**Technical Report**
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# INJURY AND ILLNESS INCIDENCE IN SERGEANTS MAJOR ACADEMY STUDENTS

## CLASS 46

Prepared by:

Kathleen Brown, M.P.T.
Katy Reynolds, M.D.
Rebecca Gregg, B.S.
Joseph Creedon, Ph.D.
Sharon McBride, Ph.D.

Military Performance Division
U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760-5007

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This study examined the incidence of and risk factors for training injuries and illnesses for 149 male and female U.S. Army Sergeants Major Academy (SGMA) Class 46 students. This was a retrospective report based on data collected during the 9.5-month training program. Only data from injuries and illnesses incurred during physical fitness training were included in the present study. During this time period, 49.7% (74/149) of the students were injured at least once. The crude incidence rate (initial injuries) was 5.2 injuries per 100 soldiers per month. Overuse injuries were the most frequently reported injuries (68.9%), and accounted for a total of 1749 limited duty days. The three most common overuse injuries were pain, muscle strain, and tendinitis/bursitis. Descriptive analyses revealed that for illnesses, 63.1% (94/149) of the SGMA students had one or more illness visits to a medical treatment facility. The crude incidence rate (initial illnesses) was 6.6 illnesses per 100 soldiers per month. Infectious illness was the most frequent illness category reported (48.3%), and 94 students had a total of 311 days of illness-associated limited duty days. The most frequent types of infectious illnesses were bacterial and viral and these illnesses primarily affected the respiratory system. Major conclusions drawn from this study include the following: 1) musculoskeletal injuries were the major cause of limited duty days during physical fitness training, 2) overuse lower extremity and lower back injuries were the most commonly reported injuries, 3) respiratory bacterial and viral infectious illnesses were the most commonly reported illnesses, 4) alcohol consumption was a risk factor for the development of infectious illnesses, 5) smoking was associated with slower 2-mile run times when compared with nonsmokers, and 6) smokers had higher cholesterol levels than nonsmokers.

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# EXECUTIVE SUMMARY

This study examined the incidence of and risk factors for training injuries and illnesses for 149 male and female U.S. Army Sergeants Major Academy (SGMA) Class 46 students. This was a retrospective report based on data collected during the 9½-month training program. Only data from injuries and illnesses incurred during physical fitness training were included in the present study. During this time period, 49.7% (74/149) of the students were injured at least once. The crude incidence rate (initial injuries) was 5.2 injuries per 100 soldiers per month. Overuse injuries were the most frequently reported injuries (68.9%), and accounted for a total of 1749 limited duty days. The three most common overuse injuries were pain, muscle strain, and tendinitis/bursitis.

Injuries to the lower extremities and lower back were reported most frequently and accounted for 67.7% of the total clinic visits. These injuries resulted in a total of 1871 limited duty days.

Descriptive analyses revealed that for illnesses, 63.1% (94/149) of the SGMA students had one or more illness visits to a medical treatment facility. The crude incidence rate (initial illnesses) was 6.6 illnesses per 100 soldiers per month. Infectious illness was the most frequent illness category reported (48.3%), and 94 students had a total of 311 days of illness-associated limited duty days. The most frequent types of infectious illnesses were bacterial and viral and these illnesses primarily affected the respiratory system.

No significant risk factor associations were found between independent variables and musculoskeletal injuries for SGMA Class 46 students. The only significant risk factor identified for illnesses was that alcohol drinkers were two times more likely to have an infectious illness than those who did not drink alcohol.

Logistic regression analysis revealed that as run times increased by 1 minute, the odds of being a smoker increased by 54.0% or 1.54 times. No significant associations were found between smoking and push-up or sit-up scores.

The one way ANOVA analysis revealed that the group mean baseline cholesterol was significantly higher ($p=0.04$) for smokers than nonsmokers.

Major conclusions drawn from this study include the following: 1) musculoskeletal injuries were the major cause of limited duty days during physical fitness training, 2) overuse lower extremity and lower back injuries were the most commonly reported injuries, 3) respiratory bacterial and viral infectious illnesses were the most commonly reported illnesses, 4) alcohol consumption was a risk factor for the development of infectious illnesses, 5) smoking was associated with slower 2-mile run times when compared with nonsmokers, and 6) smokers had higher cholesterol levels than nonsmokers.

# INTRODUCTION

The Sergeants Major Academy (SGMA) places great emphasis on physical fitness training because it is an important component of combat readiness. As a result of this emphasis, the training-related incidence of injuries and illnesses can be high in military fitness training programs (5, 12, 16, 20, 21, 23). This can be costly in terms of limited duty time and impact on the medical care system. Investigating the incidence and types of training-related injuries and illnesses may assist in developing countermeasures to reduce such occurrences.

