical (220). Data from a study of Sailors (228) indicated 2-year attrition rates of 32% for men and 36% for women; however, 14% of total female attrition was categorized as "pregnancy." It is possible that pregnancy may be a marker for other factors such as risk-taking or a desire to leave service but this has not been explored in any study.

The Black female attrition rate has been found to be similar to or lower than the overall male attrition rate (70,220). Women with high school diplomas or higher AFQT scores attrite at higher rates than men with high school diplomas and higher AFQT scores. The gender difference among non-diploma holders or those with lower AFQT scores is smaller (220).

(3) Age

The association between age and attrition appears to be confusing at first glance. Most studies show that older age is associated with higher attrition (25,36,114,145,148,150,153,163,196,199,200,244,253,268), but some studies show no relationship (67,133,205), no consistent relationship (43,60,172), or actually show that younger individuals are more likely to attrite (64,91). Much of

this apparent discrepancy is resolved by looking at studies that use finer age graduations. These studies show that association between age and first-term attrition is bimodal. That is, attrition seems to be highest for 17 or 18 year olds, attrition decreases for 19-23 year olds, then attrition increases again for recruits over ages 23 (70,172,200,247). A study that compiled age data by 17, 18, 19, and >19 year age groups generally supports this concept when all services were combined (25). One study that stratified first-term attrition by gender showed this pattern in men, but for women there was a more linear association such that attrition increases with age (70). Zook's (268) examination of the Project A data (discussed later) was an exception in that she showed that attrition was 22%, 23%, 27% and 33% in age categories 17, 18-20, 21-25, and 26+. In Marines, basic training attrition was higher in older individuals but older age was associated with less attrition in the first-term (114).

The explanation of the bimodal relationship between age and attrition may lie in life experience. The youngest service members have little experience with the job market and they may be more likely to make an inappropriate choice in joining the services leading to efforts to exit their contractual obligation. Older individuals may be those that have failed in other types of jobs and also fail in the military environment (25). Older individuals may also have more social maladaptative problems (160).

(4) Race or Ethnic Group

White racial/ethnic group is associated with higher attrition when compared to Blacks, Hispanics, and other racial/ethnic minorities in most studies (25,42,43, 60,67,73,91,114,133,150,167,220,244,245,247,252,268) but not all (8,19,36,63, 64,70,111,114,236). The differences among some studies may be attributed to gender. Where lower attrition rates are found among Blacks, this appears to be largely accounted for by lower attrition among Black women. Attrition among Black and White men is about the same (63,70,220,252). There is lower attrition among Black women than White women even after controlling for educational level and AFQT category (70). Black women are less likely to be discharged for failure to meet minimum behavioral or performance criteria or for pregnancy (70). It has been suggested that economic opportunity may be higher in the military for most minorities (25,220), especially Black women, and this may account for the lower attrition rate (220). The lowest overall attrition among racial/ethnic categories is for Asians (63).

(5) Marital Status and Dependents

Most studies show that service members who are married or have dependents are more likely to exit the service before completion of their enlistment contracts when compared to non-married service members (61,64,67,70,82,114,150,153,172). The higher first-term attrition among married service members is independent of age, gender, or race with one exception:

married and single Black women have similar first-term attrition (70). Georgoulakis (82) hypothesized that married individuals may be more accustomed to the social support that families provide and the lack of this in the basic training environment may be related to attrition. The overall effect of marital status on attrition is relatively small (risk ratio (married/single)~1.1) (61,67,70,172).

There is some conflicting data. One study (133) found no significant association between basic training attrition and marital status but the sample size was small and this limited statistical power. The trend was in the expected direction (higher attrition among the married) with risk ratios (married/single) of about 1.1 (men) to 1.3 (women). Thomas (247) found that single Army Soldiers with one dependent had the longest time in service for first-term enlistment. Married Soldiers had longer enlistment times than single Soldiers (247). Other studies (72,163) found a slightly lower attrition rate among Navy men with dependents regardless of education, age, race or AFQT category. The reasons for these conflicting data are not clear.

b. Cognitive/Psychosocial Factors

(1) Armed Forces Qualification Test (AFQT) Score

The AFQT is an offspring of two prior tests. In WWI the Army Alpha and Army Beta tests were developed for managers to gauge the aptitude of recruits for assignments to particular jobs. The Army General Classification Test (AGCT) replaced the Army Alpha and Beta tests during WWII. The AGCT was described as an evaluation of "general learning ability" and examined vocabulary, mathematics, and spatial relationships. From 1948-1950 the services developed the AFQT to use as a single screening device for all services. In subsequent years, the AFQT has been modified with some items dropped and others added. Some services included other tests. Since 1980, the AFQT has placed increased emphasis on verbal and quantitative items while a spatial relationships section was dropped (58).

In 1974 the Department of Defense (DOD) required all services to use a single test for screening applicants and assigning them to military occupational specialties. In 1976 this single test was used DOD-wide and was called the Armed Services Vocational Aptitude Battery (ASVAB) (58). The current AFQT is part of the ASVAB. The ASVAB consists of 9 scales derived from a 200-item questionnaire. The 9 scales are 1) General Science (25-items measuring knowledge of life science, earth and space science, and physical science), 2) Arithmetic Reasoning (30-items measuring ability to solve basic arithmetic word problems), 3) Word Knowledge (35 items measuring ability to understand the meaning of words through synonyms), 4) Paragraph Comprehension (15 items measuring ability to obtain information from written material), 5) Mathematics Knowledge (25 items measuring knowledge of mathematical concepts and

applications), 6) Electronics Information (20 items measuring knowledge of electrical current, circuits, devices, and electronic systems), 7) Auto and Shop Information (25 items measuring knowledge of automotive maintenance and repair, and wood and metal shop practices), and 8) Mechanical Comprehension (25 items measuring knowledge of the principles of mechanical devices, structural support, and properties of materials). A Numerical Operations and Coding Speed (84 items measuring speed of matching symbols and numbers) scale was recently deleted from the test despite data showing that dropping the items reduced job classification efficiency and adversely affected women (267).

The AFQT is calculated from 4 scales of the ASVAB including 1) Word Knowledge, 2) Paragraph Comprehension, 3) Arithmetic Reasoning, and 4) Mathematics Knowledge. The AFQT is computed as the standard scores of the Arithmetic Reasoning and Mathematics Knowledge scales and twice the sum of the standard scores on the Word Knowledge and Paragraph Comprehension scales. The AFQT scores are subcategorized by percentile as shown in Table 2. The AFQT categories have been used in many studies of attrition.

Table 2. AFQT Percentiles and Categories

AFQT Percentile	AFQT Category
93-99	I
92-65	II
50-64	III-A
31-49	III-B
10-30	IV
1-9	V

Higher AFQT scores are associated with lower attrition (19,25,36,42,43,60, 63,64,70,92,111,114,121,145,150,163,167,172,199,208,220,236,247,251,253, 268), but the effect is not a strong one. Several studies found that the effect of AFQT on first-term attrition among Sailors and Marines was not diminished when high school diploma status was considered (43,61,70,98). Navy high school diploma graduates in AFQT Categories IIIA and lower have first term attrition rates 1.4 times higher than Categories I and II; this ratio is only 1.1 for non-high school diploma holders. Similar though weaker relationships were present for graduate and non-graduate women (61,70). The AFQT-attrition relationship is stronger in non-Blacks than in Blacks. Blacks show little or no difference in attrition across AFQT categories (63,70).

Other tests examining general knowledge have also been associated with attrition. Individuals scoring lower on the Navy General Classification Test (GCT) were at much higher first-term attrition risk than those scoring higher (153,200). McCraw and Bearden (173) found that recruits in Air Force Technical Training reporting to the mental health clinic were 2.1 times more likely to be discharged if their Intelligence Quotient was below 100 compared to above 116.

(2) Moral Character

Various studies have examined the association between attrition and what has been commonly referred to in the literature as "moral character". Moral character is generally defined in the literature as conformance to laws, rules and regulations. Moral character can be assessed from self-reports but more objective measures can be obtained from background checks that provide reports of arrests, traffic violations, detentions, and felony or misdemeanor charges and/or convictions. As part of the enlistment process, recruiters are required to ask enlistees about felonies, misdemeanors, and traffic violations (78).

Several studies have shown that self-reported past expulsions or suspensions from school were risk factors for attrition (20,106,153,154,199). Studies that have performed multivariate analysis have found that expulsions from school independently increased the risk of first-term attrition when other potential attrition risk factors were included in the model such as demographics, service satisfaction variables, education, family stability measures, physical health measures, and cognitive test scores (20,153,154,199).

Other risk factors for basic training attrition included self-reports of being charged with or suspected of a crime (106), traffic violations, times late for school (153), fighting while intoxicated, rebelliousness (244), and being arrested for a crime (20,154,253). Self-reported fighting while intoxicated was an independent risk factor for psychiatric/behavioral and legal discharges but not medical or inadequate performance discharges (244). Self-reported rebelliousness was an independent risk factor for attrition of all types (244). Self-reported arrest for a crime was independently related only to behavioral attrition (20). Self-reports of being jailed or being in a detention home were not related to basic training attrition (106).

Laurence (156) examined the association of 1-year attrition with several indicators of moral character. These included unfavorable information in the Defense Central Index of Investigations (DCII), and two scales derived from a questionnaire called the Educational and Biographical Information Survey (EBIS). The EBIS included an Arrest Scale (19 items covering self-report of fines, arrests, traffic violations, disorderly conduct, misdemeanors and felonies) and a Drug/Alcohol Use Scale (13 items covering frequency of alcohol and illegal drug use). In this study, many moral character variables were found to be significantly related to attrition. Those with unfavorable information in the DCII were 1.6 times more likely to attrite than those without unfavorable information (23% vs. 14%). Individuals with high scores on the EBIS Arrest Scale were 1.1 times more likely to be separated, while those with high scores on the Drug/Alcohol Use Scale were 1.2 times more likely to be separated.

Another study (41) performed criminal background checks on Navy recruits. The author found that recruits with felony convictions or felony arrests were 1.7 to 1.8 times more likely to receive a first-term unsuitability discharge than those without a felony history. Recruits with non-felony convictions or arrests were 1.4 to 1.7 times more likely to receive an unsuitability discharge than those without such a history. Another study (72) also performed criminal background checks on Navy recruits and found similar results. Recruits with felony pre-service legal encounters were 2.4 times more likely to be discharged in their first-term than those without such histories. Those with misdemeanors were also more likely to be discharged.

(3) Moral Waivers

Moral waivers are enlistments granted to individuals who have minor or major legal offenses and/or pre-service illegal drug/alcohol use. As noted above, recruiters are required to ask enlistees about past legal offenses and potential recruits with certain types of transgressions are required to obtain waivers before they can enter service. Offenses that can be waivered differ by service (78). In FY 1990-97 moral waivers accounted for 62% of all waivers granted across the services and moral waivers were granted to 13% of all personnel enlisted. Almost 75% of moral waivers were for serious misdemeanors and pre-service drug use. Traffic offenses and minor non-traffic offenses accounted for about 20% (78).

Those with moral waivers are more likely to be discharged from service than those without moral waivers in most (19,68,92,98,145), but not all studies (152,156,175). Part of the discrepancy among studies is resolved by looking at the type of discharge. As might be expected, the relationship between moral waivers and attrition is weaker when all discharges are considered (175), but is stronger when the discharge is of the adverse/unsuitability type (failure to meet minimum behavioral or performance standards) (68,92,175). Another part of the discrepancy in the literature is due to the different treatment of Marine recruits with regard to moral waivers. Several studies have shown that Marines with and without moral waivers have 1-year and first-term attrition rates that are similar (68,152,156). Waivers for minor traffic violations are granted much more often for the Marines than in the other services. When minor traffic violations were removed from the data, Marines with other moral waivers had higher attrition rates than those without waivers (68,152). The risk of attrition is generally about 1.4 times higher among service members with moral waivers compared to those without in all services except the Marines (68,92).

AFQT category and educational level moderate the moral waiver-attrition association. Those in higher AFQT categories with a waiver had lower attrition than those in lower AFQT categories with a waiver. Waivered high school graduates were more likely to be discharged than non-waivered high school

graduates; the difference in waivered and non-waivered non high school graduates was much smaller (19,68,98,175).

The effectiveness of the moral screening process has been investigated. Moral waivers do not often match the recruit's criminal history. Two studies of Navy recruits (41,72) showed that 31% of non-felony convictions and 91 to 98% of felony convictions identified from police background checks did not match the moral waiver received by the recruit. This could be either because the recruit did not reveal the information or because the recruiter did not properly pursue the correct waiver (41).

The overall impact of this mismatch may be small. A study (225) compared two groups of naval recruits. One group was composed of recruits who revealed information about themselves that required a background check (n=78). The other group was composed of recruits who did not reveal information about themselves requiring a background check (n=510). Police background checks were performed on both groups. New information was found on 12% of the group that revealed information and 5% of the group not revealing information requiring a background check. The additional background checks required a DEP discharge for 4% of the group disclosing information and 0.2% of the group not revealing information requiring a background check.

(4) Prior Job History

It is possible that individuals who have had problems in prior employment situations may have problems with their employment in the military. However, as noted earlier, it is not unusual for younger individuals to attempt a number of jobs to see which of them matches their goals, temperaments, and skills (153,248).

Bauer et al. (14) examined Army basic and advanced trainees who were entry level separation discharges and compared these to non-discharges. Discharges were: 1) 2.3 times more likely to have been unemployed when they enlisted, 2) 0.63 times less likely to have held a supervisory position if they did work, 3) 2.5 times more likely to have been dissatisfied with previous jobs, and 4) 2.2 times more likely to have had social problems in previous jobs. Discharges were more likely to join the Army to obtain a steady job or get away from financial problems while non-discharges were more likely to have joined to receive special training.

Questionnaires that include items related to prior employment, work history, or work orientation have been shown to have criterion-related validity for attrition (73,81,252,261). Unfortunately, none of these studies provide the validity coefficients for the employment questions by themselves. One study (159) that reviewed 11 item types from questionnaires used in a military setting found that work history items ranked among the best for predictors of 6-month attrition.

Other questionnaires have suggested that prior job instability is associated with attrition. On the Life Path Questionnaire the scale most related to basic training discharge or recycling was the Authority Scale which contained a question on the number of jobs quit because of problems with a supervisor (81). Antel (8) found that joblessness at the time of enlistment or, if employed at the time of enlistment, having been jobless at least once in the last year, were associated with 6- and 36-month attrition.

(5) Military Job Satisfaction

Satisfaction with military jobs does not appear to affect 6-month attrition or attrition from basic or advanced training (25,266). Separation rates were not associated with: 1) overall job satisfaction, 2) whether or not the recruit got the job desired, or 3) other pre-enlistment knowledge of MOS (25). It is possible that those who cannot obtain the exact MOS they desire are much less likely to enter the military and that those who do take a less desirable position are merely less selective in their choice (25). Also, in the first 6 months many individuals are still in training or have just left training and have not actually worked in their specialties in an operational unit.

Once an individual is in an operational unit, job satisfaction does appear to be related to attrition. LaRocco et al. (153) evaluated job satisfaction using a questionnaire administered to Sailors who were in the operational Navy. A Need Satisfaction Scale evaluated the degree to which the Sailor's job satisfaction needs were met and a Job Involvement Scale evaluated the degree of identification with the job. Both scales were lower among those that left service before the end of their first term. Overall job satisfaction with the Navy was also lower among those who left early. Youngblood et al. (266) administered the Job Diagnostic Survey to a group of Marines and found that those who had less overall job satisfaction were more likely to leave service after assignment to a duty station than Marines who had higher job satisfaction. Allen and Bell (4) analyzed a survey given to 8,140 Soldiers assigned to 60 battalions in the continental U.S. and Europe. They found that job satisfaction was most related to organization climate and characteristics of the job (sense of control, variety, and meaningfulness). Correlations between unit-combined job satisfaction measures and unit discharges were obtained and found to be low (<0.19) and not statistically significant.

(6) Participation in the Delayed Entry Program (DEP)

The DEP has been in place since the mid-1960s. It allows individuals to sign up for the services and delay their entry into service for up to one year. The DEP is now the way over 80% of individuals enter the services (101). The program allows for better basic and advanced training planning since the flow of trainees into training can be more effectively regulated. It also provides time that trainees can use to prepare mentally and physically for military service.

Individuals in the DEP remain in their local neighborhoods and they may influence their peer group to join the services. However, the DEP does take up recruiter time since all services require at least biweekly communication and monthly face-to-face meetings between the recruiter and the DEP participant (189). The average time in the DEP was about 3-4 months in FY90-93 (167).

Longer participation in the DEP is associated with lower attrition (8,19, 25,42,43,60,70,114,145,167,208,236). The difference in attrition rates remains after controlling for educational level, AFQT category, gender, and other factors. The effect is stronger for men than for women (8,70,167). One study that examined finer time graduations (months in DEP) showed that there was a U-shape relationship between time in the DEP and subsequent basic and advanced training attrition. From about 0 to 6 months in the DEP there was a steady decrease in basic and advanced training attrition. After this attrition began to gradually increase such that by 11-12 months attrition was similar to that seen at 4-5 months in the DEP (167).

One hypothesis for the DEP-attrition association is that those who remain in the DEP longer are those waiting for more desirable MOS and when they obtain these MOS they are more likely to stay in service (8,25). However, Buddin tested this hypothesis and found no evidence for it (25). It has also been hypothesized that while in the DEP, recruits have more time to consider their selection of the military and those less committed to their initial decision drop out of the DEP before beginning active duty (8,25). Part of the DEP-attrition association appears to reflect disqualifications of seniors with low AFQT who do not graduate from high school (25). This increases the "quality" of the individual who enters from the DEP pool since they are more likely to be high school graduates with higher AFQT scores.

There are studies that have examined risk factors for attrition from the DEP and these studies are reviewed in Appendix B. These tend to be similar to risk factors for attrition once individuals begin their training but there are some unique findings.

c. Mental Health-Related Factors

A large number of studies have examined risk factors for attrition among Air Force trainees who were referred to mental health facilities. In a few cases, mental health attrition has been studied in services other than the Air Force and beyond the advanced training period (e.g., 6-months or the first-term); these studies are reviewed in the appropriate subsections. This section will first review the size of the Air Force subpopulation to define how large the problem is, then risk factors for mental health attrition.

About 4% to 6% of all Air Force recruits are referred to mental health facilities for evaluation during basic training (34,62,239). About 2/3 of these are

returned to duty and about 1/3 recommended for discharge (34,62,239). A diagnosis of adjustment disorder accounts for about ½ of all mental health referrals and slightly over ½ of referrals that are eventually discharged from service. For discharges, depressive disorders and anxiety disorders are the next most common diagnoses accounting for about 17% and 5%, respectively, of all discharges (62).

As might be expected, some demographic risk factors such as lower aptitude and White race, also found in the studies cited above using broad recruit samples, have also been found in these mental health investigations (173). Unique risk factors identified in mental health investigations include a history of physical and/or sexual abuse, past mental health history, negative attitudes, low motivation, certain mood states, personality characteristics, suicide/self-harm ideation, and the referral to the mental health facility itself.

