Final Performance Report

Knee-Related Injuries and Disabilities in the U.S. Army 1980-1987
NIOSH Grant # 5 R03 OH03787-02

(Project Director: Roy Fleming, PhD)

November 30, 2001

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List of abbreviations

BLS	Bureau of Labor Statistics
CDC	Centers for Disease Control
CI	Confidence interval (95%)
CMF	Career Management Field
FTE	Full-time equivalent
ICD-9-CM	Ninth revision of the International Classification of Diseases, Clinical Modification
OR	Odds ratio
PMOS	Primary Military Occupational Specialty
TAIHOD	Total Army Injury and Health Outcomes Database
U.S.	United States
VASRD	Veteran's Administration System for Rating Disabilities

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Summary Report

Abstract

We studied knee-related occupational disability and associated injuries using information recorded in the Total Army Injury and Health Outcomes Database (TAIHOD). Of interest were two different, but related events: hospitalization for severe knee injury and knee-related disability discharge from the Army. The overall objective was to investigate the nature of and differences among the risk factors for these two events. The data source, the TAIHOD, is a relational database containing occupational and selected health information for all individuals on active duty in the U.S. Army, beginning January 1, 1980. The source population for this study consists of all enlisted personnel in the U.S. Army on active duty at any time between 1980 and 1998, about 2.7 million individuals (11% women). We analyzed selected sub-samples of the TAIHOD to address three specific aims:

1. What are the risk factors for knee-related disability discharge?
2. What are the risk factors for severe knee injury defined by hospitalization for a knee-related diagnosis or procedure?
3. How do risk factors for injuries that lead to disability compare to risk factors for injuries that do not lead to disability?

For each aim, an appropriate analysis sample of the TAIHOD was constructed using standard methods of incidence density sampling. For aim one, this yielded a sample size numbering 6,810, of whom 1,703 were discharged for knee related disability. For aim two, the analysis sample numbered 12,000, of whom 4,000 were hospitalized for severe knee injury. Aim three entailed a comparison of the results of analyses for the other two aims, with particular attention to ways in which the model for each outcome differed.

Analysis results suggested that predictors of knee-related disability discharge from the Army and predictors of knee-related hospitalization were different. For knee-related disability discharge, occupational characteristics were less potent correlates of the outcome than were sociodemographic characteristics. This was especially true for women, for whom no specific work task was associated with odds of knee-related disability discharge.

Among both men and women, non-whites had reduced odds of knee-related disability (OR=0.5 for women and OR=0.8 for men), but higher odds of knee injury (OR=1.3 for women, OR=1.2 for men) than whites. For both genders, those in the oldest age quintile had higher odds of both injury and disability compared to those in the youngest age quintile. Even controlling for age and other factors, duration of service was positively associated with odds of knee injury (OR=1.4 for fifth quintile vs. first quintile for each gender). Pay grade was negatively associated with odds of disability (OR=0.2 for E7-E9 vs. E1-E3, men and women) and with odds of injury for men (OR=0.7), in spite of its positive correlation with both age and duration of service. Patterns of odds ratios for other occupational and demographic factors differed for men and women by outcome. Exploratory analyses of possible effect modification suggested interactions between demographic and occupational factors including race/ethnicity, age, and duration of service. We also assessed the adequacy of the final outcome- and gender-specific models for different types of injuries and disabilities.

These analyses were possible because of the availability of a large database containing occupational, demographic and health information for a cohort of Army personnel. The wide range of data elements and the large, relatively diverse population enabled the evaluation of the separate and combined influence of sociodemographic and occupational characteristics on the risk of occupational injury and disability. The differences between the final injury and disability models suggests that the use of separate case-control comparisons to identify risk factors for related outcomes is a viable research method.

Significant Findings

Specific aim one: What are the risk factors for knee-related disability discharge? Few occupational characteristics were associated with knee-related disability discharge for either men or women. Women in the highest pay grade category (E4-E9) were at 80% reduced risk of knee-related disability compared to those in the lowest category (E1-E3), and those in the highest quintile of duration of service had 40% higher odds of discharge compared to those in the lowest quintile. Specific jobs held, defined by Career Management Field (CMF), tended to show increased odds compared to Support/Administration, although these estimates were generally quite imprecise. Among men, those in the highest pay grade category also had 80% lower odds of knee-related disability discharge from the

Army compared to those in the lowest pay grade category after controlling for other factors. Longer duration of service and being in a job that required some amount of kneeling were associated with increased odds of disability. CMF was not clearly associated with the odds of disability discharge, though it was an important confounder of terms included in the final model. Odds ratios for most CMF were slightly below one when compared with Support/Administration. For both men and women, age was positively correlated with odds of knee-related disability discharge, and being of nonwhite race was negatively associated with disability discharge.