Several injury risk factors have been identified in recent military studies. Smoking history has been reported as a risk factor for injury in male and female Army basic trainees (5, 24, 26). Reynolds et al. (20) reported a higher incidence of lower extremity injuries among smokers in an infantry battalion. Jones et al. (11) reported that male basic trainees with the highest and the lowest body mass index (BMI) were at a greater risk of injury. Low physical fitness has also been identified as a risk factor for injury in male (11) and female basic trainees (1, 11, 26) and male Ranger students (3).

Previous military studies have also examined risk factors for illness during training. Reynolds et al. (20) found that female recruits reporting to basic training with a low iron status (serum ferritin <20mg/ml) had a higher likelihood of developing an infectious illness than other female recruits. Additionally, Jones et al. (13) reported an increase in respiratory infections among male and female recruits that demonstrated low levels of fitness at the beginning of basic training.

Previous reports have primarily examined the incidence of illness and injury among younger soldiers. The present study will examine 1) the incidence of illness and injury among a population of older soldiers (average age is 42) and 2) the risk factors that may contribute to the occurrence of illness and injury among this population that were attending a 9½-month military training course.

# METHODS

## DESCRIPTION OF SERGEANTS MAJOR ACADEMY COURSE

The SGMA program is a 9½-month course designed to provide the total Army with competent, confident Sergeants Major and Command Sergeants Major soldiers who are better able to serve in a force projection environment. The SGMA course is a task-based, performance-oriented, scenario-driven course of instruction. The course integrates the learning objectives from the Battle Staff NCO Course, the Master Fitness Trainer Course, and Facilitator Training. Course emphasis is on skills, knowledge, and attitudes required for Sergeants Major to excel in positions of greater responsibility throughout the defense establishment.

Physical fitness training was an important component of the SGMA Class 46 course. Organized fitness training during the course was conducted 2 - 3 days per week for 16 consecutive weeks starting on the 3rd week of the course. Physical fitness training consisted of aerobic exercise and muscular strength and endurance activities. Exercise included organized runs from 3 to 6.2 miles in length for an average total distance per week of 6 - 10 miles, a 5-mile rucksack march and aerobics. Muscular strength training included push-up and sit-up improvement exercises, circuit training, rifle physical training, sandbag circuit training and guerilla drills.

Throughout the 9½-month course, individual or small group physical training was encouraged, and fitness facilities were available for use by the students throughout their course.

## SUBJECTS AND STUDY DESIGN

Subjects were 149 (143 males, 6 females) Master Sergeants (E8) from different military units and geographic regions enrolled in SGMA Class 46 from 14 August, 1995 to 31 May, 1996. Injury and illness data were obtained by retrospective review of all available medical records for 149 of the 200 enrolled students (74.0%). Physical

fitness data were based on performance on the initial Army Physical Fitness Test (APFT) administered in the second week of the course.

## DEMOGRAPHIC DATA

Demographic data were obtained from a Health Risk Appraisal (HRA) questionnaire administered during the first week of the course, which included questions about race, gender, height, weight, smoking history and alcohol use. A BMI was calculated ($wt/ht^2$) for each student using the height and weight data collected from the HRA. Students were asked if they had smoked cigarettes and, if so, the number of cigarettes per day and the length of time these products have been used. For alcohol history, they were asked about number of drinks consumed per week and the number of years of alcohol usage. Some individuals chose not to answer certain questions.

## PHYSICAL FITNESS DATA

Baseline physical fitness was assessed from the soldier's initial APFT, which was conducted at the beginning of the course. The APFT consists of three events: 2-mile run for time; the maximum number of push-ups completed in 2 minutes; and the maximum number of sit-ups completed in 2-minutes. Each event has a maximum point score of 100 which is adjusted by age and gender.

## INJURY AND ILLNESS DATA

Of the 200 students enrolled in SGMA Class 46, 149 (74.0%) had records available for review in the medical clinic. These records were examined in the last month of the course by a physician and a physical therapist. Injury and illness data were documented at this time. Only data from injuries and illnesses documented in the record as occurring during SGMA Class 46 physical fitness training were included in the present study. For each visit, information extracted from medical records included the date of each clinic visit, the verbatim diagnosis, body system involved, anatomic location of each injury, and the disposition and days of limited duty resulting from the injury or illness.

For classification purposes, injury cases were defined as any medical complaint documented in the medical record during course attendance that occurred during physical fitness training and resulted in at least one clinic visit. Overuse injuries were defined as injuries caused by repetitive microtrauma (e.g., strains, tendinitis, stress fractures) associated with such activities as running and marching. Traumatic injuries were defined as injuries associated with a specific single event (e.g., twisting an ankle or falling while running). Illness cases were defined as any medical complaint documented in the medical record during course attendance that resulted in at least one clinic visit. Injuries and illnesses that were not clearly defined in the medical record were categorized as "not otherwise specified" (NOS). A limited duty time injury or illness was defined as a complaint that resulted in at least 24 hours of medically restricted activity prescribed by medical personnel[1].