(1) Physical or Sexual Abuse

A history of pre-service physical or sexual abuse is a consistently demonstrated risk factor for mental health-related attrition from basic training (20,30,34,46,235,239). The two studies on the prevalence of physical or sexual abuse among service trainees have found widely different prevalence values probably because of the different questionnaire instruments that have been used and different definitions of abuse. One study that administered a series of questionnaires to Naval recruits found that 41% of women and 39% of men reported parental physical violence before the age of 18. Childhood contact sexual abuse was reported by 48% of women and 35% of men. Another study (235) examined responses of Air Force recruits to the question "I believe I have been sexually abused" on the History Opinion Inventory (HOI). Prevalence of positive responses was 1.5% for men and 15.1% for women. Basic training attrition rates were higher for men who responded positively than those who did not (12% vs. 4%, $p<0.01$) and results were similar for women (10% vs. 6%, $p<0.01$).

Crawford and Fiedler (46) matched 25 Air Force recruits about to be discharged from basic training with 25 basic trainees who successfully completed training. They found that 40% of the discharged group and 4% of the control group reported physical or sexual abuse ($p<0.01$). Abusers were predominately male and family members. Of subjects reporting abuse, 91% said they had mental health treatment while only 23% of non-abused gave such histories.

Negative mental health symptoms may arise in basic training among those with former abuse because of the close quarters, close contact with other trainees, and the physical and emotional demands of training. Training instructors often present as harsh and aggressive individuals and trainees with previous abuse may feel they are again being abused. They may be unable to emotionally tolerate the stress (46,239).

(2) Mental Health History

The association between mental health histories and basic training attrition of trainees referred to the mental health service has been examined (34,239). The authors of one study (34) did not provide a statistical analysis of their data but sufficient information was provided for a secondary analysis (chi-square). The following pre-service factors were significantly different ($p<0.01$) between those discharged and those not discharged (risk ratios (RR) are those with characteristic/those without characteristics): a previous mental health counseling (RR=1.7), previous treatment with medication (RR=3.3), previous psychiatric hospitalization (RR=2.8), previous physical or sexual abuse (RR=1.7), and a family member with either mental health counseling (RR=1.5), treatment with medication (RR=1.5), psychiatric hospitalization (RR=1.8), and/or drug treatment (RR=1.4). It was not possible to perform a secondary multivariate analysis. It is possible that physical/sexual abuse may be confounded with previous mental health history considering the results of Crawford et al. study cited above (46).

A previous history of alcohol or drug treatment has produced conflicting results with regard to mental health-related discharge (34,239). A history of this type appears to be related only to psychiatric hospitalizations and recommendations for immediate discharges, but this type of discharge makes up less than 16% of all outcomes in the mental health service (239).

(3) Attitude and Motivational Variables

Attitude and motivational variables among Air Force basic training mental health referrals have been studied using biographical questionnaires (30,34). Variables reflecting low motivation, pessimism toward training, and lack of self-reliance were associated with higher risk of attrition. In a multivariate analysis involving 59 variables, 7 variables were found to be independent risk factors for attrition. Questions most related to successful completion of basic training were expectancy of graduation ("I will graduate from training"), optimism toward training ("I look forward to learning new skills") and self-reliance ("No one is willing to listen or understand me" [scored in opposite direction]). Individuals responding negatively to these questions had adjusted odds ratios of discharge that were 1.4, 1.5 and 1.3 times higher, respectively, than those who responded positively (30). With regard to self-reliance, another study demonstrated that basic trainees who are over-dependent at the start of training were less likely to graduate (209). Mental health referrals who were discharged were more likely to have joined to escape problems back home or to please someone else and less likely to have joined for education or travel (173).

(4) Depression and Other Mood States

A higher rating of Depression on the Minnesota Multiphasic Personality Inventory (MMPI) has been shown to be an independent risk factor associated with mental health discharges (30,239) and discharges of all types (17,165,166). However, a look at a wider variety of mood states suggests other factors may be important (17,166). One study (166) found that Anxiety, Hostility, Affect, Sensation Seeking, and Depression were all related to discharge. The authors of this study noted that "it may be that young men and women who are simultaneously more anxious, depressed, hostile, and sensation seeking are more sensitive to the effects of environmental and psychological stress [of basic training]. An individual who fits this profile may engage in more acting out, increasing the likelihood of getting unwanted attention from authority figures (e.g., punishment), or engage in more self-destructive behavior or perform poorly in situations requiring cooperative teamwork, therefore increasing the likelihood of early discharge".

(5) Personality Factors

Some personality factors associated with basic training attrition have been identified. One study (28) used the Millon Clinical Multiaxial Inventory (MCMI) to predict discharges among 175 Air Force recruit referrals. The MCMI is a self-report instrument designed to help the clinician assess personality disorders and clinical syndromes. Responses to the MCMI were subjected to a factor analysis and 4 factors were identified that were termed Distress, Social Activity, Social Submissiveness, and Suspiciousness. The factors were able to correctly discriminate 77% of the return to duty Airmen and 83% of the discharged Airmen.

Another study (174) administered the California Psychological Inventory (CPI) to individuals in Air Force advanced training. The CPI is designed to assess relatively enduring personality traits reflected in 18 empirically derived scales. The scale of Dominance and the scale of Achievement via Conformance were the two that most effectively discriminated between the discharged and not-discharged Airmen or Airmen having adjustment problems. Dominance assesses factors like leadership, persistence and social initiative; low scores reflect a lack self-confidence and avoidance of stress and decision making. Achievement via Conformance is associated with achievement in settings where conformity is a positive factor; those scoring low tend to be "stubborn, insecure, opinionated, pessimistic about their occupational futures, and easily disorganized under stress or pressure to conform" (174).

(6) Suicide Ideation and Self-Harm

Another factor associated with mental health-related discharge is a self-report of suicide ideation or planning to hurt/kill self (34,239). Given 1) the command emphasis on reducing suicide incidence, 2) the amount of medical

attention that has been directed at the study of suicides, and 3) the possibility that recruits use suicide ideation as a method to obtain a discharge from service (105,218,219), this is not surprising. Suicidal intent is the single factor most associated with psychiatric hospitalization (to prevent self-injury) and immediate discharge (239). It should be noted that the clinical decision to hospitalize the trainee is based not only on ideation of suicide or self-harm but also on previous history of self-harm, family history, religious beliefs, and other factors (239).

(7) Referral to Mental Health Facility

Two studies have examined the longer-term attrition of Airmen who were returned to duty after being referred for mental health evaluations during basic training (33,214). A 5.7-year follow-up of 48 trainees found that 30 (63%) did not complete their first term (214). A follow up of 261 trainees found that 172 (66%) did not complete their 4 years of service (33). Many in this latter cohort (99 of 261) did not complete basic training (38% vs. 8% who were not referred). The simple fact of referral to the mental health clinic in basic training appears to be a strong predictor of first-term attrition.

(8) Mental Health Hospitalization

One study (149) examined the association between early hospitalization and attrition from the services. Cases were active duty service members who were hospitalized within the first 6 months of entry to service. Hospitalizations were grouped by International Classification of Diseases-Version 9 (ICD-9) codes as follows: mental disorders (ICD-9 codes 295-302.9 and 306-316), alcohol and drug dependence/abuse (ICD-9 codes 303-305.9), injuries and poisoning (ICD-9 codes 800-999), acute respiratory illness (ICD-9 codes 460-496), and other (all other ICD-9 codes). These accounted for 26%, 10%, 7%, 2% and 56%, respectively, of all hospitalizations during the first 6 months. Table 3 shows the 1- and 6-month loss rates by category. By far, mental disorders account for the largest proportion of loss after hospitalization. More than half of those hospitalized for mental disorders were lost in the first month in all services but the Marines. Over 75% of those hospitalized for mental disorders were lost within the first 6-months. A follow up study (7) confirmed that 6-month attrition was much higher among those hospitalized for psychiatric reasons, regardless of the psychiatric diagnosis. Psychiatric hospitalization was 3 times more likely than non-psychiatric hospitalization to result in attrition in 3 months and those with psychiatric hospitalization had 90% overall attrition.

Table 3. Proportion (%) of Service Members Lost from Service After Hospitalization Within the First Six Months of Service (From Reference 150)

	1-Month Attrition				6-Month Attrition			
	Army	Navy	Marines	Air Force	Army	Navy	Marines	Air Force
Mental Disorders	53	63	31	78	83	89	77	95
Alcohol and Drug	11	14	0	10	54	55	48	33
Injuries/Poisoning	10	11	9	20	28	27	32	38
Acute Respiratory	6	14	8	10	17	29	12	23
Other	8	11	7	12	24	24	21	23

Between 1990 and 1999, 13% of all hospitalizations in the four services included a diagnosis of a mental health disorder (104). Hoge et al. (104) examined attrition of all service members who were hospitalized for any reason during 1996. Hospitalizations (n=7902) with a diagnosis of a mental health disorder (ICD-9 codes 290-319) were compared to hospitalizations (n=59,969) with a diagnosis of virtually any other injury or illness (ICD-9 codes 001-289, 320-759, 780-999). Table 4 shows the results. In all categories, individuals hospitalized with a mental health disorder had much higher attrition. Two years after the hospitalization only 26% of the former mental health patients were still serving. For 1997 hospitalizations, those with mental health diagnoses had 27% attrition after 6 months while those with any other diagnosis had 9% attrition after 6 months. The authors report that these differences remained after controlling for age, gender, and length of service but they did not present these data.

Table 4. Attrition after Hospitalization in 1996 (All Military Services Combined) (From Reference 104)

Follow-Up Period	Mental Health Disorder Hospitalization (%)	Other Than Mental Health Disorder Hospitalization (%)
3 Months	33	6
6 Months	47	12
12 Months	61	22
24 Months	74	28

d. General Health-Related Factors

(1) Medical Waiver Process

Since 1814, individuals who desire to enter the services have had to meet the certain standards of medical fitness to assure they are free of contagious diseases or conditions that would involve excessive medical treatment. Since 1996, the Army Accessions Medical Standards and Analysis and Research Activity (AMSARA) has had the mission of assuring that medical accessions standards are based on the best available medical evidence (38). AMSARA has performed several studies examining the attrition among service members who have received medical waivers of various types. The most common waivers among those who entered the service were hearing loss (10%), asthma (9%), refraction error (9%), essential hypertension (5%), flat feet (5%), musculoskeletal condition (4%), knee derangement (4%), knee ligament repair (3%), neurotic disorders (2%), bone/cartilage disorder (2%), attention deficit/hyperactivity disorder (2%), and cardiovascular symptoms (2%) (150).

(a) Attrition Associated with Any Medical Waiver. One-, 2-, and 3-year attrition was compared among those who received a waiver for any medical condition and those who did not require a waiver. Table 5 shows the discharge rates adjusted for age, race, marital status, BMI, and AFQT. Attrition was 1.1 to 1.3 times higher for the waivered group compared to the non-waivered group and these differences were statistically significant for all services but the Air Force (150).

Table 5. One-, Two- and Three-Year Attrition (%) for Service Members With and Without Medical Waivers (From Reference 150)

Attrition Years	Waiver	Army	Navy	Marines	Air Force
1	No	17	20	16	14
	Yes	21	22	18	15
2	No	23	26	20	18
	Yes	28	28	24	19
3	No	36	36	32	28
	Yes	45	39	37	30

(b) Waivers for Hearing Deficiencies. As indicated above, more waivers are granted for hearing deficiencies than for any other single medical condition accounting for 10% of all medical waivers. A study (7) examined attrition among those granted a hearing waiver. The waivered group was compared to a control group which was matched on service, gender, race, age, AFQT score, BMI, and month beginning active duty. Results are shown in Table 6. After adjusting for control variables, the relative risk of attrition for those with a hearing waiver was higher than the controls as shown in Table 6. Air Force data was not analyzed because of the small number of hearing waivers (n=12)

Table 6. Relative Risk of Attrition Among Service Members with a Hearing Deficit Waiver Compared to A Matched Control Group without a Wavier (from Reference 7); values are relative risk (waivered/not waivered); numbers in parentheses are 95% confidence intervals.

	6-Month Attrition	12-Month Attrition	36-Month Attrition
Army	1.3 (1.1-1.5)	1.3 (1.1-1.4)	1.2 (1.1-1.3)
Navy	1.4 (1.1-1.7)	1.4 (1.2-1.7)	1.4 (1.2-1.6)
Marines	1.1 (0.8-1.4)	1.1 (0.9-1.4)	1.1 (0.9-1.4)

(c) Asthma Waivers. The medical condition that has the second highest number of waivers is asthma accounting for 9% of all medical waivers. Several reports (36,39,150) describe preliminary results of a study examining recruits who were waivered for asthma. In a peer reviewed analysis, Clark et al. (37) compared 587 waivered asthmatics to a control group matched on service, gender, month started training, and race. Over a 3-year period, discharge rates were similar, though slightly lower, for those who were waivered compared to the matched control (waivered = 22%, controls=25%, $p>0.05$). The probability of an asthma-related event (EPTS, hospitalization, disability discharge) was higher in the asthma group (waivered=4.3%, control=0.8%, $p<0.01$). A follow-up study (149) examining a total of 1,510 asthma waivers with 4,529 controls showed that the waivered group continued to have a slightly lower attrition rate (waivered=23%, not waivered 25%, $p=0.09$ by secondary analysis). These data generally indicate that the waiver process for asthmatics seems successful.

(d) Attention Deficit/Hyperactivity Disorder Waivers. Three studies (36,39,149) examined a total of 508 cases of attention deficit/hyperactivity disorder (ADHD) that were waivered for this problem. These ADHD waiver cases were compared to all service members who entered the military in this same time period. Discharge rates were not different for those waivered (22%) when compared to all service members (24%). In another study (39), ADHD cases (n=132) were compared to a control group matched for service, gender, race, age and month and year of service entry. Discharge rates were not

different for those waivered (22%) when compared to the matched controls (23%). These data suggested that the current waiver policy was justifiable.

(e) Skin and Cellular Tissue Waivers. There are 26 skin and cellular tissue conditions that do not allow an individual entry to the service. Waivers for these conditions can be applied for and granted. A study (150) examined attrition in 334 cases that were waivered for skin diseases and that entered any of the 4 services. The cases were matched to a control group on the basis of service, gender, race, age, and entry date to service. The two groups initiated training between January 1995 and December 1997 and were followed through September 1998. A secondary analysis performed on the data showed that 11.1% of the cases received either an EPTS or disability discharge compared to 7.2% of the controls (p=0.02).

(f) Waivers for Depression and Related Disorders. A study (149) examined individuals who were granted a waiver for "neurotic mood, somatoform, dissociative or factitious disorders". Individuals (n=502) who were waivered were compared to another group of service members (n=1501) matched for age, race, service branch, and month of entry to service. Survival analysis showed that waivered service members were much more likely to attrite than controls regardless of service.

(g) Waivers for Back Disorders. A study (150) examined attrition among service members who received a waiver for back conditions. The waivered group (n=248) was compared to another group matched on branch of service and month/year of entry into service. For the Army, waivered Soldiers had a higher probability of attrition over the study period (about 600 days). No differences were found for the Marines or Navy but the number of waivered individuals were small in these services reducing the statistical power and possibility of finding a difference. Differences for the Air Force were not analyzed because of the very small number of waivers (n=12).

(h) Waivers for Prior Knee Injury. A study (44) examined attrition among service members who received a waiver for a prior knee injury. The waivered group (n=281) was compared to a control group matched on branch of service, gender, race, age, and month and year of entry into service. Follow-up times ranged from 6 months to 30 months depending on the date of entry. Waivered Soldiers were 2.3 times more likely to get an EPTS discharge (9% vs. 4%) and 6 times more likely to get an EPTS discharge for a knee condition (6% vs. 1%) than the control group. When portioned into 3 services, survival analysis showed that the Army waivers had higher risk of attrition than Army controls but the other services did not differ with regard to waivers and controls.

(2) Drug/Alcohol Use

It is difficult to determine the influence of drug and alcohol abuse on attrition because of the conflicting data. All studies have used self-reports (questionnaires) and the various studies define drug and alcohol abuse differently.

In studies of Air Force basic trainees referred for mental health evaluation, those self-reporting a history of drug and alcohol treatment had similar discharge rates compared to those who had no such history (34). In a more detailed analysis of these mental health referrals, it was found that a history of alcohol treatment was associated with a recommendation for an immediate discharge but was not associated with a later administrative discharge. Immediate discharges made up only 8% of recommended discharges while administrative discharges made up 84% (239).

Several studies have looked at attrition in basic training in association with pre-service drug and alcohol use. Guinn et al. (90) examined a 29-item scale called the Prediction of Drug Use Admission (PDA) that was part of a questionnaire called the Health Opinion Inventory (HOI). The PDA was designed to "measure those characteristics associated with the admission of previous drug usage and subsequent discharge" (151). Trainees scoring high on the PDA scale were 4.4 times more likely to be discharged from Air Force basic training than those scoring lower.

A study of Air Force basic trainees (244) found that pre-service alcohol consumption of 8 or more drinks per day was independently related to a "legal" discharge (fraudulent enlistment or discovery of the commission of a serious offense). Those reporting 8 or more drinks per day had an adjusted risk of legal discharge 1.2 times higher than those not reporting consumption at this level (adjusted for demographics and health/psychosocial variables). Legal discharges made up 20% of total discharges in this study and heavy alcohol consumption was not independently related to discharges for psychiatric, medical, or inadequate performance reasons. A secondary analysis of the data from a study of Naval basic training (154) showed that individuals who reported pre-service alcohol use on a weekly or daily basis were 1.8 times more likely to be discharged for any reason compared to individuals who never used alcohol. Bauer et al. (14) found that discharges and non discharges from Army basic training reported the same level of pre-service drug and alcohol use except for marijuana use. For marijuana use, non-discharges were more likely to have used marijuana prior to basic training.

A study of 1-year Naval attrition (20) found that Sailors reporting frequent pre-service alcohol use were 1.4 times more likely to be discharged for any reason, 1.2 times more likely to be discharged for medical reasons, and 1.6 times more likely to be discharged for behavioral reasons; discharges for administrative

reasons were similar for frequent and less frequent alcohol users. In multivariate analysis that included 39 variables, frequent alcohol use was an independent risk factor for discharge for any reason (adjusted risk ratio=1.1) and discharge for behavioral reasons (adjusted risk ratio=1.2). Frequent alcohol use was not defined in this study.

Klein et al. (127) examined the individual discharge packets of Soldiers to obtain detailed information on their reasons for discharge. Of the 10 leading causes of discharge examined, drug and alcohol use ranked sixth and seventh, respectively, accounting for only a small proportion of the total discharges. Drug and alcohol problems became a more predominant reason for discharge the longer the Soldier was in service.

As the above review suggests, the influence of drug and alcohol use/abuse on attrition is not clear. Pre-service treatment for drug and alcohol abuse does not appear to influence overall attrition in basic training. In basic training, the influence of pre-service drug and alcohol abuse is conflicting. Beyond basic training an association between attrition and drug use would be expected because of the military policy begun in 1981 of discharging those with positive results on routine and random drug testing (179). This policy is likely to discourage those with major drug abuse problems from entering service in addition to rapidly screening out those with drug problems. Alcohol abuse beyond basic training does appear to be associated with a higher risk of discharge.

Another consideration in studying this relationship is interaction between alcohol and drug abuse with other psychosocial factors that are measured in some of the questionnaires used in the studies cited above. Kolb et al. (146) found that pre-service drug abuse in Navy men admitted to a rehabilitation center was associated with adverse family background characteristics (leaving home at an early age, negative relationships with father, living with person other than parent), police problems, school adjustment problems, and personal adjustment problems.