Specific aim two: What are the risk factors for severe knee injury defined by hospitalization for a knee-related diagnosis or procedure code? Several additional work-related characteristics were correlated with knee-related hospitalization compared with covariates included in the model for disability discharge. Women having jobs associated with climbing tasks had slightly higher odds of knee injury than women in jobs not requiring climbing; this job task was a confounder of other terms in the model, as were running/walking distance, kneeling, sitting and standing. Women in most CMF had lower odds of injury compared to those in Support/Administration. For men, being in the highest pay grade category (E4-E9) was associated with 30% lower odds of knee injury compared to being in the lowest pay grade category (E1-E3) after controlling for other demographic and job characteristics. Those with a job rated as very physically demanding or one that required any amount of sitting had higher odds of knee injury compared with men in less demanding jobs, or jobs not associated with sitting. Although there were no obvious patterns in the odds of injury associated with specific CMF compared to Support/Administration, this parameter was an important confounder of other terms included in the final model. Other jobs tasks (higher climbing heights, standing, and lifting and carrying) were included in the model for the same reason. For both men and women, age and being of nonwhite race were both positively correlated with odds of knee injury. Women with larger numbers of dependents also had higher odds of injury compared to those with one or no dependents.

Specific aim three: How do risk factors for injuries that lead to disability compare to risk factors for injuries that do not lead to disability? For women, none of the specific job tasks considered were predictors of knee-related disability, but several specific tasks (running/walking; climbing; kneeling, sitting and standing) as well as physical demand ratings were included as predictors of knee injury, at least due to their confounding effects on other terms in the model. Although increased age was

associated with higher odds of both injury and disability for women, the other two terms that correlated with both injury and disability showed different patterns in their effect estimates: Nonwhite women were at lower risk of disability but higher risk of injury compared to white women, and the Administration/Support CMF was associated with lower risk of disability but higher risk of injury compared to other CMF. The injury and disability models for men contained a number of sociodemographic and occupational factors in common, although more occupational characteristics were correlated with odds of injury than of disability. The patterns of higher and lower odds of outcome were generally similar for all of the common covariates except CMF (Administration/Support associated with higher odds of disability and lower odds of injury) and lifting/carrying (higher weights associated with higher odds of disability and lower odds of injury). The only additional covariate associated with knee-related disability discharge for men was duration of service (positively correlated with odds of disability discharge and not associated with knee injury).

Usefulness of Findings

Identifying occupational risk factors for knee-related hospitalization and disability among Army personnel may be helpful in reducing the risk of future knee injuries and disabilities. Such risk factors may be modifiable by implementing changes to work tasks, training, equipment or job assignments. The observed interaction between occupational and demographic characteristics suggests that there may be subgroups within certain job assignments that are more susceptible to injury or disability than others. If so, then an evaluation of the adequacy or appropriateness of equipment, training or job assignments may be targeted to certain subgroups, thus increasing the efficiency of future intervention efforts.

These analyses also demonstrate the utility of administrative data for analytical research. The complexity of the analyses we were able to carry out, and the rich variety of results obtained, show the cost-effectiveness of using existing data for analytical epidemiology. This approach should be considered a reasonable alternative to other, more expensive research paradigms.

List of Publications

Sulsky S, Mundt KA, Bigelow C, Amoroso PJ, Fisher D. Knee-related injuries and disabilities in the U.S. Army, 1980-1997. Frederick, MD: U.S. Army Medical Research and Materiel Command, 2000

Submitted to Occupational and Environmental Medicine June 2001:

Sulsky SI, Mundt KA, Bigelow C, Amoroso PJ. "Knee injuries among enlisted women in the U.S. Army."

Anticipated publications:

A comparison of risk factors for knee-related hospitalization and disability discharge from the U.S. Army: Men

A comparison of risk factors for knee-related hospitalization and disability discharge from the U.S. Army: Women

Explanation of How Publication Relates to Study Aims

The published Army Technical Report "Knee injuries among enlisted women in the U.S. Army",[Sulsky, 2000 two08] listed above and provided with this report, addresses all three specific aims. It summarizes the background and rationale for the overall study, including a description of the conceptual framework for the selected approach, in chapter one. Chapters two and three describe the results of analyses directed at the first two specific aims. The third specific aim is addressed, with some cautions, in chapter four.

The cautions relate to a bias identified in the sampling strategy employed to create the research database. The bias was described in the progress report for this project, submitted to the funding agency in June 2000, and is also addressed in chapter four of the attached publication.