## STATISTICAL ANALYSES

Analyses of the data obtained in this study centered on risk factors for injuries or illness in students attending the SGMA. Statistical analyses were performed using SPSS 8.0 and Epi-Info 6.04. An alpha of 0.05 was utilized as the level of significance for all hypothesis testing.

### Summary Statistics

Descriptive analyses were performed on 143 male soldiers and 6 female soldiers. All injury and illness data were double-entered and cross-checked for error control and then up-loaded for analysis. Univariate and Multivariate analyses were conducted using Statistical Package for Social Sciences (SPSS).

The total number of initial visits, follow-up visits, and limited duty time were compiled for injuries and illnesses. The cumulative incidence (percentage) of

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[1] Limited duty day medical restrictions may have included bed rest, light duty, no weight lifting with the upper body, running at own pace or no running.

individuals experiencing injuries or illnesses was calculated by dividing the number of soldiers with one or more injuries or illnesses by the total number of soldiers with available medical records.

Categorical variables were described by frequency, percentage, and 95 % confidence intervals through the use of Epi Info Version 6.04. Continuous data were summarized by estimates of the mean, standard deviation, median, minimum and maximum.

**Univariate Testing**

Univariate testing was performed using chi-square, and the one way ANOVA test to evaluate potential Univariate associations of the outcome variables with the various independent variables. Estimates of both incidence and relative risk were calculated.

**Multivariate Modeling**

In order to control for confounding, statistical modeling was accomplished through the use of multiple logistic regression. Unadjusted odds ratios were estimated though Univariate methods and then adjusted by logistic regression. Model reduction was accomplished primarily through selection of biologically important variables. Decisions regarding inclusion or exclusion of variables in the statistical model were based upon the difference in the - 2 log likelihood score from models with and without a particular variable included in the statistical model. In addition, if the entry of a variable into the model changed the odds ratio by more than 20% and was biologically important, this variable was considered to be a confounder and kept in the model. Model fit was assessed utilizing the Hosmer-Lemeshow Statistic.

# RESULTS

## DESCRIPTIVE AND COMPARATIVE DATA

Tables 1 and 2 present all available descriptive and APFT data for 149 male and female SGMA students. On average, male students were younger than female students (41.9 vs. 49.2 yrs). The age range for males was 30 to 51 and for female the range was 44 to 53. For comparison purposes, the data from SGMA Class 42 are presented in Tables 3 and 4. SGMA Class 42 data were obtained in 1991 from a demographic questionnaire administered by the SGMA Health Promotion Office. This historical database was used because it included the most complete set of demographic data available for comparison purposes. For male students, the age, height, weight and total APFT score data for both classes did not appear to be different. For female students, class comparisons were difficult to make due to the small sample size in SGMA Class 46. However, SGMA Class 46 female students were slightly older, on average, than SGMA Class 42 female students.

Mean cholesterol value ± S.D. for male SGMA Class 46 students (n=141) was 187.6 ± 29.3 mg/dl. This value was lower than the national average for males ages 35-54 (212 mg/dl) from 1988-91 (National Center for Health Statistics, Centers for Disease Control and Prevention). The mean cholesterol value ± S.D. for female students was 195.8 ± 25.1 mg/dl. Due to the small number of females in this study (n=6), these data were not compared to the female national average.

Among 129 male soldiers, 34 males (26.4%) reported smoking within the last year. This is below the 1994 nationally reported average of 31.0% for males ranging in age from 25 to 64 (National Center for Health Statistics, Centers for Disease Control and Prevention). Smoking data were collected for 5 female SGMA Class 46 students. Only one female reported smoking within the last year (20.0%). These data were not compared to the female national average due to the small sample size.

Sixty-eight out of 128 SGMA Class 46 soldiers (53.1%) reported consuming alcoholic beverages (65 males and 3 females). This is lower than the percentage of

Army-wide personnel (55.9%) who reported consuming one or more drinks per week[2] [Total Army Injury and Health Outcomes Database (TAIHOD), unpublished data].