(3) Cigarette Smoking

A history of prior cigarette smoking is associated with higher attrition in basic training (145,154,208,238,244) and after one year in the Navy (20). Two studies found that cigarette smoking was related to Naval basic training attrition in a dose-response manner. In one study, smoking 0, 1, 2, and 3 packs/day were associated with attrition of 8%,12%, 23%, and 28%, respectively (208). In the other study, smoking 0, 1, 2, and 3 packs/day were associated with attrition of 18%, 32%, 43%, and 54%, respectively (154).

Several hypotheses can be explored in an attempt to explain this association. It is possible that smokers have more trouble performing long-term

physical activity in basic training because of their lower aerobic capacity. However, the aerobic capacity of young smokers in basic training is similar to that of non-smokers (48,144) and a history of not running and smoking are independent risk factors for basic training attrition (145). Alternately, individuals who are smokers have been shown to be more susceptible to injuries (119,144) and illnesses (13,183) and they may have more medical problems in basic training that contribute to attrition. However, two studies (20,244) found that cigarette smoking was a risk factor for only "legal" (fraudulent enlistment or the commission of a serious offense) or "behavioral" (substandard performance, personality disorder, drug/alcohol abuse, fraudulent entry and misconduct) discharges. The association with medical attrition was very weak (20,244). This may suggest that cigarette smoking may be a marker for some yet undefined psychosocial factors (e.g., risk taking) that is linked with attrition.

(4) Injury

Pre-service injury has been found to be associated with attrition from service. In univariate analysis, naval recruits who reported a pre-service history of recurrent knee pain, limitations from past bone or joint injury, recurrent back pain, flat feet, painful shoulder/elbow, or broken bones had odds of attrition that were 1.5, 1.4, 1.4, 1.4, 1.4, and 1.3 times higher than those who did not report these histories, respectively (154). Among Sailors reporting a pre-service history of recurrent back pain or broken bones, odds of 1-year attrition were 3.7 and 2.0 times higher, respectively, than Sailors not reporting these histories (20). In multivariate analysis involving 4 demographic variables (gender, ethnicity, education, age) and 35 physical health and psychosocial variables, adjusted odds ratios were 1.5 for recurrent back pain (pain/no pain) and 1.5 for broken bones (broken bones/no broken bones) (20).

Not only does injury prior to basic training increase attrition risk, but injury during basic training increases the odds of attrition. One study (133) found that men who experienced an injury of any type during training were 3.3 times more likely to be discharged than men who were not injured. Women who experienced an injury of any type during training were 1.2 times more likely to be discharged than women who were not injured. Discharges were 2.6 to 3.8 times higher among trainees (men and women, respectively) with injuries severe enough to temporarily remove trainees from basic training, even when rehabilitation and the potential for return to training was offered to recruits who experienced these injuries.

It would be expected that a hospitalization for injury would indicate a serious injury that would increase the likelihood of attrition. One study (7) quantified this relationship. About 9% of enlisted hospitalizations within the first year of service were for an injury. Service members who were hospitalized for an injury within their first 2 years of service were compared to service members who were not hospitalized in their first 2 years of service. The 2 groups were matched on

gender, age, race, and month beginning active duty. Kaplan-Meier survival curves were presented and showed that regardless of when service members were hospitalized, those with injury hospitalizations were more likely to attrite. Attrition differences between injury hospitalizations and controls became smaller if the injury occurred later in service. Because not all demographic factors could be controlled in the matching process, Cox regression was used to adjust for other factors such as BMI, educational level, and marital status. After adjustment, attrition among those hospitalized within the first 3 months of service was found to be 1.7,1.8, 2.6 and 2.4 times higher for injury hospitalizations compared to controls for the Army, Navy, Marines, and Air Force, respectively.

Another study (187) examined attrition among those with an injury hospitalization within the first 6-months of service. Table 7 shows the results. Sprains and strains, open wounds, other injuries and dislocations accounted for the highest 6-month attrition. Other injuries, sprains and strains, and dislocations accounted for the highest attrition after 1 year. After controlling for gender, race, age, BMI, education and AFQT performance, 12-month attrition after injury hospitalization was low compared to hospitalization for mental illness and poisoning.

Table 7. Proportion (%) of Service Members Lost from Service (6-Month and 12-Month Attrition) After Hospitalization within the First Six Months of Service (From Reference 187) (Refer to Table 1 for baseline attrition)

Hospitalization Cause	Attrition (%)	
	6-Month	12-Month
Injury Hospitalization		
Sprains and Strains	33	45
Open Wound	33	38
Dislocation	29	43
Intracranial	22	32
Fracture	20	35
Internal Injury	20	30
Superficial Injury	14	22
Other Injury	30	47
Non-Injury Hospitalizations		
Poisoning and Toxic	66	70
Mental Health	89	91
Respiratory Illness	17	23
Other	25	31

e. Physical Activity and Physical Fitness

Physical fitness and physical activity have often been confused in the literature so a definition of these terms is an appropriate starting point. Physical activity can be defined as "any bodily movement that results in the expenditure of energy" (31). Physical fitness can be defined as "the ability to carry out daily tasks with vigor and alertness, without fatigue, and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies" (1). Physical activity of sufficient frequency, intensity and duration can improve physical fitness but physical activity is conceptually distinct from physical fitness. Physical activity is a behavior, fitness is a physical state produced by a particular type and amount of physical activity.

The major components of performance-related physical fitness include muscular strength, muscular endurance, cardiorespiratory endurance (aerobic capacity) and body composition. Most of these fitness components can be characterized behaviorally by types of physical activity performed, and physiologically by the energy systems used to fuel them. Muscle strength is the ability of a muscle group to exert a maximal force in a single voluntary contraction (e.g., manually lifting a box that contains as much weight as it is possible for an individual to handle). Energy is derived primarily from adenosine triphosphate (ATP) and creatine phosphate (CP) in the active muscles. Muscular endurance is the ability of a muscle group to repetitively perform short-term, high-power physical activity (e.g., manually lifting heavy boxes so that fatigue occurs in several seconds). Energy is derived primarily from glycogen in the active muscle. Cardiorespiratory endurance is the ability to sustain long-term, low-power physical activity (e.g., manually lifting boxes for several minutes or hours). Cardiorespiratory endurance depends on the functioning of the circulatory and respiratory systems and energy is primarily derived from carbohydrates and fats, some located in the active muscles, and some in other body locations (31,87,107). Body composition is an important component of fitness because muscle mass is highly correlated with absolute strength (112,113,169), power production (93), cardiorespiratory endurance (255), and the performance of many physical tasks (94,255). Individuals with more fat tend to have more difficultly performing certain tasks, especially those requiring weight bearing activity and cardiorespiratory endurance (47,255). "Physical Fitness and Military Bearing" has been identified as one of the 5 major military job performance criteria in the Army (258,268).

(1) Physical Activity

Despite differences among studies with regard to how physical activity is defined, the literature in unanimous in demonstrating low physical activity prior to service is associated with higher attrition in basic training. An early study noted that naval recruits who reported taking an active part in school sports were less likely to be discharged for unsuitability (197). Jones et al. (120) found that Army basic trainees who had not been physically active within 6 months of basic training were 3.6 (men) and 1.9 (women) times more likely to be discharged than those who were active in the 6 months before training. Snoddy and Henderson (238) noted that self-reported running and weight training in the 6 months before entry to service were associated with lower attrition in infantry basic training. Talcott et al. (244) administered a lifestyle and behavioral questionnaire to new Air Force recruits and found that recruits with low physical activity levels were 1.3-1.4 times more likely to be discharged than those with higher activity levels. In all Marine recruits reporting to boot camp from October 1995 to December 1997, Knox (145) found that individuals who reported running or jogging at least 3 times per week were much less likely to be discharged. The time prior to basic training that the exercise was performed was not specified in the article.

(2) Physical Fitness

The data on the association of fitness and attrition are not totally consistent. Some studies suggest that low physical fitness is associated with discharge but other investigations have found mixed results. It may be possible to resolve these differences.

There are 5 studies that show low fitness is associated with higher attrition in basic training. One study (133) found that men and women who scored at or below the 25th percentile on any of the APFT events at entry were 1.9 to 3.3 times more likely to be discharged than those scoring at or above the 75th percentile. A dose-repose was demonstrated such that progressively lower fitness levels were systematically associated with progressively higher discharge rates. Fitness was independently associated with discharge when race, educational level, marital status and injuries in basic training were considered in a multivariate analysis. An Australian study (205) demonstrated that the least aerobically fit basic trainees (based on a progressive 20-meter shuttle run) were about 6 times more likely to be discharged than trainees of average fitness. A study involving Army infantry basic trainees (238) showed that men with lower performance on any one of the three APFT events in infantry basic training were at 4.1 to 8.0 times higher risk of discharge. A study cited in a 1998 GAO report (77) indicated that those who failed the initial Marine physical fitness test were 1.8 times more likely to be discharged than those who passed the test (24% vs. 13%). Army basic training data from Ft Jackson South Carolina in 2003 shows that those who fail their first APFT were 2.2 times more likely to be discharged (7.3 vs. 3.3%) (Knapik, 2003, Unpublished data from Reference 135).

Not only is lower fitness on entry associated with higher attrition in basic training but Army trainees who have great difficulty achieving the basic training Army Physical Fitness Test (APFT) graduation standards have higher attrition later in service. One study (139) examined individuals who did not pass the APFT by the end of basic training and were sent to a special program where they worked exclusively on their fitness (the APFT Enhancement Program). The final graduation rates of these individuals were lower than recruits who graduated "on time". One-year attrition for men in this program was 26% compared to 8% for men who were not in the program; 1-year attrition for women in the program was 37% compared to 16% for women not in the program.

Three studies (32,148,245) on associations between attrition and fitness have found mixed results. In the first of these studies, Kowal et al. (148) examined the influence of a number of physical fitness factors (aerobic fitness, body composition, muscle strength) on discharges from basic training. The analysis of each fitness variable alone was not shown but discriminate function analysis indicated that for men, self perception of fitness (fitness rated on 5 point scale) distinguished between men who were and were not discharged. Self-perception of fitness, isometric trunk strength and isometric leg strength

discriminated between women who were and were not discharged. VO_2max, predicted from a progressive step test, did not independently discriminate between those discharged and those not discharged. It should be noted that discriminate function was not the most appropriate statistic to use to demonstrate associations with attrition. Epidemiologically-related tests of association like chi-squares, Fisher Exact Tests, or logistic regressions would have been more appropriate.

The second study showing mixed results was that of Tate (245). She examined the association of 6-month attrition with push-up performance for men; for women, attrition and an index composed of push-ups and flexed arm hang was studied, but it is not clear how this index was calculated. Unfortunately, other APFT measures were not investigated. For men, push-ups were associated with all separations from the Army but the strength of the relationship was considerably diminished when examining non-medial separations suggesting the association was stronger for medically-related separations. For women the push-ups/flexed arm hang index was not associated with 6-month attrition.

In the final study showing mixed results, Chin et al. (32) examined associations between attrition from Air Force basic training and passing the Air Force cycle ergometry test and/or two-mile run times. The Air Force cycle test estimated VO_2max on the basis of changes in heart rate to specific power outputs. Basic training attrition rate (which included discharges, medical holds and recycles) was 13%. Failure on the cycle test based on Air Force standards (indicative of very low fitness) was not related to attrition ($p=0.72$). However, secondary analysis indicated the small sample size (n=50 men and 50 women) and low attrition rate resulted in a statistical power of only 0.14. Chin et al. (32) also examined associations between attrition and two-mile run times. Those completing basic training had faster 2 mile run times than those not completing basic training (21.3±1.4 vs. 22.5±0.4 minutes) but the 1.2 minute difference was reported as not statistically significant. Risk of attrition based on specific run times were not calculated and could not be calculated from the data provided in the article.

The discrepancy between studies which do and do not show a relationship between fitness and attrition may be resolved by examining differences between performance tests and physiological tests. A performance test can be defined as an evaluation that requires a particular fitness component or a number of fitness components and is related to the accomplishment of a specific task under the volitional control of the individual (e.g., 2-mile run, push-up). A physiological test can be defined as one that measures a specific physiological capability or condition (VO_2max measuring cardiorespiratory endurance, or densiometry to measure body composition). The two studies that did not show a relationship between aerobic fitness and attrition used heart rate to predict aerobic capacity just prior to basic training (32,148). Heart rate can be elevated by stress,

especially early in new situations (88,162,243) and new trainees are under considerable initial stress in basic training (188). The bicycle test used by Chin et al. can generate higher heart rates among non-cyclists than field or treadmill tests at similar power outputs (11). An elevated heart rate at a set work load on predictive VO_2max tests is an indicator of lower fitness and thus if a new trainee has an elevated heart rate due to conditions other than his/her fitness level, that trainee may be incorrectly classified (32). Further, the use of heart rate to predict VO_2max can be subject to errors, as great as 30% among the very fit, probably due to the asymptotic nature of the relationship between heart rate and VO_2 (171). However, this may not be a problem where the goal is merely to determine whether or not the individual meets a minimum fitness level (191).

Most studies that have used performance tests of aerobic fitness or muscular strength/endurance (77,133,205,238, Knapik, Unpublished data) have demonstrated that those scoring higher have less attrition. The two exceptions (32,245) have methodological problems. One study had mixed results (245), but the performance test that did not show a relationship with attrition used an undefined index of push-ups and flexed arm hang. The Chin et al. study (32) reported that those who did not complete basic training ran a 2-mile distance 1.2 minutes slower than those who did complete basic training but they provided insufficient information to calculate risk of discharge based on lower fitness levels. Individuals who achieve high scores on performance tests of fitness may demonstrate both a higher level of physical capacity and a higher level of motivation. The higher fitness level eases their effort in performing physical tasks while their higher motivation helps them complete what they start. This may be a partial explanation of the association of fitness and attrition.

Many studies and reports have recommended that new recruits should have a physical fitness test prior to entry to basic training (74,77,103,238,249,256). A 1984 TRADOC-directed study group which was reviewing the Army Trainee Discharge Program (now called an Entry Level Separation) noted that many recruits arrived in poor physical condition and that this lack of physical conditioning was a major reason for discharges. They recommended a physical fitness prescreening in the MEPS (249). A 1999 report on basic training discharges noted that 26% of recruits given an entry level separation failed their first APFT and over 70% of these failed multiple events. APFT failure was among the 3 most common items found on counseling statements. Analogous to the requirement for educational and intelligence credentials required for service entry, the report recommended a fitness screening prior to service (256). A 1998 GAO report (77) indicated that service officials acknowledge that the poor physical condition of recruits contributes to attrition. The GAO recommended that the Secretary of Defense implement a policy of administering fitness tests to recruits before basic training and the Acting Assistant Secretary of Defense concurred with this recommendation. The Secretary noted that the Army was developing a physical training plan for DEP members as well as running shoe guidance and APFT standards. However, the Acting Assistant Secretary's reply

did not directly address the issue of pre-accession testing for physical fitness (77).

(3) Body Weight and Body Composition

Several studies have examined associations between attrition and various aspects of body weight or body composition (27,67,114,133,148,155,224). These findings should be considered in the context of current military screening for body weight. Individuals who desire entry into the services are screened by the use of specific charts that provide maximal weights for specific heights. Individuals with excessive weight for their height are tested for body fat and if estimated body fat is excessive they are not allowed to enter the services. Thus, service studies involve a population that has been pre-screened for excessive body weight and excessive estimated body fat.

Body weight in the upper 5th percentile increased 6-month attrition risk in the Army by 1.4 (men) or 1.5 (women) times and was independent of educational status, demographics, gender, AFQT category, and other factors. This may simply be associated with an inability to meet the Army height-weight standards later in training (67). Body mass index (which is a surrogate measure of body fat (132) was not found to be associated with basic training discharges in men, but women in the upper 25th percentile of BMI were 1.6 times more likely to be discharged than women in the lower 25th percentile (133). Jones et al. (120) also found that females in the upper 25% percentile of body fat were 1.6 times more likely to be discharged than those in the lower 25th percentile (no data was reported for men). Individuals who were discharged from Marine basic training were found to be heavier than those who graduated (164 vs. 152 lbs, $p<0.01$) (224). Kowal et al. (148) found that fat-free mass was one variable (among others) that discriminated between men who were and were not discharged in a multivatiate analysis.

Laurence and Ramsberger (155) performed an analysis of a modified TIER 2 educational category and performed a multivariate analysis of this cohort that included age, gender, marital status, AFQT category, educational status, race, dependents, waiver status, and BMI. They found that BMI was independently associated with higher attrition in the Army and Air Force, but not the Navy. In the Army, each unit change in BMI increased the odds of attrition by about 5%.

Jackson (114) performed a multivariate analysis of failure to meet the Marine Corps active duty weight standard on attrition from basic training and in the first term. He developed two multivariate logistic regression models that included AFQT category, educational TIER, age, training location, dependents, race, year of entry, enlistment program (air, ground, open contract), and whether or not the weight standard was met. The latter factor was found to be the variable that had the strongest association with basic training attrition and was also a strong independent predictor of first term attrition.

Buddin (27) examined BMI in men and women in the 4 military services. He showed that for men in all of the services, attrition increased as BMI increased above a value of about 27 kg/m^2. For Army men, those with BMI of 31 kg/m^2 had 3 times the attrition rates of those with BMI of 23 kg/m^2. For advanced training or while in the operational military, only Army men with higher BMI had higher attrition than Army men with lower BMI. BMI differences among women had little influence on attrition, possibly because BMI entry standards were much more restrictive than that of the men.

f. Other Risk Factors

(1) Military Occupational Specialty

Different MOSs or different groupings of MOSs have different attrition rates (26,66,167,228,247,258). Buddin (26) studied first-term post-training (basic and advanced training) male attrition in the Army and Air Force in a FY 1978 cohort. For the Army, attrition ranged from 5% for teletypewriters to 28% for combat engineers. For the Air Force, attrition ranged from 10% for radio communication/security to 45% for audiovisual services. After controlling for demographics, aptitude, duty location and career turbulence, MOS was found to be an independent predictor of attrition.

Finstuen and Alley (66) found 3-year Air Force attrition rates ranged from 3% (Flight Engineer) to 84% (Linguist/Interrogator) with an average of 36%. Personal characteristics resulted in higher multiple regression correlations with attrition (r=0.22) than MOS alone (r=0.15). Adding the MOS to personal characteristics minimally increased the correlation (r=0.25). The authors demonstrated that if they included the interaction effects of numerous personal characteristics and MOSs the correlation was highest (r=0.31). However, this analysis resulted in 5,208 independent variables that only added modestly to the prediction. Correlations were an inappropriate statistical test to use in this case; more appropriate would have been tests for dichotomous outcomes (chi-squares, logistic regression) that would distinguish between those who did and did not attrite.

Sealey (228) examined 4-year attrition across groups of Navy MOSs using a standard DOD 10 category classification system. Attrition rates varied from 28% to 39% for women and 24% to 33% for men (exclusive of the "non-occupational" category which included patients, prisoners, and personnel in training). The MOS category with the highest attrition for women was "Infantry/Gun Crew/Seamanship" and that for men was "Electrical/Mechanical Equipment Repairers".

Lukasiewicz (167) categorized U.S. Army MOS into Combat Arms and Non-Combat Arms. Combat Arms (comprising about 1/3 of all accessions) included

MOS relating to Aviation, Air Defense Artillery, Armor, Engineer, Field Artillery, Infantry, and Special Forces. Combat Arms MOSs overall tended to have lower basic and advanced training attrition rates than other Non-Combat Arms. However, when infantry MOSs were partitioned out, individuals in these MOSs tended to have slightly higher basic and advanced training attrition rates.