Table 1. Age, physical characteristics and fitness of male students in SGMA Class 46 at the beginning of training.

| Characteristic | n | Mean | S.D. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 132 | 41.9 | 4.1 | 30.0 | 51.0 |
| Height (cm) | 141 | 177.2 | 7.0 | 160.0 | 198.1 |
| Weight (kg) | 141 | 81.1 | 8.8 | 59.1 | 100.5 |
| BMI ($kg/m^2$) | 141 | 25.8 | 2.1 | 19.4 | 33.7 |
| Push-ups (#) | 102 | 45.2 | 13.7 | 18.0 | 85.0 |
| Sit-ups (#) | 103 | 54.7 | 13.8 | 32.0 | 106.0 |
| 2-mile run (min) | 102 | 15.5 | 1.5 | 12.1 | 21.1 |
| Total APFT Score | 97 | 238.4 | 49.3 | 168.0 | 300.0 |

Table 2. Age, physical characteristics and fitness of female students in SGMA Class 46 at the beginning of training.

| Characteristic | n | Mean | S.D. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 5 | 49.2 | 4.8 | 44.0 | 53.0 |
| Height (cm) | 6 | 165.5 | 6.3 | 157.5 | 175.3 |
| Weight (kg) | 6 | 67.1 | 6.5 | 57.3 | 74.5 |
| BMI ($kg/m^2$) | 6 | 24.5 | 2.8 | 21.0 | 28.2 |
| Push-ups (#) | 2 | 18.5 | 9.2 | 12.0 | 25.0 |
| Sit-ups (#) | 2 | 52.0 | 12.7 | 43.0 | 61.0 |
| 2-mile run (min) | 1 | 19.4 | — | 19.5 | 19.5 |
| Total APFT Score | 1 | 229.0 | — | 229.0 | 229.0 |

[2] These data are a part of the Health Risk Assessment database collected between 1987 and 1996 and are based on the self-reported consumption rates of 498,338 active duty U.S. Army soldiers.

Table 3. Comparison of age, physical characteristics and APFT scores between **male** students in SGMA Classes 42 and 46.

| | Class 42 - Males | | | Class 46 - Males | | |
|---|---|---|---|---|---|---|
| **Characteristic** | **n** | **Mean** | **S.D.** | **n** | **Mean** | **S.D.** |
| Age (yrs) | 439 | 40 | 3.4 | 132 | 41.9 | 4.1 |
| Height (cm) | 438 | 177.5 | 6.6 | 141 | 177.3 | 7.1 |
| Weight (kg) | 438 | 80.9 | 9.5 | 141 | 80.8 | 8.7 |
| Total APFT Score (#) | 413 | 237.5 | 37.5 | 97 | 238.4 | 49.3 |

Table 4. Comparison of age, physical characteristics and APFT scores between **female** students in SGMA Classes 42 and 46.

| | Class 42 - Females | | | Class 46 - Females | | |
|---|---|---|---|---|---|---|
| **Characteristic** | **n** | **Mean** | **S.D.** | **n** | **Mean** | **S.D.** |
| Age (yrs) | 21 | 40.2 | 3.2 | 5 | 49.2 | 4.8 |
| Height (cm) | 21 | 164.8 | 5.8 | 6 | 165.6 | 6.3 |
| Weight (kg) | 21 | 66.3 | 8.1 | 6 | 66.7 | 6.5 |
| Total APFT Score (#) | 19 | 242.6 | 55.2 | 1 | 229 | – |

## INJURY AND ILLNESS DATA

### Incidence and Distribution of Injury

During the 9½-month course, 49.7% (74/149) of the soldiers incurred one or more injuries. Seventy-two of the 143 male students (50.3%) and 2 of the 6 female (33.3%) students were injured at least once during the course. A total of 129 injuries were documented in the 74 soldiers that reported at least one injury while attending SGMA Class 46. A total of 316 injury visits were reported, resulting in 2379 limited duty days. The average number of limited duty days per injured student was 32 days. The crude incidence rate (initial injuries) was 5.2 injuries per 100 students per month. Table 5 presents the frequency and distribution of injuries, clinic visits, and associated limited duty days. Injuries were divided into the following four general categories: overuse injury, traumatic injury, wound injury and NOS injury. Injuries were further broken down

into subcategories which are outlined in Table 5. Overuse injuries were reported most frequently (69.0%) and accounted for the greatest number of total clinic visits (n=194) and limited duty days (n=1749). The three most common overuse injuries reported were pain, muscle strain, and tendinitis/bursitis.

Traumatic injuries were the second most frequently reported injuries. Among traumatic injury cases, tears resulted in the greatest number of traumatic injury clinic visits (n=38), while ligament sprains accounted for the greatest number of limited duty days (n=317). Four traumatic fractures were also reported and resulted in 95 limited duty days.

Finally, the least frequently reported injury cases were wound injuries (n=8). These injuries accounted for the lowest number of clinic visits and limited duty days.