Thomas (247) examined time in service (up to 4 years) of non-high school graduates in selected Army MOSs representing Combat Arms, Combat Support, and Combat Service Support. Combat Arms (Infantryman, Artilleryman) had the longest time in service followed by Combat Service Support (Supply Specialist, Food Service Specialist), with Combat Support (Motor Transport Operator, Multichannel Communications Operator) having the highest attrition.

On the other hand, White et al. (258) found that Soldiers in combat MOSs had higher 3-year attrition than non-combat MOSs but it is not clear exactly which MOSs were included in this analysis. Also, Smith et al (236) noted that Army Soldiers that had a DOD occupational code of "combat" had higher attrition than the 5 other DOD occupational codes. Buddin (26) found that Soldiers with a DOD code of "Combat" had attrition rates 1.3-1.5 times higher than those in 4 other DOD occupational codes.

It is difficult to make generalizations about MOSs and attrition because different studies categorize MOSs differently and there are differences in jobs across the services. Physical hazards, environmental conditions, and the potential for employment outside the military are factors that may influence attrition differences among MOSs. Because direct combat-related MOS are less desirable, enlistment bonuses are more common in these specialties (167). The more arduous nature of direct combat work and the high probability of injury (129,216) may also influence attrition.

(2) Traditionality of MOS for Women

"Traditionality of MOS" indicates whether or not an MOS has been populated by women in the past. Ross et al. (220) examined the influence of traditionality of MOS on first-term female attrition in the Army in a 1976 cohort. An independent evaluation by the Army Deputy Chief of Staff for Personnel divided Army MOSs into 3 job traditionality categories: traditional, less traditional, and non-traditional. Ross et al. found that first-term female attrition increased from 37% to 43% to 47% in traditional, less traditional and non-traditional jobs, respectively. Male attrition rates did not differ across these categories. Women in non-traditional MOSs were 1.3 times more likely to leave service early than men in these same MOSs; in traditional MOSs women were only 1.1 times more likely to leave service early. Women in more traditional MOSs may have more role models and a more supportive social structure that has developed coping strategies and traditions over time.

In an examination of a FY 1986-90 cohort of male and female Sailors, Sealey (228) found that women in support/administration MOS were less likely to attrite over a 4-year period than women in other occupational categories. However, health care (another traditional MOS for women) had the fifth highest attrition rate out of 10 MOS ranking categories. One problem with this study was the broad categorization of MOS that may not have adequately reflected MOS traditionality. In the health care area for example, nursing would be considered a traditional MOS for women but corpsman may not.

(3) Differences among Services

Table 8 shows first-term attrition rates over an 11 year period from data assembled by the GAO (75). These data are consistent with other studies (25,60,70,172,252) indicating that attrition rates are lowest in the Air Force with mixed results for other services, depending on the year examined. This may suggest that over the long term, attrition rates are similar among the Army, Navy, and Marines. More recently, attrition rates in the Army and Navy seem highest (75). One study that examined 3-year attrition and separated the data by gender showed that the highest female attrition rates were in the Marines followed by the Army and then the Navy. In this same study, male attrition was similar for these three services (70).

Table 8. Attrition Rates for Active Duty Service Members (From Reference 75)

FY[a] of Enlistment	Army	Navy	Marines	Air Force	DOD
1985	30.5	30.6	33.7	24.6	29.6
1986	31.3	33.8	35.4	26.3	31.4
1987	31.4	31.5	33.0	25.3	30.5
1988	33.7	31.6	30.4	25.5	31.3
1989	35.3	34.0	32.7	30.1	33.7
1990	36.4	32.6	36.2	30.4	34.2
1991	36.8	30.5	34.2	31.7	33.6
1992	35.9	32.2	32.2	30.0	33.2
1993	39.3	35.8	31.5	32.5	35.8
1994	40.1	37.8	33.2	32.7	36.9
1995	39.0	39.6	33.2	31.9	36.8

[a]FY=Fiscal Year

Differential attrition rates between services may reflect different policies or different leadership styles within services (160). Alternatively, specific job characteristics within the services may affect attrition rates. The Marines, Army, and Navy may have more physically demanding jobs than the Air Force. Army Regulation 611-201 (9) rates the physical demands of each Army MOSs, placing them into one of five categories based on U.S. Department of Labor guidelines (9). Sixteen percent of entry-level Army MOS are classified in the "heavy" category (lift 100 lbs occasionally and 50 lbs frequently) and nearly 50% are rated "very heavy" (lifts *exceed* 100 lbs occasionally and 50 lbs frequently) (230). Of the 300 Air Force enlisted jobs, 1/2 have minimum physical demand ratings and only 13 jobs have what the Air Force considers high physical demands (100).

g. The Interaction of Attrition Risk Factors in an Operational Setting

Despite the requirements for more high school diploma holders, attrition did not decline and actually rose from 1985 to 1995 as noted earlier (60,76). Part of this may be due to the distribution of demographics in the population and offsetting policy decisions. For example, there have always been more high school graduates than non high school graduates and thus graduates account for a much greater part of the total attrition. Lower AFQT cut scores and moral waivers are more likely to be applied to high school graduates and these factors are known to increase attrition. Also it is possible that the relationship between the diploma and perseverance, discipline, and dependability has been diluted over the years as students move into the next grade despite problems and deficiencies that would have held them back in the past (social promotion) (160).

Elis (60) noted how the interaction of attrition risk factors over time can influence attrition rates. Between 1984 and 1994 the proportion of non-high school graduates/GED holders decreased by 3.1% and AFQT scores rose by 5.9 points. Based on these changes alone a 1.3% decrease in attrition should have occurred based on statistical modeling. However, in this same time there was an increase in the number of women recruited and time in the DEP decreased, both factors known to increase attrition.

h. Attributable Risk of Attrition in Relation to Fitness, Injury, and Educational Status

In an attempt to more fully explore associations between attrition, physical fitness, injury and educational status we calculated attributable risk of discharge from data in two studies (133,135). Attributable risk is that proportion of discharges that can be ascribed to a particular factor (116). For example, if we compare the most physically fit 25% of new recruits to the least fit 25% we can estimate the reduction in discharge risk if the least fit reached the level of the most fit. One weakness with this analysis is that the relationship has to be "causal" (low fitness has to cause higher discharge, not just be associated with it in some unspecified manner) and this has not been demonstrated for the risk factors we will discuss (2). However, this analysis can provide some insight into the relative strength of particular risk factors.

Tables 9 and 10 show the attributable risk of discharge for men and women, respectively, from one published BCT study (133); Tables 11 and 12 show the attributable risk for men and women, respectively, from another BCT study (135). For men, injury accounted for the largest proportion of the attrition risk. PUs, SUs and the 2-mile run also accounted for appreciable proportions of the attrition risk. Holding a GED (as opposed to a high school diploma) had attributable risk similar to that of the fitness measures. For women, more of the attrition risk could be attributed to the fitness measures, especially the 2-mile run,

than could be attributed to injury or the GED. This may not be surprising since women have less fitness relative to men and BCT will be more physically taxing for women.

Table 9. Attributable risk (AR) of Discharge by Selected Fitness Risk Factors for Men (From Reference Number 133)

Risk Factor	Relative Risk of Discharge (95% Confidence Interval)	Prevalence of Risk Factor Among Discharged	Attributable Risk of Discharge
Lowest performance quartile, first diagnostic APFT run (19.18-31.58 minutes/2 miles)	1.67 (1.07-2.62)	0.36	0.14
Lowest performance quartile, initial APFT push-ups (0-22 reps/2 minutes)	2.22 (1.46-3.37)	0.44	0.24
Lowest performance quartile, initial APFT sit-ups (0-32 reps/2 minutes)	1.84 (1.20-2.82)	0.41	0.19
Highest quartile of body mass index (26.81-38.12 m/kg^2)	1.02 (0.66-1.59)	0.26	0.01
General Educational Development (GED)	1.82 (1.16-2.86)	0.37	0.17
Injury (one or more) during basic training	3.30 (2.20-4.96)	0.66	0.46

Table 10. Attributable risk (AR) of Discharge by Selected Fitness Risk Factors for Women (From Reference Number 133)

Risk Factor	Relative Risk of Discharge (95% Confidence Interval)	Prevalence of Risk Factor Among Discharged	Attributable Risk of Discharge
Lowest performance quartile, initial APFT run (23.49-28.68 minutes/2 miles)	2.27 (1.49-3.46)	0.43	0.24
Lowest performance quartile, initial APFT push-ups (0-2 reps/2 minutes)	1.79 (1.16-2.76)	0.43	0.19
Lowest performance quartile, initial APFT sit-ups (0-22 reps/2 minutes)	1.70 (1.09-2.64)	0.37	0.15
Highest quartile of body mass index (25.02-33.21 m/kg^2)	1.55 (1.09-2.21)	0.34	0.12
General Educational Development (GED)	2.15 (1.27-3.64)	0.18	0.10
Injury (one or more) during basic training	1.17 (0.82-1.68)	0.67	0.10

Table 11 Attributable risk (AR) of Discharge by Selected Fitness Risk Factors for Men (Previously Unpublished Data From Reference Number 135)

Risk Factor	Relative Risk of Discharge (95% Confidence Interval)	Prevalence of Risk Factor Among Discharged	Attributable Risk of Discharge
Lowest performance quartile, first diagnostic APFT run (minutes/2 miles)	1.60	0.35	0.13
Lowest performance quartile, initial APFT push-ups (reps/2 minutes)	1.19	0.26	0.04
Lowest performance quartile, initial APFT sit-ups (reps/2 minutes)	1.25	0.29	0.06
Highest quartile of body mass index (m/kg^2)	1.44	0.32	0.10
Injury (one or more) during basic training	2.05	0.43	0.22

Table 12. Attributable risk (AR) of Discharge by Selected Fitness Risk Factors for Women (Previously Unpublished Data From Reference Number 135)

Risk Factor	Relative Risk of Discharge (95% Confidence Interval)	Prevalence of Risk Factor Among Discharged	Attributable Risk of Discharge
Lowest performance quartile, first diagnostic APFT run (minutes/2 miles)	2.10	0.41	0.21
Lowest performance quartile, initial APFT push-ups (reps/2 minutes)	1.42	0.32	0.09
Lowest performance quartile, initial APFT sit-ups (reps/2 minutes)	1.75	0.31	0.13
Highest quartile of body mass index (m/kg^2)	1.36	0.31	0.08
Injury (one or more) during basic training	1.30	0.57	0.14

5. STRATEGIES TO REDUCE ATTRITION

There are 2 major categories of attrition-reduction strategies that have been studied. One category involves prescreening of individuals before they enter service in order to select those most likely to succeed. Screening procedures that have been examined include the use of biographical questionnaires, compensatory screening, and psychiatric screening. Another approach provides special assistance or incentives to service members who are already in service. Assistance programs that have been examined include job previews, psychiatric counseling/stress management training, enlistment bonuses, educational opportunities, leadership initiatives, special remedial training, efforts to reduce injuries, and pre-basic training programs.

a. Biographical Questionnaires

Biographical surveys or biodata are self-reported personal information provided by individuals on questionnaires. Questionnaire responses are empirically linked to attrition. Items on biodata questionnaires might include demographics (education, age, race), self-history (family relations, prior job history), attitudes, behaviors (school behaviors, alcohol/drug use), temperaments, and other factors. Various biodata instruments may emphasize different types of items.

Biodata questionnaires tested in the military have well-established validity. The criterion-related validity correlation between attrition and biodata surveys are generally in the range of 0.30 (161). The reason biodata questionnaires have some validity in predicting attrition probably relates to content areas that are assessed. As noted above, some questionnaires contain items on demographics and other factors known to be associated with attrition. Some questionnaires sample particular attitudes or temperaments that may be less compatible with military service and individuals who have these attitudes or temperaments may be more likely to leave service early. Some biodata questionnaires tap into past behaviors and these may be predictive of future behavior. For example, an

individual who has had many job changes in the past may be likely to leave the military to change jobs; an individual who has had many arrests and traffic violations may be a discipline problem in the military and is likely to be discharged. The reasons individuals leave service is generally complex and multifactorial and biographical questions sample this multifactorial space (110,161,252)

(1) Concerns with the Use of Biographical Questionnaires

There are a number of concerns with the use of biodata that have been reviewed in several reports (161,251,252). These concerns include the empirical nature of the questionnaires, validity issues, reliability issues, and problems relating to coaching and faking.

The first concern is that biodata questionnaires are based on empirical relationships that do not always have a sound theoretical basis. The main approach for scoring biodata instruments is called "empirical scaling" in which individual items are weighted according to their ability to predict attrition. In developing biodata questionnaires, items are retained only if they increase the ability to predict attrition regardless of why or how they contribute to the prediction. Criticisms of the atheoretical empirical scaling approach has led to alternative scoring approaches (161) including rational scaling, factorial scaling, and subgrouping. In rational scaling, the behaviors involved in a job are determined and questionnaire items are developed that capture similar behaviors earlier in a person's life. In factorial scaling, questionnaires are subjected to factor analysis to see what constructs the questionnaire is measuring. In subgrouping, the factorial structure of the questionnaire is established, a profile is determined for each individual based on this factorial structure, then cluster analysis is used to identify subgroups with similar characteristics (182). Although one study showed that rational scaling and the factor analytic techniques have higher predictive ability, other studies have shown similar criterion-related validity for all techniques (110).

The second issue of concern with biodata is the reduction in validity with new samples and over time. As noted above, the correlation between attrition and biodata questionnaire scores is about 0.30 for military questionnaires that have been cross-validated (153,212). Similar results have been reported for other non-military questionnaires when predicting training success (53). However, cross-validation tends to lower the validity coefficient possibly due to chance relationships in the initial sample (161). Other factors that could influence validity are changes in the characteristics of potential recruits over time that are not fully understood (e.g., social promotion in high school, population movement from rural to urban centers, reduced physical activity in youth) that alter the relationship between the item responses and attrition. Changes in personnel policies and performance assessment criteria (e.g., reductions in force, changes in moral waiver policy, changes to the APFT, elimination of the

Skills Qualification Test) can also affect validity. To maintain stability over time it is necessary to reevaluate empirically-derived items and develop new items that measure similar constructs. Questionnaires developed using factorial scaling tend to be more stable over time than those derived using the empirical approach (182).

Test-retest reliability is a critical concern but it has not been examined very often. Reliabilities in military biodata studies have ranged from 0.3 to 0.8 with a median of about 0.70 (161,258). Other empirically-keyed questionnaires have reported test-retest reliabilities of 0.80 or higher while those using factorial scaling report somewhat higher reliability values (182).

Another issue is faking. Respondents can answer questionnaires in socially desirable ways or in ways more likely to allow them to achieve a specific objective (e.g., enter the military). Studies have shown that faking on biodata questionnaires was possible (15,109,264,265), but it is also possible to reduce the effects of faking (15,264). More objective and verifiable items were less amenable to faking and items faked in practice were less historical and more job related (15). Other techniques for minimizing faking include warning that items will be verified, the development of lie scales to detect inaccuracies in self reporting, and special scoring techniques (161,251,252,264).

A final issue is one of coaching. Once item responses more favorable to achieve an objective are known (e.g., enter the military) it may be possible to coach individuals on these favorable responses. The effects of recruiter coaching are a concern since recruiters have a vested interest in contracting high numbers of recruits (161,251,252).

(2) Biographical Data Studies in the Military

Published studies on biodata as a predictor of attrition in the military has a long history dating back to the 1960s and much of this history has been reviewed by Laurence (161). Plag (197) in 1962 reported on a 195-item questionnaire administered to Naval recruits. He showed that items relating to educational background/behaviors, age, and sports participation had the strongest relationship with unsuitability discharge in validation and cross-validation samples. In the 1970s and 1980s a number of questionnaires were developed with the goal of predicting attrition. These included work with the Life Path Questionnaire (81) and the Enlisted Profile and Early Experience Questionnaire (73). Instruments that were tested or implemented in operational settings included the Air Force History Opinion Inventory (HOI), the Navy Recruiting Background Questionnaire (RBQ), the Army Military Applicant Profile (MAP), the DOD Educational and Biographical Information Survey (EBIS), and the Armed Services Applicant Profile (ASAP) (161,241).

The original Air Force HOI was a 100-item true-false survey that covered school adjustment, family stability, social orientation, emotional stability, physical complaints, motivation and expectation for achievement, and response to authority (89,90,151,159). The HOI was tested on 15,252 Airmen in 1972 and it was shown that two scales had predictability for attrition from basic training. These scales were the Prediction of Emotional Instability and the Prediction of Drug Use Admission. A third scale called the Adaptation Index combined these 2 former scales. Correlations between undesirable discharges and the 3 indices ranged from 0.22 to 0.31(89). A follow-up of the 1972 cohort did not report the validity coefficient with first-term attrition alone but rather reported on HOI data with composites of other aptitude and demographic data. A combination of 122 variables from enlisted files and 64 items from the HOI produced a validity coefficient of 0.50 (90). In 1975, the HOI was reduced to 50 items and called the Military Service Inventory (MSI). The MSI was administered to all Air Force recruits when they arrived for basic training to assist in identifying individuals who may have problems adjusting to military life (79). In a subsequent study in 1977, the MSI was shown to be related to basic training attrition (159).

Development of the Navy RBQ began in 1975 with a 370-item questionnaire that was subsequently reduced to 2 alternative forms each containing 55 items. This survey covered school and work experiences, hobbies, interests and family history. The format was multiple choice with 3 to 5 response categories. The RBQ was administered to 15,430 Naval recruits in 1979 and 1980. Correlations with 6-month attrition ranged from 0.28 to 0.38 for male high school graduates, 0.17 to 0.21 for male non-high school graduates, 0.28 to 0.34 for minority samples, and 0.18 to 0.26 for women. The RBQ was combined with another screening instrument called the Success Chances for Recruits Entering the Navy (SCREEN) which used aptitude, education, and age to determine the odds of early Navy attrition. Validity coefficients for men rose from 0.28 with the SCREEN alone to 0.34 for the RBQ plus the SCREEN. It was estimated that the RBQ could reduce overall attrition by 1% to 1.5% (12,79,159).

The Army MAP was developed from work performed by the Army Research Institute during the Korean War and subsequent work on the Early Experience Questionnaire (57,73,159,252). The development of the MAP began in 1972 (79) with an initial version containing 240 items (251). A 60-item MAP was administered to 4,282 male recruits at Fort Dix, New Jersey, and Fort Sill, Oklahoma, during 1976-1977. The questionnaire consisted of items relating to family, academic and work experiences, athletic and physical competence, self confidence, and socialization. Neither race nor age interacted with the MAP X 6-month attrition relationship but educational status did. The MAP could much more effectively predict 6-month attrition among non-high school graduates (57). The MAP was used operationally beginning from 1979 to screen 17-year old male non-high school graduates and its use was continued into 1984 (79,159,251).

The DOD EBIS was a 34-item questionnaire that contained items related to educational credentials, high school behaviors and achievements, adjustment to the school environment, criminal offense data (traffic violations, arrests), alcohol and drug use, employment history, family background, and demographic data (177,241). It was administered to 40,000 recruits in 1983 and 6-month attrition was tracked (159). We could not locate the final studies on this instrument.

A 1982 GAO report supported the validity of biodata instruments and recommended the services consolidate their biodata instruments. Consolidation was recommended because of the cost savings and the efficiencies that could be obtained. The questionnaire could be updated as new knowledge developed in the biodata area and as the potential recruit population changed (79,252). An ad-hoc committee called the Adaptability Screening Group (ASG) reviewed the 3 questionnaires (HOI, RBQ, MAP) that were under development or in use at the time. Because of problems with the original sample used to develop the HOI (89,151), ASG did not consider the HOI items any further. The ASG took 360 questionnaire items from the RBQ and MAP added another 21 for an initial questionnaire to develop what was called the Armed Services Applicant Profile (ASAP). Reviews by outside agencies (for item sensitivity, bias reviews, intrusiveness, etc.) reduced the questionnaire to 206 items and further work reduced the questionnaire to 130 multiple choice items (252).

The ASAP asked questions related to educational achievement, arrests and youthful transgressions, family relations, work history, and drug and alcohol use (161). Two forms of the questionnaire were administered to 55,675 service members and they were tracked through their first 21 and 36 months of service. Based on this work, the questionnaire was reduced to 50 items (252). Factor analysis of two forms of the questionnaire showed that 13 or 14 components accounted for 43% to 44% of the variance in the questionnaire but 6 components accounted for 27% of the variance. These components were School Achievement (academic involvement/achievement, non-delinquency), Delinquency (drinking, smoking, police/arrest involvement), Work Ethic (employment status/duration/quality), Independence (age, independent friends, economic self-sufficiency, self-esteem, motivation), Social Adaptation (self-esteem, dominance, sociability, risk-taking, problem solving), and Physical Involvement (athletic activities/involvement, preference for white or blue collar work) (251). Individuals who completed their first term were compared to those who failed to complete their enlistment contracts for adverse reasons. The correlation between attrition and the ASAP was 0.29, compared to 0.20 for attrition and a high school diploma. A logistic regression model that included educational attainment, AFQT, and the ASAP was developed and the correlation with service completion was 0.29. Using this model, a cut score that would make 10% of service applicants ineligible would result in a correct classification of 78% of individuals (i.e., they would successfully complete their service), but 52% would be falsely rejected. Savings (1979 dollars assuming $18,400/recruit) would be $54 million annually. In 1989, a DOD committee postponed use of the

ASAP and DOD eventually declined operational implementation because of concerns with recruiter coaching, faking of answers, and changes in validity over time (251).

(3) Temperament Surveys

Some biodata instruments contain more items relating to individual dispositions and self-perception and may be termed temperament surveys. Early military temperament surveys were designed primarily for psychiatric screening. A100-item "personality inventory" was given to Army recruits by Danielson and Clark (49) and showed promise in that it correctly identified 63% of psychiatric discharges and 68% of other discharges. The Navy tested a 115-item yes-no questionnaire called the Recruit Temperament Survey (RTS) (24,106). A cluster of 17 RTS items, score on the Navy General Classification Test, score on a Mechanical Aptitude test, and expulsions or suspensions from school produced a criterion-related validity correlation of 0.50 with unsuitability attrition. The validity of the RTS alone was not reported.

An ambitious attempt at a temperament-type survey was the development of the Assessment of Background and Life Experiences (ABLE). Questionnaire development was begun in 1982 as a part of the Army's "Project A". ABLE attempted to measure job-related motivational constructs related to performance (262) but the relationship of the questionnaire to attrition was also examined. A 220-item questionnaire contained a total of 15 scales. The 11 content scales were Dominance (12 items), Energy Level (21 items), Self-Esteem (12 items), Work Orientation (19 items), Emotional Stability (17 items), Cooperativeness (18 items), Traditional Values (11 items), Nondelinquency (20 items), Conscientiousness (15 items), Internal Control (16 items) and Physical Condition (6 items). Four scales were designed to examine the quality of the responses and included Nonrandom Response (to detect random/careless answers by the use of obviously correct items, 8 items), Social Desirability (to detect attempts to "look good", 11 items), Poor Impression (to detect faking in an undesirable direction, 23 items), and Self-Knowledge (to assess how well respondent knows self, 11 items). A 199-item version of the ABLE was administered to 48,731 Army recruits in FY 1986 and FY 1987. It was found that the ABLE Emotional Stability scale was the best predictor of 1-year attrition while the Nondelinquency scale was the best predictor of 36-month attrition. Validity coefficients were not reported (258).

The 199-item ABLE was reduced to 70-items for operational use with a 50-item ASAP questionnaire. These 2 instruments were combined to form the Adaptability Screening Profile (ASP) (258). Factor analysis of the ABLE showed that the questionnaire could be reduced to 3 primary temperament domains characterized as Achievement (striving to competently complete work), Dependability (tendency for discipline and to obey and respect rules and regulations), and Adjustment (even and positive affect and perform well under

stress), with Social Desirability as a quality of response scale. The Achievement scale included many of the items included in the Dominance, Energy Level, Self-Esteem and Work Orientation scales. The Dependability scale included many items from Traditional Values, Nondelinquency and Conscientiousness scales. Adjustment included items from the Emotional Stability scale. Unfortunately, time limitations on administration of the test prohibited inclusion of the Internal Control, Cooperativeness, and Physical Condition scales. It was found that screening out the bottom 5% of ABLE scores would reduce attrition by 0.9% overall (i.e., if attrition was 12%, it could be reduced to 11%). Screening out non-high school diploma graduates could reduce attrition by 1.2% overall. ABLE had little overlap with cognitive aptitude and previous education demonstrating it was independently related to attrition (29,258). Despite positive findings, the ABLE and the ASAP were not operationally adopted because of concerns with coaching and faking. Subsequent research showed that individuals could raise their scores if they were told how to do so (259,262) and ABLE was not operationally implemented.

Efforts were made to create a faking resistant questionnaire that would measure similar job-related motivational constructs to ABLE. Beginning in 1993, ARI tested several versions of a new test called the Assessment of Individual Motivation (AIM) and created a final prototype in 1996 (262,263). The AIM measured 6 constructs: Achievement (tendency to strive for excellence in the completion of work-related tasks), Adjustment (tendency to have a positive effect, positive outlook on life, and feeling of self-control), Agreeableness (tendency to get along and work well with others), Dependability (tendency to respect and obey rules, regulations, and authority figures), Dominance (tendency to seek out and enjoy leadership positions), and Physical Conditioning (tendency to seek out and participate in physically demanding activities). The AIM also contained a quality of response scale for detecting inaccuracies due to intentional or unintentional attempts to distort answers. Each AIM item had 4 response categories and respondents are asked to state which of the 4 categories are most and least characteristic of themselves (259). Young et al. (262) evaluated the effectiveness of the AIM in predicting 3-month, 6-month, and 9-month attrition among 16,847 recruits at all 5 Army Reception Stations. Point-biserial correlations between the AIM score and the 3 attrition measures were -0.12, -0.14, and -0.15, respectively. This was a considerable improvement over TIER 1 status and AFQT category that had coefficients of -0.06 and -0.02, respectively. Thus, the AIM was twice as effective at predicting attrition as TIER 1 status alone. The authors did not provide a multivariate model that included AIM score, educational level and AFQT category. AIM scores were similar across gender and racial categories so that it had no adverse impact (262). It was demonstrated that the AIM was resistant to faking and was still related to basic training attrition even when recruits were told to fake scores (259,264).

(4) Biographical Questionnaire Items

Biographical questionnaires used in the military to predict attrition have included items related to educational achievement, school behaviors/attitudes, family relations, work history, status, arrests, alcohol/drug use, minor behaviors, self-perceptions, past behaviors, and attitudes about the military. Some questionnaires include temperament items. Laurence and Means (159) reviewed the relationship of these factors to attrition for 4 questionnaires that had been used in military settings. Where possible, they partitioned the data into high school graduates and non-graduates. Their results are shown in Table 13. There are problems with this analysis because of the different time periods over which attrition was examined. The HOI and the EBIS validated against 6-month attrition while the MSI and RBQ validation involved 36-month attrition.

Table 13 shows that the item type with the highest relationship to attrition across the questionnaires involves school behaviors and attitudes. Family-relation items and work-history items were also among those with a high relationship to attrition. Interestingly, alcohol/drug items, present only to any extent of the EBIS, had low criterion-related validity with high school graduates but high predictive ability with non-high school graduates.

Table 13. Relationship of Attrition[a] to Item Types on Four Biographical Questionnaires Used in Military Operational Settings (From Reference 159)

Item Type	HOI			MSI			RBQ		EBIS		
	Best Item (%)[a] HSG[b]	Best Item (%)[a] NHS[b]	# Items	Best Item (%)[a] HSG[b]	Best Item (%)[a] NHS[b]	# Items	Best Item (%)[a]	# Items	Best Item (%)[a] HSG[b]	Best Item (%)[a] NHS[b]	# Items
Educational Achievement	---	---	2	0.00	0.20	5	0.40	5	0.44	0.11	18
School Behaviors/Attitudes	0.50	0.38	12	0.58	0.50	12	0.33	12	0.42	0.13	31
Family Relations	0.40	0.20	5	0.25	0.00	8	---	4	0.00	0.33	12
Work History	---	---	3	---	---	1	0.40	5	0.00	0.43	17
Demographic Variables	---	---	0	---	---	1	---	3	0.14	0.14	7
Arrest Related	---	---	2	---	---	2	---	2	0.00	0.07	15
Alcohol/Drug Use	---	---	2	---	---	1	---	0	0.08	0.75	12
Minor Behaviors	---	---	1	---	---	2	---	2	0.17	---	6
Self-Perceptions	0.12	0.15	17	0.07	0.00	15	0.00	10	---	---	1
Past Behaviors	---	---	0	---	---	0	0.11	9	---	---	1
Military Attitudes	---	---	4	---	---	3	---	3	---	---	0
Total Items			48			50		50			120

[a]Probability that an item was among the top 1/5 of the items in terms of the criterion-related validity with attrition for each questionnaire. The number of items in the top 1/5 was 10 for HOI, 10 for MSI, 11 for RBQ and 24 for EBIS. Item types with fewer than 5 items were not evaluated.
[b]HSG=High School Graduate; NHS=Non-High School Graduate

(5) Recent Biographical Questionnaire Studies

There have been 3 biodata questionnaire studies published in the peer-reviewed medical literature in the last 5 years that relate to attrition. These studies are extremely useful because they provide the risk of attrition for specific questionnaire items that are not provided in most other biographical questionnaire studies cited above. The 3 studies are among the more recent ones and thus are testing more recent recruits (recruit characteristics may change over time). The questionnaires used in these studies include many medically-related items that are not included in other biodata instruments. For these reasons, these studies are reviewed in more detail. The results of these studies have also been included as they relate to specific risk factors above.

Talcott et al. (244) examined responses of 32,144 Air Force trainees to the Biographical Evaluation and Screening of Troops (BEST) questionnaire (3). The questionnaire was a routine inprocessing instrument used by the Air Force at Lackland Air Force Base. The study used data only from August 1995 to August 1996. Basic training attrition was separated into medical, psychiatric/behavioral, legal, and inadequate performance discharge categories. Logistic regression models were developed for each type of attrition (dependent variables) by first forcing into the model age, gender, race, educational level, and family income; by backward elimination variables related to component (active, reserves), substance abuse, risk taking, rebelliousness, physical activity, social support and Air Force career plans were then considered. For all discharge categories except inadequate performance, odds of discharge were increased with greater age, female gender, White ethnicity, self-forecast of a short military career, rebelliousness, and lower physical activity. An additional risk factor for medical discharge was a higher propensity to engage in risk taking. Additional risk factors for psychiatric/behavioral discharge were less education, lower family income, active duty component (compared to reserve or national guard), and fighting while drinking alcohol. Additional predictors of legal discharge included being a smoker, heavy alcohol intake, and fighting while drinking alcohol. Predictors of inadequate performance discharge included male gender, active duty status, self-rating of rebelliousness, and lower physical activity.

A Navy study (154) examined the responses of 66,690 Naval trainees to the Sailor Health Inventory Program (SHIP) questionnaire. The SHIP was routinely administered to recruits on arrival for training at Recruit Training Command, Great Lakes IL and the study used data from the 1997-1999 period. The SHIP questionnaire contained demographic questions followed by 191 items assessing medical and psychosocial variables (20). The authors report that exploratory univariate analysis was used to select 43 items for inclusion in further analysis but the criteria for this selection was not specified. A backward stepping logistic regression was used to identify independent risk factors for discharge. Since 40 variables entered the model, factor analysis was used to reduce the number of predictor variables. Factor analysis revealed 10 major factors that were labeled

Depression/Anxiety (12% of variance), Asthma Symptoms/Breathing Problems (5% of variance), Tobacco Use (4% of variance), Misconduct, Ear/Nose/Throat Problems, Bone or Joint Dysfunction, Headaches, Hospitalizations, Broken Bones, and Flat Feet (the latter 7 factors accounting for <4% of total variance). A 40-item SHIP composite score was derived using the questions with the highest multivariate odds ratios from logistic regression. The correlation of the 40- item SHIP composite with attrition was 0.32, significantly higher than attrition with educational credential (r=-0.11) or AFQT (r=-0.10). It is interesting that no demographic, educational, or AFQT factors were included in the 40-item SHIP composite.

Another study using the SHIP questionnaire (20) examined 1-year Naval attrition among the 66,690 recruits from the Larson et al. study (154) reviewed above. A backward stepping logistic regression was used to examine questions that best predicted overall attrition, medical attrition (which included attrition for low fitness), behavioral attrition (misconduct or substandard performance), sexual behavior attrition (homosexuality, sexual misconduct), and administrative attrition (fraudulent enlistment, hardship, other factors). Out of the 191 items, 39 were selected on the basis of at least 5% of the discharge group having the item. Four demographic items were also included (gender, ethnicity, education, age). The items most strongly associated with attrition in multivariate analysis are shown in Table 14. Item types that predominated included demographics (educational level, female gender), physical and mental health questions (shortness of breath, depression/excessive worry, recurrent back pain), and moral character items (suspended or expelled, arrested for a crime).

Table 14. Top 10 Questionnaire Items Most Strongly Associated with Adjusted Odds of 1-Year Attrition on SHIP Questionnaire (the first number is ranking of questionnaire item for the type of attrition in the column; the second number in parenthesis is the adjusted odds ratio)[a] (From Reference 20)

Questionnaire Item (Reference Group)[b]	Overall Attrition (rank(AOR[c]))	Medical Attrition (rank(AOR[c]))	Behavioral Attrition (rank(AOR[c]))	Administrative Attrition (rank(AOR[c]))
Educational Level (High School Graduate)	1 (1.9)		1 (2.0)	6 (1.7)
Shortness of Breath (No Shortness of Breath)	2 (1.8)	1 (2.5)	5 (1.5)	3 (1.8)
Suspended or Expelled (Not Suspended or Expelled)	3 (1.7)	8 (1.5)	2 (1.8)	5 (1.7)
Depression or Excessive Worry (No Depression or Excessive Worry)	4 (1.7)	9 (1.5)	5 (1.5)	1 (2.1)
Fainting or Dizziness (No Fainting or Dizziness)	5 (1.5)	6 (1.5)		3 (1.8)
Recurrent Back Pain (No Recurrent Back Pain)	6 (1.5)	4 (1.8)	8 (1.4)	
History of Broken Bones (No History of Broken Bones)	7 (1.5)	5 (1.6)	9 (1.4)	9 (1.5)
Arrested for Crime (Not Arrested for Crime)	8 (1.4)		3 (1.7)	
Female Gender (Male Gender)	8 (1.4)	2 (2.2)		2 (2.1)
Pressure or Pain in Chest (No Pressure or Pain in Chest)	10 (1.4)	6 (1.5)		6 (1.7)
Cigarette Smoking (No Cigarette Smoking)			4 (1.5)	
Hospitalized Overnight (Not Hospitalized Overnight)		3 (1.9)		
Allergies (No Allergies)		10 (1.4)		
Cut, Burned, Tattooed Self (Have Not Cut, Burned or Tattooed Self)			7 (1.4)	
Physical, Emotional, Sexual Abuse (No Physical, Emotional, Sexual Abuse)			10 (1.3)	
Past Counseling for Problems (No Past Counseling for Problems)				9 (1.5)
History of Learning Disability (No History of Learning Disabilities)				8 (1.5)

[a]Odds ratios are rounded to a single decimal in consonance with the rest of this report. The article provides 2 decimal points. If 2 separate items have the same rank in the table those 2 items had the same odds ratio in the article.
[b]Reference group is in parenthesis and has odds ratio=1.0.
[c]AOR=Adjusted Odds Ratio (from multivariate analysis)

b. Compensatory Screening

There have been several attempts to counterbalance personal characteristics that increase attrition with personal characteristics that favor retention in service. Mathematical models have been developed to determine the risk of attrition for individuals that have specific sets of personal characteristics. For example, a non-high school graduate in a high AFQT category who needs a moral waiver and participated in junior ROTC might have lower attrition risk than a non-high school graduate who does not need a moral waiver but has no junior ROTC experience. This approach can be termed compensatory screening—compensating high attrition risk characteristics with lower attrition risk characteristics. Compensatory screening depends on verifiable personal characteristics and thus avoids many of the potential self-reporting problems associated with biographical questionnaires. However, compensatory screening studies show that this approach tends to have lower criterion-related validity for attrition than biographical questionnaires.

Early Navy work on compensatory screening began with an analysis of data collected from Plag's studies of attrition (196,198,199). Plag's data was used to develop what was called the Odds for Effectiveness (OFE). Implemented by the Navy in 1973, the OFE was a actuarial table that determined the odds of a recruit's effective service based on AFQT score, years of school completion, school expulsions or suspensions, arrests and/or traffic violations (161,211). This was subsequently replaced by another tool called the Success Chances for Recruits Entering the Navy (SCREEN) which used aptitude, education, and age (12,161). Subsequent tools have included a device actually called the Compensatory Screening Model (CSM) and, most recently (begun in 1999), High Performance Predictor Profile (HP3) (86).

Studies on a Compensatory Screening Model (CSM) stemmed from congressional concerns that individuals who were non-high school diploma graduates were being unfairly discriminated in the military since many of them were successful. From existing data, several logistic regression models were developed to predict 2-year attrition. These models included ASAP scores, educational credentials, AFQT percentile, age group, service, and dependents. Race and gender could not be included because employment discrimination on these factors was not legal. The attrition validity coefficient was 0.24 for the equation that developed optimal regression weights. Concerns with coaching and faking on the ASAP led to an approach where the ASAP was not applied and only verifiable personal data was used. Without the ASAP score in the model the uncorrected validity coefficient was 0.17. For service-specific models, the highest predictive validities were for the Army and Navy (172).

Another study (71) examined the use of an alternate CSM for non-high school graduates. The final logistic regression model contained number of years of education completed, type of educational credential, age, AFQT category, employment status, military youth program participation, and moral waiver status. Employment data was missing in much of the analyzed sample and had to be simulated. The validity coefficient (2-year attrition in Sailors) was 0.12 which was higher than that for the AFQT and SCREEN which had coefficients of 0.08 and 0.05, respectively, in the same sample. It was also shown that the CSM had fewer false positives than the SCREEN. Application blanks were developed for recruiters so they could quickly determine the eligibility of recruits.

The CSM was implemented for operational use by the Navy in 1992 for TIER 2 and 3 applicants in AFQT categories I to IIIA. In 1994, the CSM model was modified to include AFQT score, age, years of education, and educational credential with less stringent criteria for military youth program participants and applicants who pass a recruiting commander's interview (155).