Table 5. Frequency and distribution of injuries and associated limited duty days by type in SGMA Class 46.

| INJURY | Injury[1] | | Total Clinic Visits[2] | | | Total Limited Duty Days | | |
|---|---|---|---|---|---|---|---|---|
| | # | % | # | % | Mean[3] | # | % | Mean[4] |
| Overuse | 89 | 69.0 | 194 | 61.4 | 2.2 | 1749 | 73.5 | 19.7 |
| Pain | 38 | 29.5 | 95 | 30.1 | 2.5 | 863 | 36.3 | 22.7 |
| Muscle Strain | 36 | 27.9 | 65 | 20.6 | 1.8 | 660 | 27.7 | 18.3 |
| Tendinitis & Bursitis | 9 | 7.0 | 17 | 5.4 | 1.9 | 170 | 7.2 | 18.9 |
| Stress Reaction | 3 | 2.3 | 8 | 2.5 | 2.7 | 42 | 1.8 | 14.0 |
| Calcaneal Bone Spur | 3 | 2.3 | 9 | 2.9 | 3.0 | 14 | 0.6 | 4.7 |
| Traumatic | 23 | 17.8 | 81 | 25.6 | 3.5 | 580 | 24.4 | 25.2 |
| Ligament Sprain | 11 | 8.5 | 28 | 8.9 | 2.6 | 317 | 13.3 | 28.8 |
| Tear | 4 | 3.1 | 38 | 12.0 | 9.5 | 140 | 5.9 | 35.0 |
| Fracture | 4 | 3.1 | 11 | 3.5 | 2.8 | 95 | 4.0 | 23.8 |
| NOS[5] Trauma | 4 | 3.1 | 4 | 1.3 | 1.0 | 28 | 1.2 | 7.0 |
| Wound | 8 | 6.2 | 13 | 4.1 | 1.6 | 14 | 0.6 | 3.5 |
| Blister | 4 | 3.1 | 5 | 1.6 | 1.3 | 14 | 0.6 | 3.5 |
| Abrasion/Laceration | 3 | 2.3 | 6 | 1.9 | 2.0 | 0 | 0.0 | 0.0 |
| Contusion | 1 | 0.8 | 2 | 0.6 | 2.0 | 0 | 0.0 | 0.0 |
| NOS[5] | 9 | 7.0 | 28 | 8.9 | 3.1 | 36 | 1.5 | 4.0 |
| **TOTAL** | **129** | **100.0** | **316** | **100.0** | **2.5** | **2379** | **100.0** | **18.4** |

1. Students may have more than one injury.
2. Total Clinic Visits = Initial and follow up visits.
3. Mean = Mean # of clinic visits per injury.
4. Mean = Mean # of limited duty days per injury.
5. NOS = Not otherwise specified.

The anatomical sites of injuries and limited duty days are presented in Table 6. The site of injury was categorized in one of the five following regions: lower extremities, back, upper extremities, head and trunk, or NOS. The site of injury was further subcategorized by specific location, and these sites are outlined in Table 6.

The most frequently reported site of injury was to the lower extremities (55.0%), and these injuries resulted in the highest number of limited duty days (n=1185). The most common lower extremity injury sites were the knee, foot and ankle, and they accounted for the greatest number of total clinic visits (n=128) and limited duty days (n=1042).

The second most common site of injury was to the back (15.5%), and these injuries resulted in the second highest number of limited duty days (n=686). By far, injuries to the lower back occurred much more frequently than injuries to the upper back (19 vs. 1). Injuries to the back resulted in the highest average number of limited duty days (n=34.3) per injury when compared to other types of injuries.

Injuries to upper extremities accounted for 14.7% of all reported injury cases and 364 limited duty days. The most frequently reported upper extremity injury site was the shoulder (n=12).

Head and trunk injuries were reported least frequently (12.4%) and accounted for 136 limited duty days. The majority of these cases involved injuries to the neck .

Table 6. Frequency and distribution of injuries and associated limited duty days by site of injury in SGMA Class 46.