Trent and Devlin (253) performed further work with a CSM for non-high school graduates. Their final logistic regression model contained only

educational credential, years of education, AFQT category and age. The validity coefficient (2-year attrition in Sailors) was 0.12 and 0.13 (2 separate samples).

Golfin and Houch (86) examined the effectiveness of the HP3 screen for non-high school graduates. Implemented for operational use in 1999, screening variables included educational credential, years of education, AFQT category and age but also included employment history and character references. It was found that the CSM and the HP3 were very comparable in their ability to screen high risk non-high school graduates.

c. Psychiatric Screening

At the beginning of WWII, the U.S. Navy performed psychiatric screening at Naval and Marine recruit centers (210). The purpose was to identify recruits who had personality, character, or cognitive characteristics which might affect their adaptation to the military. This screening was done in two phases, both of which required the application of clinical judgment. The first phase included a questionnaire about social history and psychiatric symptoms, a physical examination, and a 2- to 3-minute interview. About 15 to 25% of incoming recruits were considered at risk and had follow-up consultation after a trial basic training period. About 3% to 6% developed emotional/adjustment problems resulting in a review by a board. These trainees were usually discharged (196,198,199,210).

The effectiveness of the 2- to 3-minute psychiatric interview in predicting attrition was tested in Naval recruits at San Diego CA, and Great Lakes IL, during 1960-1961 (211). In univariate analysis, Plag (196) found that the validity of the clinical evaluation in predicting 2-year attrition was no greater than prediction from educational level, age, or Navy General Classification Test Score. When the clinical evaluation was added to the other factors in a multivariate analysis it did not add to the predictive value. These results were supported in a follow-up study examining first-term attrition among Sailors (199). The clinical psychiatric rating was examined along with 20 other more easily obtained variables. It was found that education, the mechanical and arithmetic scales on the AFQT, expulsions from school and family stability independently contributed to the odds of first-term attrition; the psychiatric rating did not.

In a further study, Plag and Arthur (198) examined 134 recruits who were referred to the psychiatric discharge board for discharge in basic training. Rather than discharge these trainees, they were allowed to graduate and entered the fleet. They were compared to a group of controls matched on the basis of age, aptitude, education and other variables. It was found that 2.5 years after enlistment, 72% of the potential discharges were still on active duty compared to 86% of controls ($p=0.03$). While the efficacy of the psychiatric discharge program was validated, there were still many false positives.

d. Retaining Mild Asthmatics

A study (187) examined the Navy recruits at Great Lakes Training Center who were diagnosed with symptoms of mild asthma and were retained on service. Those with moderate or severe asthma were discharged. In a 9-month period (up to April 2001), 66 recruits with mild asthma were matched to 196 controls (matching criteria not specified). As of December 2001, 52% of the mild asthmatics and 16% of the controls had left the Navy. Two asthmatic cases (3.0%) and 5 controls (2.6%) were hospitalized during the study. Results were considered favorable since almost ½ of the mild asthmatics were still in service with low risk of hospitalization.

e. Psychological Counseling and Stress Management Training

Individuals entering the services face a number of physical, emotional and cognitive challenges (143,188). Basic training introduces a whole new set of rules and regulations and recruits must quickly adapt or suffer adverse consequences. Personal freedom and individuality is lost and recruits have no identity other than that established through performance and conformity. Social support systems such as friends and family are no longer available and new relationships must be established (188). As noted above, there are individuals that have problems adjusting to these conditions and who may develop mental health problems that result in discharge from service (34,62,239). It is possible that counseling and/or the teaching of stress management skills designed specifically for basic training might reduce attrition among those having the most difficulty in adjusting. Several studies have examined the effectiveness of such programs in reducing attrition.

Georgoulalis et al. (82) identified 269 new Army recruits at Ft Knox Kentucky, who were classified as vulnerable to attrition on the basis of responses to questionnaires. These recruits were divided into 2 groups, an Early Intervention (EI) group and Control (C) Group. The EI group received one-on-one counseling through the Community Mental Health Activity the first day they were assigned to their units. The C group received no such counseling but trainees in either group could receive counseling through normal command channels. There was no difference between groups for non-completion of basic training (EI=18%, C=15%, $p=0.61$). Among the entire cohort classified as vulnerable to attrition, individuals who were counseled at any time during basic training were less likely to be discharged than those who were not counseled (17% vs. 40%, $p<0.01$).

Another study (185) reports on Israeli trainees that were successfully treated with behavioral-cognitive therapy. The therapy involved 1) desensitization through gradual exposure to anxiety-producing events, 2) cognitive change through the identification of anxiety-producing beliefs and their replacement with more adaptive thoughts and, 3) acquiring coping skills. Three

successful case studies were presented but all required highly individualized interactions between therapist and patient. The time-consuming nature of interaction may limit usefulness of this technique in basic training.

Cigrang et al. (35) examined the effectiveness of a stress management class designed for Air Force recruits who had been referred to the mental health clinic for psychological evaluation and who were recommended for return to duty. The class participants (n=94) and non-participants (n=84) had similar demographics and psychiatric diagnoses (most were adjustment disorders). Participants were enrolled in two, 90-minute classes. The classes were highly interactive and covered relaxation training (deep breathing, progressive muscle relaxation), problem solving, and development of "self-talk" techniques. One or 2 additional trainees who were coping very well with the military were assigned to assist and serve as role models. Due to training conflicts only 59% of trainees attended both classes; 87% attended one session. Graduation rates did not differ for participants and non-participants (participants 52%, controls 58%, p=0.41). The relationship between the number of classes attended (regardless of group) and graduation was also not significant (p=0.51). The authors noted that the majority of referred Soldiers are pessimistic about completing training and the literature on dispositional optimism/pessimism suggests that this leads to disengagement and giving up on goal achievement. Thus, a class that focuses on coping skills may have a low probability of success. In another article (33), these same authors note that the socializing effect of interacting with other low motivational trainees who were focused on discharge may have an adverse effect on programs of this type.

These studies suggest that one-on-one sessions with behavioral specialists may reduce attrition in early military training. However, large classes that do not provide therapy for individual problems do not appear to be effective.

f. Realistic Job Previews

Unrealistic expectations that recruits have about the military could lead to early disenchantment and efforts to leave the military (84). In an effort to provide a more realistic picture of the basic training experience, several studies have examined the efficacy of providing realistic job previews (RJP). RJP are films that are designed to provide recruits a balanced picture of the positive and/or negative aspects of the military training and operations. Some RJP also provide trainees with information on how to react to specific training experiences (23). Information on how to react to specific situations may be helpful because repeated inappropriate/inadequate responses to training situations could result in feelings of failure and lowered self-esteem that could influence motivation to continue in the military.

Brose (23) reviewed the results of 3 meta-analysis studies that used similar methods to determine the effectiveness of RJP in a wide variety of environments.

These studies indicate that RJP lowered attrition rates by 6% to 24%. The reduction in attrition was greatest for jobs with high attrition. The increase in retention was 6%, 12%, and 24%, for low, medium, and high attrition jobs, respectively. This suggests that RJP may be most effective where they are needed most – in jobs with high turnovers.

There are 3 studies that have examined the effects of RJP on attrition in military basic training. In one study (108,181) the research team developed an 80-min film that was based on interviews and training experiences of over 300 trainees and training personnel. It emphasized types of training perceived to be the greatest cause of concern among recruits. It considered experiences that recruits said they wished they had known more about before they entered training. Advice was given on how to react to particular situations and how to approach training. A study was conducted in which a total of 678 Marine recruits were separated into groups that either watched the specially developed film, watched another series of films, or viewed no film at all. The other series of films were 3 traditional Marine Corps recruiting videos. The experiment was carried out within 2 days of recruit arrival at Parris Island, South Carolina. Those viewing the film tended to have lower 3-month basic training attrition compared to control groups (10% vs 15%, $p=0.08$). Six and 12-month attrition was also lower in the group viewing the film (6 month - 15% vs 24%, $p=0.01$; 12-month – 22% vs 33%, $p<0.01$)[a].

Githens and Zalinski (83) examined platoons of Marine recruits who viewed films when they arrived for training at San Diego. One film provided a realistic preview of initial training. This was the same film as the study above (181). The other film was professionally designed to prepare recruits for training by providing them specific techniques for coping with stress. Four groups (each consisting of about 20 platoons of about 81 men each) were tested: RJP film, coping film, both films, and no films. Basic training attrition was 12%, 10%, 12%, and 11%, respectively, and not different among groups ($p=0.48$).

A final study (178) developed two types of RJP for basic training. One type (reduction preview) was designed to reduce overly optimistic expectations by presenting unanticipated problems and difficulties. The other type (enhancement preview) was designed to dispel negative impressions and emphasized that the largest basic training challenge was not the training events, but rather the psychological aspects (adjustment to Army life, lack of privacy, authority, orders). There were 533 trainees in 4 companies that were divided into 4 groups. The groups received either the reduction preview, the enhancement preview, both previews, or no previews before basic training. The groups were similar on demographic measures known to influence attrition rates such as age, race, AFQT score, and educational attainment but the reduction group had more women. Turnover rates (this is assumed to be discharge rate but it was not defined as such in the study) were 13.2%, 5.3%, 2.5%, and 7.8% for the

[a] Data were reanalyzed using chi-square without Yates correction

reduction, enhancement, enhancement/reduction, and control groups, respectively. The previews were more effective among trainees in the upper 50th percentile of AFQT scores or those more committed to the Army (measured with a standard organizational commitment questionnaire). The higher proportion of women in the reduction group could explain the higher turnover in this group since women have higher basic training attrition (133,244).

Despite the one negative study (83), RJP show promise with regard to the reduction of attrition. The films are easy to administer and most of the cost is in the upfront expense of production. One problem with the military studies cited above is that trainees viewed the films after they had already signed their enlistment contract and were committed to the military. Films may still be effective at this point because identification of difficult aspects of training may help trainees recognize areas of concern and mentally prepare for these. Coping skills suggested in some RJP may be used by some recruits. But, it may be most effective to provide a RJP in the DEP (23). Viewing the film in the DEP may result in more DEP attrition but it is more desirable to lose a person at this point because of the lower cost compared to later points in the accessions process.

g. Leadership Attitudes, Beliefs and Policy

It is reasonable to assume that the policies, attitudes, and beliefs of commanders, officers, and senior enlisted service members will affect attrition. These individuals either make the final separation decisions or influence those decisions. A 1975 report on the Army Trainee Discharge Program (now called an entry level separation discharge) found that many basic training company commanders were willing to provide a discharge to every trainee who wanted one (14).

Sarason et al. (224) examined Marine basic training platoons with high, medium and low attrition. There were no platoon differences on demographics, aptitude, or performance (rifle marksmanship, physical fitness changes, oral and written tests). However, drill sergeant attitudes differed among platoons. In lower attrition platoons drill sergeants believed they had more influence on attrition rates, felt there were fewer differences between summer and winter recruits, and that given a chance to leave, recruits would chose to persevere and stay in training. In high attrition platoons drill sergeants thought they had less influence on attrition, felt summer recruits were superior to winter recruits, and that recruits would choose to leave basic training if given a chance. The authors conclude that differences in drill sergeants' attitudes, beliefs, and expectations influence attrition rates more than other factors. The authors note that it is useful to think of basic training as a social environment in which the drill sergeants' attitudes and beliefs are transmitted to the recruits. These attitudes and beliefs influence recruits' self-confidence, commitment and motivation. A specific

socialization plan for Army basic training has been outlined by a previous battalion commander (99).

Besides attitudes and beliefs, quantitative data show how leadership policies can influence attrition rates. One study (256) examined entry level separations in 1997 and 1998 at 4 Army posts. Table 15 contains their findings. It can be seen that from 1997 to 1998 basic training entry level separations more than doubled at Fort Jackson while entry-level separations at 3 other Army basic training sites increased only slightly. Entry level separations *after* basic training at Ft Jackson also increased from 1997 to 1998. Not stated in the article was the fact that during the 1998 period, senior command policy at Fort Jackson was to discharge any individual who desired a discharge (personal communication, LTC Robert Redfren).

Table 15. Entry Level Separation Discharges (%) at Four Army Training Post During 1997 and 1998 (from Reference 256)

Post	Basic Training		Advanced Training [a]	
	1997	1998	1997	1998
Ft Jackson, SC	5.0	11.9	2.4	3.6
Ft Benning, GA	6.6	8.2	0.0	0.2
Ft Knox, KY	4.2	4.7	1.4	1.2
Ft Wood, MO	4.7	5.9	1.2	1.0

[a]The time period after basic training was not clear but the authors refer to the end of Initial Entry Training so this time period was assumed to be advanced training. It was not clear how basic and advanced training were separated out for units performing One-Station Unit Training. The authors note that the average number of days successful trainees spent on post was 162 for Ft Jackson, 114 for Ft Benning, 135 for Ft Knox, and 130 for Ft Leonard Wood.

Besides increasing discharge rates, leadership policy can influence attrition in the opposite direction, a reduction in basic training attrition. In the first 8 weeks of FY 1984, the entry level separation rate from Army basic training was 8.2%. Noting this increase in attrition, the Commander of the Army Training and Doctrine Command stressed the need to reduce attrition during FY 1985. In FY 1985 entry level separations decreased to 3.5%. EPTS rates rose slightly from FY 1984 to FY 1985 but figures were not provided in the article (245).

Quester (208) reported on attrition during a major policy change. From FY 1979 to FY 1985 6-month attrition rates for high school graduates from Naval basic training ranged from 8% to 10%. In FY 1986, attrition rose to 12%, and by FY 1987 it was up to 14%. In late 1989, initiatives were undertaken by Vice Admiral Boorda to reduce attrition. These initiatives included a moratorium on discharges for the first 3 weeks of training and specific numeric goals for attrition at 3 Naval basic training locations at the time. Overall attrition was reduced to 8% in 1990 and 1991. In 1992 many of the restrictions placed by Vice Admiral Boorda on basic training were no longer followed. From 1993 to 1997 overall basic training attrition rose to about 14% and in 1998 it was 16%.

One concern with senior leadership initiatives to reduce basic training attrition is how this will influence attrition later in the service. It is possible that some training cadre are better at identifying recruits who are not suitable for military service and these cadre efficiently discharge these trainees early in training. A senior leadership policy that limits discharges in basic training might

pass on marginal individuals who would be discharged later in service. Several studies indicate that this in not the case. When basic training attrition was reduced by senior leadership initiatives later attrition was not different or was actually lower.

Quester (208) followed 33-month attrition for the 1990-1991 cohort when Vice Admiral Boorda's restrictions (cited above) were in place. The decreased basic training attrition in 1990 and 1991 was not associated with higher 33-month attrition in the fleet in FY 1990-91; fleet attrition did not change. As attrition rose in basic training from 1992 to 1995 so did 33-month fleet attrition suggesting that high attrition in basic training was associated with higher attrition later in operational units.

Another study (56) in the 1976-1978 period examined Army basic training attrition before and after a policy calling for a reduction in entry level separations was instituted by the Infantry Brigade Commander at Ft Benning, Georgia. Entry level separations declined from about 7% to about 3.5% in the time the brigade commander's policy was in place. A graphic presentation of the data showed that when discharges were elevated in basic training (prior to the brigade commander's policy), they were also elevated in advanced training and later in the operational Army. When discharges were reduced in basic training (after the brigade commander's policy) they were also reduced in advanced training and later in the operational Army. The correlation between basic training and advanced training attrition was 0.78; the correlation between basic training attrition and the first 90 days in a line unit was 0.59.

In a related study, Novaco et al. (188) showed that Marine cohorts having high basic training attrition continue to have higher attrition later in service. A total of 15 platoons were tracked during basic training and beyond. Demographic, aptitude, and personality factors were similar among the platoons at the start of training. The 2 platoons with the lowest basic training attrition had 2-year post-basic training attrition of 18% and 16%. The 2 platoons with the highest attrition rates had 2-year post-basic training attrition of 49% and 33%.

Taken together these studies suggest that basic training attrition-reduction policies on the part of senior leadership can have dramatic longitudinal effects. It does not appear that policy changes aimed at reducing basic training attrition negatively influences later attrition. On the contrary, it appears that efforts to reduce basic training attrition can reduce attrition later in service, although why this is the case is not clear. It may be that the basic training environment effects future adjustment such that a more positive basic training experience translates to better future adjustment and vice versa. When attrition is reduced by senior leadership initiatives marginal recruits may be provided with more time to successfully adjust to the military environment.

h. Service Member Remedial Programs

Service member remedial programs are special courses put in place to help service members that are having specific problems. Most of the programs reviewed here are those assisting recruits in basic and advanced training.

(1) Overview of Basic and Advanced Training Remedial Programs

The Army has the largest number of remedial programs. These include the Fitness Assessment Program (FAP), Army Physical Fitness Test Enhancement Program (APFTEP), Physical Training and Rehabilitation Program (PTRP), the Basic Rifle Marksmanship Enhancement Program (BRMEP), English-As-A-Second-Language Program (ESL), Functional Academic Skills Training Program (FAST), "Think-It-Over" Program (TIO), Prepare-to-Train (PTT) Course, and the See-It-Through Program (SIT).

The FAP involves a physical fitness test that all trainees take when they first arrive for training. Recruits who pass the test go on to basic training while those that fail are given up to 3 weeks of physical training before they enter basic training. The APFTEP is for trainees who complete all basic training requirements but cannot pass the APFT at the end of basic training. They are given up to 3 weeks of special physical training emphasizing the APFT events for which they have problems and they are given additional opportunities to pass the test. The PTRP is for trainees who are injured or ill to the extent that they cannot continue in basic training. They are put into a special unit under the direction of a physical therapist where they can recover from their injuries and be rehabilitated (76,96,97,134,135,139). The BRMEP takes recruits who have not qualified with the M-16 rifle by the end of basic training and provides them with additional one-on-one training to assist them in qualifying with the weapon.

The ESL program is a course given to trainees who may have problems with the English language. It consists of general English, acronyms, and military terms for those who do not have English as their first language. The FAST program provides enlisted Soldiers with basic academic competencies necessary to improve military skills (76, and personal communications with basic training personnel).

The TIO program is for recruits who are having second thoughts about their decision to join the Army shortly after arrival at the reception station. The PTT course is primarily given to trainees with AFQT scores below 90 and consists of classes and a computer program helping trainees with psychosocial adaptations to training. The SIT program is applied to basic trainees that are having major discipline or motivational problems in basic training. Trainees are removed from their training company and put in a special company that provides counseling and motivation and a final chance before they are discharged.

The Navy has 6 remedial programs including: 1) a PT-O program for recruits that have initial physical fitness problems, 2) a Physical Training Unit to assist trainees that cannot pass their final physical fitness test, 3) a 3- to 4-week Fundamental Applied Skills Training Course designed to improve academic skills, 4) a 1-week Personal Applied Skills Streaming designed for recruits with anger, motivational, or other behavioral problems, 5) a 1-week Academic Capacity Enhancement Program to improve academic skills, and 6) a Battle Stations Remedial Unit for recruits that have difficulty with the final Navy basic training exercise, The Navy also rewrote the training schedule to reduce recruit running and marching in order to reduce training-related injuries (76).

Marines have a week long remedial program for recruits having trouble with marksmanship qualification and a physical training program for recruits who are low fit on arrival for basic training. Parris Island and San Diego Marine Recruit Depots also developed a Sports Medicine and Rehabilitation Therapy (SMART) Center to more effectively rehabilitate injured recruits (55,76).

The Air Force added a central physical therapy clinic closer to the training area. Emphasis was put on rehabilitating rather than discharging trainees (76).

(2) Association of Remedial Programs and Overall Attrition

Data from Fort Jackson, South Carolina indicate that since remedial programs were initiated in 1998, basic training attrition has declined. Basic training attrition was 18%, 15% and 14% in FY 1998, FY 1999, and FY 2000, respectively. In FY 1999, 7,612 recruits were placed into these programs and 68% successfully completed them. The Navy has not collected overall information on the effectiveness of their programs, but has reported that after the new physical training schedule was introduced, stress fracture rates declined from 3.5/1000 recruits (FY 1998) to 0.5/1000 recruits (FY 1999). Marines reported that attrition due to lower extremity problems decreased by 10% in the first 6 months after the SMART Center was opened at Parris Island, South Carolina. The Marines reported that overall basic training attrition declined from 18% in FY 1998 to 12% in FY 1999. The Air Force reported that separations for medical reasons were reduced by about half from FY 1998 to FY 1999 (75). Factors other than remedial programs are likely to account for some of these attrition reductions.

(3) Improving Physical Fitness before Basic Training

In October 1999, fitness standards for entry to basic training were mandated by the Army Training and Doctrine Command for all 5 locations where Army basic training was conducted (246). When new recruits arrive at an Army Reception Station they take the Reception Station Physical Fitness Test. Those passing this screening test go on to basic training. Those who fail the test do not enter basic training but rather enter the FAP where they physically train until they

can pass the test. The FAP in one form or another has been in place at Fort Jackson, South Carolina, since 1987. Prior to 1998 the only criterion to enter basic training was ≥1 push-ups (PU) for women and ≥13 PUs for men. In October 1998, the test was changed to a 3 event evaluation that included PUs, sit-ups (SUs), and a 1-mile run and this is now the test that is administered Army-wide.

The fitness criteria for entry to Army basic training from 1999 to 2004 are shown in Table 16. The tests were administered in the order shown. For all 3 test events, the recruit only had to meet, not exceed, the requirement. For example, when a male recruit successfully completed 13 PUs, the event was ended and the recruit had passed that event. Recruits were tested in large groups with Reception Station drill sergeants administering the tests. A drill sergeant read detailed instructions on how to perform the tests from Army Field Manual (FM) 21-20 (194). A drill sergeant monitored the performance of each trainee on the PUs and SUs. If a recruit failed the PU on the first attempt, they were sent to a station where they were given specific, individualized instruction on how to perform a correct PU and a second attempt was allowed. Only one attempt was allowed for the SU and the 1-mile run. For the 1-mile run, recruits were provided a "pacer" who runs at the exact pace required to pass the test. In addition, "chasers" attempted to motivate recruits who fall behind the pacer and remind recruits where the pacer was located.

Table 16. Fitness Criteria to Enter Army Basic Training

Event	Men	Women
PUs (repetitions)	13	3
SUs (repetitions)	17	17
One-Mile Run (minutes)	8.5	10.5

If a recruit failed to meet the criterion on any single event in the test, they enter the FAP. In the FAP recruits performed a specific physical training program, which included running, weight training, PU and SU improvement, road marching, and stretching. They also participated in military training such as customs and courtesies, drill and ceremony, wearing of the uniform, Uniformed Code of Military Justice, and Army values. New tests were given twice a week and once the trainee passed the test they move on to basic training.

The proportion of trainees entering the FAP has declined since 1998. Table 17 shows the proportion of trainees failing each event of the test from January to August 1998 obtained from the FAP orderly room in 1998 (134). Table 18 shows more recent data on the proportion of trainees who failed the test obtained from the Reception Station Plans, Training and Operations Office (S-3). It is not clear why the proportion of trainees who fail the test have declined. Some administrative changes that may account for the decline include the introduction of the chasers and pacers, running of men and women together (they previously ran at separate times), and a stronger verbal emphasis to the trainees on the consequences of not passing the test.

Table 17. Proportion of Trainees Failing Each Event on the Reception Station Physical Fitness Test from January to August 1998

Event	Men (%)	Women (%)
PU	3.6	13.8
SU	1.7	7.7
1-Mile Run	3.1	8.8
Any Event	6.9	23.9

Table 18. Proportion of Trainees Failing Any Event on the Reception Station Physical Fitness Test, 2000-2002.

Year	Men	Women
2000	4.3	12.2
2001	4.4	12.7
2002	5.4	14.8
2003	3.9	10.1

Three studies have examined the effectiveness of pre-conditioning physical training programs on injuries in basic training. One investigation (54) found similar discharge rates among trainees coming from the FAP and those that did not enter the FAP. This study was conducted in 1989 when only the PU criterion was in place.

Another investigation (134) examined basic training attrition among recruits after the 3 event test was in place. A group who failed the Reception Station Physical Fitness Test, trained in the FAP (FAP group) and then entered basic training was compared to a group who passed the test and directly entered basic training (Not-FAP group). On entry to basic training, FAP women had similar 2-mile run times compared to Not-FAP women (21.6 vs. 21.5 min, respectively, $p=0.86$). FAP men were considerably slower on the 2-mile run than Not-FAP men (20.3 vs. 17.3 min, $p<0.01$). FAP and Not-FAP women had similar attrition but FAP men had higher attrition than Not-FAP men.

The most recent investigation (135) examined 3 groups of trainees: 1) recruits who passed the Reception Station Fitness Test were designated the No Need of Pre-Conditioning (NNPC) group; 2) recruits who failed the test, entered the FAP, and later entered basic training were designated the Pre-Conditioning (PC) group; 3) trainees who failed the test but entered basic training without going into the FAP were designated the No Pre-Conditioning (NPC) group. The proportion of NNPC, PC and NPC groups who were discharged were 7%, 6%, and 19%, respectively ($p=0.03$), for men, and 12%, 12%, and 22%, respectively for women ($p=0.04$). When individuals who were discharged within the FAP (i.e., those that never made it into basic training) were included, these numbers were 7%, 11%, and 19%, respectively, for men, and 12%, 22%, and 22%, respectively, for women (note that only the PC group numbers changed because only PC trainees could be discharged from the FAP). These data suggest that while trainees in the FAP have lower attrition in basic training, overall attrition (FAP plus basic training) is similar, although still somewhat lower than for individuals who do not go to the FAP. These studies indicate that the FAP removes low fit trainees who are likely to attrite early in the training process. Further studies are necessary to examine if attrition can be reduced by increasing fitness to higher levels than is currently achieved in the FAP.

(4) Army Physical Fitness Test Enhancement Program

During Army basic training, recruits generally take an Army Physical Fitness Test (APFT) at Week 7 of the 9-week basic training cycle. The Week 7 test is considered the final APFT and is the one trainees have to "pass" to meet a mandated basic training graduation requirement. To "pass" the APFT, all trainees are required to meet certain age and gender adjusted criteria. These criteria involve obtaining a minimum of 50 age- and gender-adjusted "points" on each test event (push-ups, sit-ups and 2-mile run) (194). Trainees who fail to pass the final APFT at Week 7 are allowed to retake the test up to the date of graduation and there is no limit on the number of retakes, at the drill sergeant's discretion. Trainees who failed to meet the passing criteria after all retakes are considered APFT failures. Prior to 1988, Soldiers who could not pass the APFT could be sent to a new unit if that recruit was close to passing the test or be discharged if the commander was convinced the recruit could not pass the test. In 1998 the APFTEP was initiated and final APFT failures were sent there. In the APFTEP, trainees physically trained with emphasis on the events with which they are having problems. They took the APFT once a week and were allowed up to 3 weeks of training in the APFTEP. They either passed the APFT within this time or they were discharged.

In FY 1999, 81% of trainees who entered this program (472/586) successfully graduated from basic training (133). The latest data obtained directly from the APFTEP at Ft Jackson (CPT William Bryant, personal communication) indicate that 76% of those entering the APFTEP (299/395) successfully completed the program in FY 2003. In the first quarter of FY 2004 the successful completion rate was 88%.

One study (139) demonstrated that trainees who entered the APFTEP had slightly lower overall basic training graduation rates than those who did not have to enter the program because they passed the final APFT. Graduation rates (January 1999 to June 2001) for APFTEP personnel men and women were 85% and 80%, respectively, while graduation rates for those that passed the APFT during the normal basic training cycle in this same time were 93% and 87%, respectively. This lower graduation rate for APFTEP personnel would be expected because some of these trainees would have difficulty passing the test even after intensive training, presumably because of a genetic predisposition to low trainability (21,122,192,206), or due to lower motivation. One-year attrition rates were 1.2 (men) and 1.3 (women) times higher in APFTEP graduates compared to individuals who did not have to enter the APFTEP. Despite the higher attrition, 74% of APFTEP men and 63% of APFTEP women were still serving after 1 year. This program may assist in retaining Soldiers who would otherwise be discharged as APFT failures.

(5) Army Physical Training and Rehabilitation Program

The Physical Training and Rehabilitation Program (PTRP) was established at Fort Jackson in 1995 to provide supervised training for Soldiers who were injured in basic training to the extent they could not continue with basic training (97). The PTRP allows trainees a more favorable environment for rehabilitation and allows training units to focus on their primary training mission with one less distraction. In 1998, 6% of all basic trainees at Fort Jackson entered the PTRP and 52% of those who entered were returned to duty. The average(±SD) time spent in the PTRP was 62±42 days for those returned to duty and one day longer for those who were discharged (97). A local Fort Jackson policy established in January 1998 allowed trainees who were injured to opt for an entry level separation discharge rather than enter the PTRP. In October 1998, this policy was rescinded and anyone who was injured was required to enter the PTRP regardless of their desire to be discharged. On 15 April 1999, a memorandum from the TRADOC Deputy Chief Of Staff for Training mandated establishment of a PTRP for all 5 Army basic training locations and provided guidance for implementation (85). The proportion of trainees who enter the PTRP appears to have been reduced from 3% of men and 12% of women in 1998 (97) to about 2% of men and 5-6% of women in 2003 (135).

A preliminary study (150) examined active duty Army trainees who were successfully rehabilitated in the PTRP and returned to basic training in the January-September 1998 timeframe. The control group was composed of trainees who were matched on the basis of age, gender, race, season of entry, and week of basic training for entry into the PTRP. Soldiers were tracked in service up to the conclusion of 1999. There were no differences in attrition between the PTRP and control groups.

Hauret et al. (96) examined trainees entering the PTRP from January 1998 through July 2001. Forty-three percent were retuned to duty in this time period. The lower return to duty rate was shown to be associated with the policy of not allowing trainees to opt out of the PTRP (discussed above). Those who were returned to duty had basic training graduation rates that were similar to those who never injured to the extent they had to enter the PTRP. PTRP trainees who graduated from basic training had 2-year attrition rates that did not differ from basic training graduates who were never injured to the extent they had to enter the PTRP.

Overall, these results indicate that seriously injured trainees who are successfully rehabilitated in the PTRP have basic training graduation rates and 2-year attrition rates that are similar to those who were never injured to the extent that they had to enter the PTRP.

(6) Navy Sports Medicine and Rehabilitation Therapy Center

The SMART Center at the Marine Corps School of Infantry at San Diego, California, is for conservative treatment of non-surgical musculoskeletal complaints. The Center is staffed by a sports medicine physician, podiatrist, physical therapist, physician's assistant, dietician, chiropractor, orthopedic technician, physical therapy technician, and corpsmen. In essence, the idea is to care for Marines like athletes (rather than patients) and rapidly treat and/or rehabilitate them so they can return to duty (124).

Drozd (55) evaluated the effectiveness of the SMART Center by examining medical attrition from the Marine Corps School of Infantry. Medical attrition in FY 1996 was compared to medical attrition in FY 1997. FY 1997 medical attrition was only available for the first 6 months so a "weighted average" was calculated to estimate 1-year attrition. It is not clear from the article exactly how this weighted average was calculated. Another problem with this analysis was the fact that the SMART Center opened on 1 August 1996. Since FY 1996 ranged from October 1995 to September 1996, some of the FY 1996 data would include medical data for 2 months after the Center had been in operation. At any rate, 160 trainees were discharged for medical reasons in FY 1996 compared to an estimated attrition of 50 for FY 1997. The return to duty rate was 57% in FY 1996 and a projected 75% in FY 1997. More conclusive data may have been obtained by comparing the first 6 months of both fiscal years.

(7) Functional Academic Skills Training Program

The FAST program is voluntary and is provided at Army Education Centers by accredited civilian institutions in a typical classroom lecture setting. Prior to the early 1990s, the FAST program was called the Basic Skills Education Program (BSEP). In FY 1987, the BSEP enrolled 94,000 Soldiers. A study of the BSEP (234) showed that those who were BSEP graduates were much less likely to attrite than a comparison group (3% vs. 35%, $p<0.01$ by secondary analysis). The attrition period and nature of comparison group were not specified in the article. Soldiers' supervisors noted that BSEP graduates were more highly motivated and had higher levels of self-esteem after program participation (234, personal communication Roslyn Strickland, Aberdeen Proving Ground Education Center).

A more recent study (242) performed a detailed analysis of the association between attrition and the FAST program. After controlling for race, gender, AFQT category, educational attainment, and MOS, it was found that participation in FAST within the first 6 months of enlistment was associated with a 6% reduction in both 1-year and 2-year attrition. Participation in FAST within the first year of enlistment was associated with a 6% reduction in 2-year attrition.

(8) English as a Second Language Program

In FY 1987, the ESL program enrolled 978 enlisted Soldiers. The program was conducted at the Defense Language Institute's English Language Center. A study of the ESL program showed that those in the program were about one-half as likely to attrite as a comparison group (23% vs. 44%, $p<0.01$ by secondary analysis). The attrition period and nature of comparison group were not specified in the article (234).

(9) Conclusions Regarding Service Member Remedial Programs

Taken together, these studies show favorable effects for the Soldier remedial programs that have been examined. The FAP appears to screen out very low fit Soldiers earlier in the process and physically train these soldiers to reduce attrition. Modifying the FAP by lengthening trainee time in the program such that higher fitness levels are achieved prior to basic training may help further reduce attrition. Soldiers in the APFTEP have higher 1-year attrition than Soldiers who do not enter the program but most APFTEP Soldiers are still in the Army a year later. Although there is high attrition from the PTRP due to the severity of some injuries, those who successfully complete the program have subsequent 2-year attrition similar to Soldiers who never had to enter the program. More appropriately designed studies are necessary to evaluate the effectiveness of the SMART Center. FAST program and ESL programs are associated with lower attrition.

i. Incentives to Remain in Service

A few investigations have examined associations between attrition and educational opportunities and enlistment bonuses. These incentives are designed primarily to increase recruiting but they may influence attrition if taking advantage of them encourages individuals to remain in service.

(1) The Army Continuing Education System (ACES)

Many individuals enter the military to further their education under the assumption that the military can provide them with opportunities not available or that they cannot afford outside of the services. Army recruiting promotional literature often emphasizes money for education and in-service educational benefits. This fact is one of the first items listed under "Army Benefits" at the Army's recruiting website in 2003 (www.goarmy.com/army101/benefits.html).

High school graduates and high school seniors who enter the military and expect to obtain more education in the Army are about half as likely to attrite in their first six months and about 63% times less likely to attrite in a 35-month period than those who do not expect to obtain more education (8).

One study (242) performed a detailed analysis of the association between attrition and the Tuition Assistance (TA) Program. TA assists Soldiers in financing off-duty post-secondary education. After controlling for a variety of factors known or suspected to affect attrition (race, gender, AFQT category, educational attainment, MOS), it was found that participation in TA within the first 6 months of enlistment reduced 1-year attrition by 5%. Participation in TA within the first year of enlistment reduced 2-year attrition by the same amount.

(2) Enlistment Bonuses

Enlistment bonuses are cash incentives designed to encourage potential recruits to enter specific MOS. In general, they attempt to increase the quality and number of recruits in hard to fill MOS. Bonuses have advantages over other recruiting methods such as the fact they can be added, adjusted, or rescinded at any time, they can be directed to specific demographic groups, and they cost less than a general pay increase since shortage MOS can be targeted. Favorable recruiting effects have been demonstrated such as increasing the length of enlistment contracts, channeling high-quality recruits into difficult to fill MOS (primarily combat arms) and increasing the overall number of high quality recruits (high school graduates with high AFQT scores) enlisted. Enlistment bonuses have been offered since 1972 to Army and Marine recruits and are now available for all services. Estimates of the additional proportion of recruits attracted by enlistment bonuses in the Army and Marines have ranged from 4% to 9% (111,190,201).

A few studies were found examining the influence of enlistment bonuses on attrition but these were conflicting. A study of the Marine Corps Enlistment Bonus Program (EBP) was conducted examining recruits who enlisted in FY 1978. At that time, the Marine Corps offered two types of bonuses, 1) a technical bonus that was used to direct high quality recruits into specific technical MOS, 2) a combat bonus was used to direct men into combat-related MOS (Infantry, Artillery, Tank and Amphibian Tractor). Overall results were identical for both types of bonuses. Enlistment bonuses were not associated with attrition from basic training but those granted bonuses had less 3-year attrition (190).

Another study (167) examined the association of enlistment bonuses with attrition from Army basic and advanced training in FY 1990 through 1993. Contrary to expectation, it was found that those taking enlistment bonuses were about 18% less likely to complete basic and advanced training than those not taking bonuses (attrition was 11% vs. 9%). The enlistment bonus was independently associated with attrition when considered in a multivariate analysis with MOS, gender, race, age, APFQ score, educational level, prior service, and time in the DEP.

Smith (236) examined first-term attrition among FY 1982 Army Soldiers who entered the service with enlistment bonuses. After controlling for education,

AFQT score, race, MOS, and DEP time there were no significant differences in service time between those entering with bonuses and those entering without bonuses.

j. Injuries and Attrition

Another important cause of attrition appears to be injuries that trainees experience in training. As noted above, 3% of all men and 12% of all women who enter Army basic training in 1998 experienced injuries serious enough to remove them from basic training (97). In 2003, this number appears to have been reduced to about 2% of men and 5-6% of women (135). Less than ½ of these severely injured individuals return to basic training (96,97). Among these seriously injured trainees, discharges are 2.6 to 3.8 times higher even when rehabilitation and the potential for return to training are offered to recruits who suffer these injuries (133). Among men in basic training, an injury of any type is associated with an over 3-fold higher likelihood of discharge compared to men not injured (133). In DOD operational units, 15% of all discharges are for physical problems (76). Reducing injuries might be expected to reduce attrition and allow service members to spend more time in training. Studies examining methods of reducing military injuries can be broadly classified into training-related and equipment-related strategies.

(1) Training-Related Strategies

Several civilian studies (40,115,147,168) and observational military investigations (117,250) have identified higher running mileage as an injury risk factor. An obvious strategy is to reduce the amount of running performed by service members although there are concerns about how this would influence aerobic fitness. An investigation by the U.S. Naval Health Research Center (San Diego, California) was conducted during the 12-week Marine basic training cycle. Stress fractures were tracked in 3 groups of Marine recruits, each group performing different amounts of organized running. Table 19 shows the running distances, stress fracture incidence, and final 4.8 km run times. As total running distance decreased, the stress fracture incidence decreased. A 40% reduction in running distance was associated with a 53% reduction in stress fracture incidence and only slightly slower (2.5%) 3-mile run times. Thus, reducing running mileage reduced stress fracture incidence with minimal effects on aerobic fitness (229).