| SITE OF INJURY | Injury[1] | | Total Clinic Visits[2] | | | Total Limited Duty Days | | |
|---|---|---|---|---|---|---|---|---|
| | # | % | # | % | Mean[3] | # | % | Mean[4] |
| LOWER EXTREMITIES | 71 | 55.0 | 153 | 48.4 | 2.2 | 1185 | 49.8 | 16.7 |
| Knee | 26 | 20.2 | 75 | 23.7 | 2.9 | 603 | 25.4 | 23.2 |
| Foot | 19 | 14.7 | 30 | 9.5 | 1.6 | 217 | 9.1 | 11.4 |
| Ankle | 10 | 7.8 | 23 | 7.3 | 2.3 | 222 | 9.3 | 22.2 |
| Thigh | 6 | 4.7 | 11 | 3.5 | 1.8 | 35 | 1.5 | 5.8 |
| Shin | 3 | 2.3 | 7 | 2.2 | 2.3 | 42 | 1.8 | 14.0 |
| Hip | 3 | 2.3 | 3 | 1.0 | 1.0 | 37 | 1.6 | 12.3 |
| Calf | 2 | 1.6 | 2 | 0.6 | 1.0 | 29 | 1.2 | 14.5 |
| Groin | 2 | 1.6 | 2 | 0.6 | 1.0 | 0 | 0.0 | 0.0 |
| BACK | 20 | 15.5 | 63 | 19.9 | 3.2 | 686 | 28.8 | 34.3 |
| Lower Back | 19 | 14.7 | 61 | 19.3 | 3.2 | 686 | 28.8 | 36.1 |
| Upper Back | 1 | 0.8 | 2 | 0.6 | 2.0 | 0 | 0.0 | 0.0 |
| UPPER EXTREMITIES | 19 | 14.7 | 51 | 16.1 | 2.7 | 364 | 15.3 | 19.2 |
| Shoulder | 12 | 9.3 | 37 | 11.7 | 3.1 | 336 | 14.1 | 28.0 |
| Hand/Finger | 4 | 3.1 | 10 | 3.2 | 2.5 | 14 | 0.6 | 3.5 |
| Wrist | 2 | 1.6 | 2 | 0.6 | 1.0 | 0 | 0.0 | 0.0 |
| Elbow | 1 | 0.8 | 2 | 0.6 | 2.0 | 14 | 0.6 | 14.0 |
| HEAD AND TRUNK | 16 | 12.4 | 44 | 13.9 | 2.8 | 136 | 5.7 | 8.5 |
| Neck | 8 | 6.2 | 20 | 6.3 | 2.5 | 53 | 2.2 | 6.6 |
| Chest | 5 | 3.9 | 10 | 3.2 | 2.0 | 83 | 3.5 | 16.6 |
| Head | 2 | 1.6 | 13 | 4.1 | 6.5 | 0 | 0.0 | 0.0 |
| Face | 1 | 0.8 | 1 | 0.3 | 1.0 | 0 | 0.0 | 0.0 |
| NOS[5] | 3 | 2.3 | 5 | 1.6 | 1.7 | 8 | 0.3 | 2.7 |
| **TOTAL** | **129** | **100.0** | **316** | **100.0** | **2.5** | **2379** | **100.0** | **18.4** |

1. Students may have more than one injury.
2. Total Clinic Visits = Initial and follow up visits.
3. Mean = Mean # of clinic visits per injury.
4. Mean = Mean # of limited duty days per injury.
5. NOS = Not otherwise specified.

## Incidence and Distribution of Illness

The cumulative incidence of soldiers with one or more illnesses during the 9½-month course was 63.1% (94/149). The frequency and distribution of different types of illnesses and associated loss of duty time are shown in Table 7. A total of 178

illnesses were documented in the 94 soldiers that suffered at least one illness while attending SGMA Class 46. A total of 435 clinic visits were reported, and these illnesses resulted in 311 limited duty days. The crude incidence rate (initial illnesses) was 6.6 illnesses per 100 soldiers per month. Infectious illness was the most frequent illness category reported and accounted for 178 limited duty days. Bacterial and viral infections were reported most frequently and accounted for 57.2% of the total limited duty days. These infections primarily affected the respiratory system. Hypertension accounted for the greatest number of total clinic visits (208 initial and follow-up visits).

Table 7. Frequency and distribution of illnesses and associated limited duty days by type of illness in SGMA Class 46.