Table 19. Mileage, Stress Fracture Incidence, and Final Three-Mile Run Times Among Three Groups of Male U.S. Marine Corps Recruits (from Reference 229)

Marines (n)	Total Run Distance (miles)	Stress Fracture Incidence (n/100)	Final Three-Mile Run Times (min)
1136	55	3.7	20.3
1117	41	2.7	20.7
1097	33	1.7	20.9

Another study (222) examined the effect on injuries of replacing running with foot marches during the 12-week Australian recruit-training course. One group of recruits performed 26.5 km of programmed running which was the usual amount in the recruit-training course (Run Group). Another group of recruits substituted foot marches with backpack loads wherever a run was scheduled (Walk Group). Foot marches for the Walk Group involved progressively increasing distances and load weights. The Walk Group tended to have fewer overall injuries than the Run Group (38% vs. 47%, $p=0.09$). Compared to the Walk Group, the Run Group had more lower-limb (25% vs. 42%, $p<0.01$) and knee (9% vs. 19%, $p=0.01$) injuries as well as almost double the number of restricted duty days and hospitalizations.

For many years sports medicine professionals recommended stretching prior to physical activity as a method for reducing the risk of injury (10,126). However, it was not until relatively recently that the effectiveness of this strategy was tested. Studies generally show that stretching prior to (202,204) or both prior to and after physical training (254) does not reduce the risk of injury. Studies that did show an effect of stretching on injuries were either non-randomized trials (95), were confounded with interventions other than stretching (59), or had other major design problems (18). Further, epidemiological data indicated that extremes of flexibility (too much or too little) might not be desirable. Studies on Army basic trainees (118,143), Navy SEAL trainees (123), and collegiate athletes (140) have shown that both high and low levels of flexibility are associated with increased risk of injury. One randomized prospective cohort study compared injury rates between two groups of male Australian basic trainees (204). One group did not stretch while the other group performed 20-second stretches of 6 lower extremity muscle groups prior to exercise. Lower extremity injuries that required at least 3 days of limited duty were tracked during the 12-week training program. There were no significant differences between the two groups for overall injury rates ($p=0.67$), soft tissue injury rates ($p=0.17$), or bone injury rates ($p=0.27$). Time spent on pre-exercise stretching may be more effectively used in warm-up activities that include low intensity activities that are similar to the training tasks for that day.

There are a number of programs that have introduced multiple injury prevention strategies into military environments. The problem with multiple strategies in a single study is the limited ability to determine the effectiveness of individual strategies and thus isolate the most effective ones. Multiple strategies may be successful because different individuals respond to different aspects of

the program. At a minimum, multiple strategy programs provide clues to effective strategies that can be investigated individually in other studies.

A study (240) among New Zealand military recruits examined the combined effect of three interventions: 1) no running in boots for the first 5 weeks of training, 2) gradual introduction of the wearing of boots, and 3) organized physical training in running shoes. Before the interventions were in place, 65% of recruits were injured; after the interventions were in place 50% were injured ($p=0.02$). Time on light duty and days off duty were also reduced in the post-intervention group.

A study using historical data (203) examined the effects of multiple interventions on pelvic stress fractures in female Australian recruits. Interventions involved: 1) a reduction in foot marching speed from 7.5 km/h to 5 km/h (but no reduction in distance), 2) allowing women to march at their own step length (rather than marching in step), 3) encouraging marching and running in more widely spaced formations (to aid in obstacle awareness), 4) conducting running on grass in preference to roads wherever possible, and 5) substituting interval running for longer-distance runs where possible (thus reducing the total running distance). The incidence of pelvic stress fractures in the pre-intervention cohort was 11.2% while it was 0.6% in the post-intervention cohort.

Another study (223) investigated a second set of changes in Australian recruit training. Interventions included: 1) cessation of running in formation and a 26.5-km reduction in total running distance, 2) introduction of interval training (400 and 800 m sprints) on grassy surfaces, 3) reduction in distance on the running test from 5 to 2.4 km, 4) standardization of foot marches to include control of march speed, progressive load increments, and a prohibition on running, and 5) running in water as a cross-training technique. Compared to the pre-intervention cohort, injury rates in the post-intervention cohort were 46% lower ($p<0.01$) for men and 35% lower ($p=0.06$) for women. Medical discharges decreased 41% among men ($p<0.01$) but unexpectedly rose 58% for women ($p=0.01$).

Three U.S. Army programs examined the combined effects of reducing running mileage with other interventions during the basic training and advanced training (130,131,135,138). Experimental groups did not stretch prior to exercise, performed a wide variety of exercises (calisthenics, dumbbell drills, movement drills, interval training, long-distance running), and had reduced running mileage. The control groups conducted the usual physical training programs consisting of stretching, calisthenics, sit-up and push-up practice, and they ran more miles. Investigators found that experimental group men and women were at lower risk of injury. The risk of injury in the control groups was 1.4 to 1.8 higher than in the experimental groups. In two studies (135,138), fitness levels at the end of training were generally higher for the experimental group while in the other study (131) final fitness levels were not different between experimental and control

groups. These studies demonstrated that injuries could be considerably reduced and fitness improved or maintained by combining prior knowledge of successful and unsuccessful interventions (reduced running mileage and stretching prior to exercise, respectively) with a well-designed physical training program.

In summary, outcomes from this group of military training intervention studies indicate that reducing the amount of running in recruit training considerably reduces injuries with little or no effect on improvements in aerobic fitness. The common practice of stretching prior to exercise does not appear to influence injury rates. Multiple intervention programs have been shown to be effective but such studies make it difficult to partition out the most effective interventions for reducing injuries. Such multiple intervention studies provide clues for future research.

(2) Equipment Modification Strategies

Military equipment-related injury reduction strategies that have been tested include the use of special sock systems and antiperspirants to reduce the incidence of foot blisters, the use of ankle braces to reduce airborne injuries, the use of shock absorbing boot insoles to reduce overall injury rates, and matching running shoes to particular foot characteristics to reduce lower extremity and low back injuries.

Foot blisters are one of the most common injuries experienced by Soldiers and Marines (52,128,195,213,217). Blisters appear to be caused by friction between the skin and sock. That friction is exacerbated by moisture produced when sweating (142). Several studies suggest that appropriately reducing moisture around the foot through the use of special socks (102) or antiperspirants (50) will reduce the likelihood of foot blisters. One investigation examined special sock systems among three groups of Marine recruits undergoing their 12 weeks of training. One group of recruits (Group 1) wore the standard U.S. military wool/cotton sock. The second group (Group 2) wore a liner sock composed of polyester with the standard sock. The polyester sock presumably moved moisture away from the foot through a combination of metabolic heat and the hydrophobic nature of the polyester material ("wicking"). A third group of recruits (Group 3) wore the same polyester liner sock as Group 2, but they also wore a specially designed and very thick wool/polyester blended sock that presumably assisted with the wicking action while reducing friction. Group 3 had a lower overall incidence of blisters than Group 1 (40% vs. 69%, $p<0.01$). Both Groups 2 and 3 had a lower incidence of blisters and cellulitis resulting in limited duty compared to Group 1 (39% in Group 1, 16% in Group 2, 17% in Group 3; $p<0.01$ for comparison of Group 1 to either Group 2 or 3). Thus, both experimental sock systems were successful in reducing blisters.

Besides particular sock systems, previous studies strongly suggested that eliminating sweat altogether through the use of antiperspirants might reduce the

incidence of foot blisters (50) if emollients were not included in the antiperspirant preparation (215). A prospective double-blinded investigation examined foot blisters in trainees who used either a placebo or an antiperspirant preparation (20% solution of aluminum chloride hexahydrate in a denatured ethyl alcohol base) (141). Trainees were asked to apply the preparations to their feet for 5 consecutive evenings prior to a 21-km foot march. Individuals performed the march on a hot day and their feet were examined for blisters before and after. There was variable compliance with the 5-day application schedule. Nonetheless, those who had used the antiperspirant preparations for at least 3 days prior to the march had lower blister incidence than those that used the placebo for at least 3 days prior to the march (21% vs. 48%, $p<0.01$). However, 57% of those in the antiperspirant group reported experiencing irritant dermatitis compared to only 6% in the placebo group ($p<0.01$). The irritant dermatitis problem was also cited in another study (50) suggesting this side effect needs to be addressed before this intervention can be widely recommended.

An intervention with mixed results is the use of insoles in the boots of basic trainees. Investigations that have examined polyurethane and sorbothane insoles worn in the boots of Marine or Army recruits have shown no effect on stress fractures, lower extremity musculosketal injury rates, or sick call rates during military training (16,80,170). However, a study that examined a polyurethane orthotic insole worn in the boots of Israeli basic trainees found a reduction in femoral stress fractures but no influence on tibial or metatarsal stress fractures; when the incidence of all types of stress fractures was combined, there was a significant reduction in incidence among the insole users (180). Studies using neoprene insoles have also shown mixed results. Neoprene insoles in the boots of U.S. Army basic trainees resulted in no effect on lower limb pain (232), but another investigation of neoprene insoles in the boots of Coast Guard recruits found a reduction in injuries related to shock and friction (e.g., contusions, blisters, callouses) (237). In South African basic trainees, neoprene boot insoles were associated with a reduction in total overuse injuries and tibial stress fractures (227). It should be noted that most, but not all (237) of the studies finding negative results are in U.S. military basic training, while studies finding positive results are in Israeli and South African basic training. This may suggest that differences in the training environments may influence the results. Future studies should better characterize the training environment as well as degree of shock absorbency, durability, and other important characteristics of insoles (22).

Soldiers in the U.S. Army have used running shoes for physical training since the early 1980s. Despite the relatively large number of studies on the biomechanics of running shoes and the hypothesized effects on injury reduction, the data linking running shoes to actual cases of injuries are very sparse (136). An Army program developed at Fort Drum, New York, was designed to reduce running injuries by matching specific running shoes to particular foot characteristics (height of the longitudinal arch and ankle flexibility). Running shoe manufacturers categorize running shoes as either motion control,

cushioned, or stability (260). In the Fort Drum study, if the Soldier had a low arch with a hypermobile foot, a "motion control" shoe was recommended; if the Soldier had a high or normal arch with a rigid foot, a "cushion" shoe was recommended; if the Soldier had a high or normal arch with a flexible foot, a "stability" shoe was recommended. Overuse-related events in the lower body and low back regions were examined before and after the program. Injury rates were reduced 6 months after the program started (37 vs. 19 injuries/1000 Soldiers/month, $p<0.01$). However, a major potential confounder was conversion of the data collection system from scannable paper sheets to a system involving direct network input from a computer screen. The network system was judged by providers to be cumbersome and time consuming and may have resulted in miscoding. A number of other potential temporal confounders were considered and discounted. Overall, the effectiveness of the program was tentatively supported but it was considered imperative that the program be tested in a randomized prospective cohort study before a full determination could be made on the program effectiveness (136).

A study conducted during Israeli infantry recruit training examined differences in injury rates between recruits wearing high top basketball shoes and those wearing the standard lightweight infantry boot. The basketball shoes had leather uppers and soles of ethylene vinyl acetate. Recruits training in the basketball shoes had a lower incidence of overuse foot injuries but the overall incidence of overuse injuries was the same in each group (65).

A successful intervention involved the use of an ankle brace to reduce the incidence of ankle injuries during airborne operations. Surveys of airborne injuries suggest that 30-60% involve the ankle (5,45,51,125,164). The sports medicine literature suggested that fewer ankle injuries occurred among athletes wearing ankle braces (221,231). One study (6) reported on a specially developed ankle brace that fit outside the combat boot and could easily be donned and doffed with Velcro straps. A randomized study of airborne trainees showed that during jump operations, those wearing this brace had fewer inversion ankle sprains compared to those who did not wear the brace (0.6 vs. 3.8 injuries/1000 jumps, $p=0.04$). Another study (233) that examined injuries over a 3-year period in a U.S. Army Airborne Ranger Battalion found that those wearing the ankle brace also had significantly fewer ankle injuries compared to those not wearing the brace (1.5 vs. 4.5 injuries/1000 jumps, $p<0.01$).

In summary, successful equipment-related strategies to reduce injuries include the use of special sock systems to reduce the likelihood of foot blisters and the use of special ankle braces to reduce ankle injuries during airborne operations. Promising equipment-related strategies to reduce injuries that require further investigation include the use of antiperspirants to reduce foot blisters, the use of special insoles in footwear, and matching running footwear to individual foot characteristics.

k. Pennsylvania Pre-Initial Entry Training Program

In response to the high basic and advanced training attrition rates the Pennsylvania National Guard, the Army National Guard Bureau established a decentralized 36-hour program of instruction administered by individual Army National Guard units over 3 weekend drills. This program covered areas such as military justice and courtesy, promotion and benefits, drill and ceremony, first aid, physical fitness training and mechanical training on the M-16 and 45-caliber pistol. Despite this training begun in 1983, attrition rates were about the same or slightly higher in 1984 and 1985. This was attributed to the additional work load the program imposed on already overloaded individual units and the resultant lack of program quality.

In 1985, the Adjutant General for Pennsylvania (TAGPA) established a centralized program called the Pennsylvania Pre-Initial Entry Training Program. This program was conducted at Fort Indiantown Gap, Pennsylvania, and was staffed by 10 personnel (including 2 medical and 3 drill sergeants). New recruits from all over the state were escorted to the training site and participated in a 4-day course that included much of the content area of the previous course. Enhancements included the state Sergeant Major providing the history and tradition course, increased emphasis on physical conditioning, and increased emphasis on identifying pre-existing and disqualifying legal and physical problems.

From November 1985 to July 1987 basic and advanced training attrition rates for the Pennsylvania National Guard decreased from an estimated 30% to an actual 3.6%. Importantly, when compared to other groups in the same time period, overall attrition rates for Pennsylvania National Guard, U.S. Army Reserve, and Regular Army were 3.6%, 4.9%, and 5.3%, respectively. Rates for both EPTS and entry level separation discharges were lower in the Pennsylvania National Guard compared to the other groups (226).

6. SUMMARY AND CONCLUSIONS

This report reviewed the literature on the size of the attrition problem, risk factors for attrition, and strategies to reduce attrition during the first term of enlisted service. Certain demographic and psychosocial risk factors appear to increase the risk of attrition by a factor between 1.1 to 2.0. These factors include lower educational level, female gender, white ethnicity, lower AFQT scores, less pre-service conformance with laws, rules and regulation (lower moral character), moral waivers, factors relating to prior job history, and less time in the DEP. Likewise, a number of health-related factors can increase risk of attrition between about 1.1 and 2.0. These factors include enlistment medical waivers, heavy pre-service alcohol use, pre-service injury, injuries in basic training, low pre-service physical activity, higher body weight on entry to service, and pre-service mental health history. On the other hand, a number of health- and fitness-related risk

factors appear to double, triple or increase the risk of attrition even more. These factors include low physical fitness on entry to service, heavy pre-service cigarette smoking, pre-service physical/sexual abuse, referral to a mental health facility in basic training, and a mental-health hospitalization early in service. Particular MOS have much higher attrition risk than other MOS. What is missing from the literature is a comprehensive study that examines a large number of these factors in a single investigation so their interaction and relative importance can be determined. It is possible that a number of these factors interact in ways that decrease (due to multicollinearlity) or increase (due to synergistic effects) their influence on attrition risk.

A number of strategies to reduce attrition have been tested. Biographic questionnaires and compensatory screening can successfully identify individuals likely to attrite but at the risk of also screening out a number of individuals likely to succeed (false positives). Short (2 to 3 minute) psychiatric interviews of incoming basic trainees do not successfully predict attrition over that which can be achieved by biographic questionnaires. Stress management classes for large groups of basic trainees that are having problems in adapting to the military have not been demonstrated to be effective in reducing attrition. On the other hand, intensive one-on-one sessions with behavioral specialists may reduce attrition in early military training but this can be very time-intensive. RJP are a very promising strategy to reduce attrition and it is surprising not more work has been performed in this area, especially the application of this technique in the DEP. One of the most powerful interventions influencing attrition appears to be senior leadership initiatives. Limited data suggests that senior leadership initiatives can double attrition or lower them by half in basic and/or advanced training. When senior leadership initiatives reduce early attrition this does not influence attrition later in service or may actually lower later attrition. Soldier remedial programs that reduce basic training attrition include FAP and the PTRP. Trainees in the APFTEP attrite at higher rates than those who do not have to enter the program but the APFTEP is successful in retaining many recruits who would otherwise be discharged. Soldiers that voluntarily take advantage of the tuition assistance program, the FAST program, and the ESL program have lower attrition but individuals enrolled in these programs may just be the more motivated service members. Better study designs are necessary to evaluate the effectiveness of the Marine SMART Center. The Pennsylvania Pre-Initial Entry Training Program may be a highly effective method of reducing training attrition in the National Guard and possibly the reserves.

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APPENDIX A

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APPENDIX B

Attrition from the Delayed Entry Program (DEP)

DEP attrition from all services is shown in Table 1B and averaged 15% between FY 1991 and 1996 (189). DEP attrition rates are highest for the Marines and Army and lowest for the Air Force (189). Between July 1995 and October 1997 the major reasons for DEP attrition were failure to obligate (the individual decides not to join the service, 48%), technical reasons (pregnancy, death, enuresis, failure to graduate, 17%), disqualifying information about individuals found while in the DEP (12%), medical (13%), drug and alcohol (4%) and other reasons (6%) (145).

Table 1B. DEP Attrition for DOD Fiscal Years 1991 to 1996 (From 189)

Fiscal Year	Men	Women
1991	13.1	20.3
1992	13.6	17.9
1993	13.6	20.9
1994	13.7	21.1
1995	14.9	23.7
1996	13.6	22.4
All Years	13.7	21.1

Intrinsic (personal) risk factors for DEP attrition included female gender (101,145,184,186,189,193,207), older age (101,145,184,186,193,207), white race (67,145,184,186,189,193,257), single marital status or no dependents, (67,101,186,189), lower AFQT score (101,145,184,186,193), high school senior status (67,184,186,189), and lower educational level (145,193). Black or non-White females appear to have low DEP attrition rates (67,101,193), lower than the overall male rate.

Extrinsic (environmental/situational) risk factors for DEP attrition include longer time in the DEP (101,145,184,186,189,193,207,257), higher regional or national employment rates (101,184,186,257), greater monetary earning potential in the civilian environment than in the military environment (186), non-participation in a service college fund (186,193,257), contract renegotiation (67,145,184,207), and lack of participation in a military youth program like junior ROTC (67). Individuals are less likely to attrite from the DEP if granted a waiver (67,189). The pay grade of the recruiter and amount of recruiting experience appears to have minimal effects on DEP attrition (184). DEP attrition tends to be highest in the Marines and Army and lowest in the Air Force (101,189).

Women have DEP attrition rates that are 1.5 to 2.1 times higher than men (67,184,189,207). Women may have fewer role models among recruiters that can provide leadership and guidance. Also, about 12-14% of female DEP attrition is due to pregnancy. Providing birth control to women may limit some attrition (189).

High school seniors may leave the DEP at higher rates than high school graduates because they find other jobs or decide to purse higher education while in the DEP. There is also a longer time for other individuals to influence their decision to join the military (189). Also, a number of seniors may not graduate and this places them in another educational TIER reducing their likelihood of acceptance into the military unless they have compensating characteristics.

Appendix C

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