| ILLNESS | Illness[1] | | Total Clinic Visits[2] | | | Total Limited Duty Days | | |
|---|---|---|---|---|---|---|---|---|
| | # | % | # | % | Mean[3] | # | % | Mean[4] |
| INFECTIOUS ILLNESS | 86 | 48.3 | 118 | 27.1 | 1.4 | 178 | 57.2 | 2.1 |
| Bacterial | 51 | 28.7 | 77 | 17.7 | 1.5 | 131 | 42.1 | 2.6 |
| Viral | 30 | 16.9 | 35 | 8.1 | 1.2 | 47 | 15.1 | 1.6 |
| Fungal | 3 | 1.7 | 3 | 0.7 | 1.0 | 0 | 0.0 | 0.0 |
| Chlamydia | 1 | 0.6 | 2 | 0.5 | 2.0 | 0 | 0.0 | 0.0 |
| NOS[5] | 1 | 0.6 | 1 | 0.2 | 1.0 | 0 | 0.0 | 0.0 |
| DERMAL | 12 | 6.7 | 16 | 3.7 | 1.3 | 46 | 14.8 | 3.8 |
| Edema | 4 | 2.3 | 7 | 1.6 | 1.8 | 46 | 14.8 | 11.5 |
| Dermatitis | 4 | 2.3 | 4 | 0.9 | 1.0 | 0 | 0.0 | 0.0 |
| Bite | 2 | 1.1 | 2 | 0.5 | 1.0 | 0 | 0.0 | 0.0 |
| Rash | 2 | 1.1 | 3 | 0.7 | 1.5 | 0 | 0.0 | 0.0 |
| GASTROINTESTINAL | 4 | 2.3 | 6 | 1.4 | 1.5 | 0 | 0.0 | 0.0 |
| Ulcer | 3 | 1.7 | 5 | 1.2 | 1.7 | 0 | 0.0 | 0.0 |
| Hemorrhoid | 1 | 0.6 | 1 | 0.2 | 1.0 | 0 | 0.0 | 0.0 |
| CARDIOVASCULAR | 40 | 22.5 | 214 | 49.2 | 5.4 | 16 | 5.1 | 0.4 |
| Hypertension | 35 | 19.7 | 208 | 47.8 | 5.9 | 15 | 4.8 | 0.4 |
| Chest Pain | 5 | 2.8 | 6 | 1.4 | 1.2 | 1 | 0.3 | 0.2 |
| OTHER ILLNESSES | 36 | 20.2 | 81 | 18.6 | 2.3 | 71 | 22.8 | 2.0 |
| NOS[5] | 19 | 10.7 | 46 | 10.6 | 2.4 | 1 | 0.3 | 0.1 |
| Allergy | 14 | 7.9 | 30 | 6.9 | 2.1 | 70 | 22.5 | 5.0 |
| Reproductive | 2 | 1.1 | 4 | 0.9 | 2.0 | 0 | 0.0 | 0.0 |
| Numbness | 1 | 0.6 | 1 | 0.2 | 1.0 | 0 | 0.0 | 0.0 |
| **TOTAL** | **178** | **100.0** | **435** | **100.0** | **2.4** | **311** | **100.0** | **1.8** |

1. Students may have more than one illness.
2. Total Clinic Visits = Initial and follow up visits.
3. Mean = Mean # of clinic visits per illness.
4. Mean = Mean # of limited duty days per illness.
5. NOS = Not otherwise specified.

## ASSOCIATION BETWEEN SMOKING, ALCOHOL USE AND APFT SCORES

Smoking, push-up, sit-up and run time data were available for 95 students. These data were analyzed using a one-way ANOVA test which indicated that smokers had significantly slower run times than nonsmokers (p=0.01, Table 8). However, no significant associations were found between push-up and sit-up test scores and smoking.

Table 8. Association between self-reported smoking history and 2-mile run times.

| Smoking | n | Mean Run Time (min) | S.D. | Range (min) |
|---|---|---|---|---|
| Yes | 22 | 16.5* | 1.7 | 13.3 - 20.8 |
| No | 73 | 15.5 | 1.4 | 12.1 - 21.1 |

*p = 0.01

A logistic regression model was conducted on smoking, run time, and age. The model was based on 93 students with complete data on these three variables. According to the model, as run times increased by 1 minute, the odds of being a smoker increased by 54.0% or 1.54 times. The age range was small and not found to be statistically significant in the model.

Self-reported alcohol use and push-up, sit-up and 2-mile run test scores were evaluated using ANOVA analyses. No significant relationships were found between alcohol use and these variables.

## ASSOCIATION BETWEEN SMOKING AND BASELINE CHOLESTEROL LEVELS

Table 9 outlines the association between smoking and baseline cholesterol level. Baseline cholesterol levels were defined as values obtained during the first week of the course. Smoking and cholesterol data were available for 134 SGMA Class 46 students. The group mean baseline cholesterol level was significantly higher (p=0.04) for smokers than nonsmokers. The difference between the mean cholesterol levels of the two groups was 7.0 mg/dl. The relationships between high density lipoprotein

cholesterol (HDL) and triglycerides and smoking history were not examined because of missing data.

Table 9. Association between smoking and baseline cholesterol levels.

| Smoking | n | Mean Cholesterol (mg/dl) | S.D. | Range (mg/dl) |
|---|---|---|---|---|
| Yes | 35 | 196.8* | 29.9 | 125.0 - 263.0 |
| No | 99 | 189.8 | 28.8 | 133.0 - 268.0 |

*p = 0.04

## RISK FACTORS FOR INJURY AND ILLNESS

### Risk Factors For Injury

No significant associations were found between musculoskeletal injuries and age, height, weight, BMI, physical fitness, cholesterol, smoking and alcohol use.

### Risk Factors For Illness

Alcohol and illness data were available for 128 students. Individuals that self-reported alcohol use were two times as likely to have an infectious illness than nonusers. These data are outlined in Table 10.

Table 10. Incidence of infectious illness, relative risk (RR) and 95% confidence intervals (CI) for alcohol consumption.

| Alcohol Use | n | Illness Incidence (%) | RR* | 95% CI** |
|---|---|---|---|---|
| Yes | 68 | 51.5 | 2.1 | 1.3 - 3.4 |
| No | 60 | 25 | Referent | N/A |

* RR=relative risk
**CI=confidence interval

The relationship between smoking and illness was also examined and no significant association was found.

# DISCUSSION

The present study examined the incidence of injury and illness among students enrolled in SGMA Class 46. While attending the 9½-month course, students were much more likely to develop an illness than incur an injury (63.1% vs. 49.7%). However, the total number of limited duty days was 7.6 times greater for injuries than illnesses. These findings are supported by other military studies (13, 19, 26).

Most of the injuries involved either the lower extremities or the lower back. These findings are again consistent with other published reports (13, 18, 19, 21, 26). These results are not surprising, since physical training involves running and marching, which are weight-bearing activities that stress the lower body.

Infectious illnesses were the most common illnesses reported among SGMA students and accounted for the greatest number of limited duty days. The majority of clinic visits for infectious illnesses involved the respiratory system (57.0%). In an earlier study, Jones et al. (13) reported that 81.5% of clinic visits for all illnesses by Army recruits were attributed to upper respiratory infections. Respiratory-transmitted infections have been reported at Army training centers where soldiers are in close quarters, training together, and immunologically susceptible to infection (2). The majority of the SGMA Class 46 students were in separate housing, but they trained together and participated in indoor classroom activities that would increase the risk for transmission of airborne infectious agents. Factors that may have attributed to increased susceptibility to airborne agents in this older student population include underlying chronic illnesses, vigorous physical training (14), and psychological stressors (4, 9) attributable to course demands and requirements.

Direct comparisons of injury and illness incidence are difficult to make between this cohort group of SGMA students and previous SGMA classes because of a lack of published data. However, comparisons to other published Army studies are of interest. Jones et al. (13) reported an injury incidence for male Army recruits that was lower than that found in males in the present study (27.4% vs. 50.3%). However, soldiers in this earlier study were younger than SGMA 46 students (mean age 20.2 vs. 41.9). It is

possible that this age differential accounts for the increased number of injuries found in the present study. This is supported by the findings of Jones et al. (11) where the relative risk of lower extremity injury was greater with increasing age among male Army recruits during basic training. The effects of age on risk of injury varies according to the population being studied (25). If soldiers train at similar intensity levels, the risk of injury is greater for older soldiers (11).

History of alcohol use prior to SGMA training was a significant risk factor for infectious illnesses. Engs et al. (8) has reported that among 1,100 undergraduate students, the incidence of upper respiratory infection was higher for students who consumed 22 or more alcoholic drinks per week when compared to nondrinkers. In the present study, the quantity of alcohol was not documented, but a strong relationship was observed between alcohol consumption and infectious illnesses. Laboratory studies (22) on spleens of mice have suggested that chronic alcohol consumption impairs lymphocytic recruitment, therefore increasing susceptibility to infection.

In the present study, 26.1% of SGMA students self-identified themselves as cigarette smokers. Subjects who self-reported a history of smoking prior to SGMA training had a significantly lower cardiorespiratory endurance (i.e., 2-mile run time) compared with nonsmokers. A recent study examined the relationship between run time and cigarette smoking among young (mean age 19.3) female Marine Corps recruits (15). This study did not find a significant association between run time and smoking history. However, the authors speculated that a positive association may have been found if the population were older and had a longer smoking history. Such speculation is supported by Daniels et al. (6) who showed that maximal oxygen consumption ($VO_2$ max) between smokers and nonsmokers was not different for a younger population (mean age 22.0), but did differ significantly for soldiers 15 - 20 years older. The present data support the findings of Daniels et al. (6) in that smoking among older subjects was correlated with slower run times.

In the present study, smoking history was associated with higher total cholesterol levels. Hughes et al. (10) reported higher mean triglyceride levels and lower mean serum HDL cholesterol levels in male smokers ages 30-69 when compared to nonsmokers. Additionally, Dullaart et al. (7) found lower HDL cholesterol levels in

non-diabetic smokers. Recent findings (17) suggest that smokers have impaired cholesterol transport mechanisms, which may explain the association between smoking history and increased total cholesterol levels.

## CONCLUSIONS

1. Musculoskeletal injuries were the major cause of limited duty days during physical fitness training.

2. Overuse lower extremity and lower back injuries were the most commonly reported injuries.

3. Respiratory bacterial and viral infectious illnesses were the most commonly reported illnesses.

4. Alcohol consumption was a risk factor in the development of infectious illnesses.

5. Smokers had slower 2-mile run times than nonsmokers.

6. Smokers had higher cholesterol levels than nonsmokers.

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