Upon identifying the sampling problem, we constructed a new research database to correct the identified bias. Since the TAIHOD had been updated during the intervening year, we included data through 1998 in the new research database. The technical report that follows this summary report addresses specific aims two and three, based on the new research database

Scientific Report

Organization of Scientific Report

As we have now published the results of analyses to address aim one (see enclosed), the content of this scientific report pertains to aim two (risk factors for hospitalization for severe knee injury) and aim three (comparison of risk factors for knee-related disability discharge versus hospitalization for severe knee injury). For completeness here, however, we also provide a rationale (including an overview of selected relevant literature), an overview of sampling and analysis methods, and a concluding discussion.

Rationale

Occupational injuries are responsible for more lost time from work, productivity and working years of life than any other health condition in the United States.[1,2]The consequences of occupational injuries include physical, psychological, and economic components for both the injured worker and the employer.[3]

The U.S. Army offers a unique opportunity to study determinants of occupational injuries and disabilities for numerous practical and methodological reasons, including: (1) the wide variety of jobs in the Army enables the analysis of many risk factors, with the potential for identifying gradations in risk; (2) many military jobs are physically demanding, representing high risk for injury and disability; (3) all injuries for which medical attention is sought are documented in central databases; (4) medical care is equally available to all Army personnel, thus removing variability in access to care as an alternative explanation for observed differences in reported injury rates across strata defined by sociodemographic characteristics; (5) large numbers of women and members of racial/ethnic minorities are employed by the Army, allowing for the investigation of demographic differences in risk; (6) many military jobs are also represented in the civilian sector. A sizeable proportion of the risk factors identified in the Army, therefore, should be applicable outside of the military setting.

Of particular interest among occupational musculoskeletal disabilities are knee-related outcomes. They are a large, growing and costly problem both in the Army and in the civilian sector.[4-7] Physical demands have been associated with knee injury and the subsequent development of knee disorders.

These demands may be the result of occupational activities such as prolonged kneeling[8-10] or recreational activities such as running or participation in certain sports.[11,12] Within the Army, especially, work is physically demanding, both due to specific job requirements and because physical fitness training is an integral part of the military life. Since Army personnel are required to meet physical fitness standards, and are regularly tested to assure adherence to those standards, exercise and fitness training may be considered occupational activities in this population.

To date, most occupational knee injury studies have focused on one or two activities (e.g., kneeling, walking) or identified the longest job held (e.g., carpet layer, painter) as a surrogate for specific activities or workload. The TAIHOD has the advantage of including semiannual records of job assignments and standardized assessments of physical demands for each coded job for all members of the population; this is a marked improvement over the level of detail available in most studies. In addition, there is a great deal of diversity in occupations represented in the Army, with jobs ranging from clerical staff to heavy construction and infantry. This variability enables the assessment of differences in risk associated with jobs that are rated similarly with respect to physical demands, or jobs that have different levels of demand but include similar activities.

Thus, rationale for this study derives from both the public health and economic significance of knee-related occupational injuries and the opportunity afforded by the TAIHOD for their investigation.

Overview of Sampling and Analysis Methods

Detailed descriptions of the data source (the TAIHOD), source population (all enlisted persons in the US Army on active duty between 1980 and 1998) and the data library have been published, (see enclosed, pp 9-11), as have case and control definitions for aim one (enclosed, pp 13-15).

Sampling

For each of aims one and two, a case-control study design was used. The analysis sub-samples of the TAIHOD were constructed by using standard methods of incidence density sampling. Briefly, this entailed selection, first, of cases of event (either knee-related disability discharge or hospitalization for severe knee injury) followed by incidence density sampling of controls matched on gender and year of case identification. Specifically, controls were randomly sampled, within strata defined by gender, in

proportion to the number of male or female cases, respectively, recorded in each six month interval during the study period. The follow-up window for all cases and controls began on the latest of enlistment in the Army or January 1, 1980 and ended on the earliest of the case date, separation from the Army or December 31, 1998. Specific case and control definitions for each aim are detailed below. The result was two case-control studies, each nested within the cohort of all enlisted personnel on active duty in the U.S. Army between 1980 and 1998. Thus, the study period began on January 1, 1980 and ended on December 31, 1998.

Case and Control Definitions for Aim One (Knee-Related Disability Discharge)

Details of the case and control series definitions for aim one are described in the enclosed publication (pp 13-15). Briefly, knee-related disability discharge was defined using 11 knee-related codes in the Veteran's Administrations System for Rating Disability (VASRD). Included as cases were the first knee-related disabilities among enlisted soldiers who were on active duty at the time of disability determination. We sampled controls from each year in proportion to the number of cases recorded in that year to approximate incidence density sampling for the study period.

Case and Control Definitions for Aim Two (Knee-Related Hospitalization)

Cases. Since no outpatient data were available in the TAIHOD, we used first inpatient hospitalization for knee-related problems to represent first reported knee injury. Although some milder injuries requiring only outpatient care are undoubtedly excluded from study under this operational definition, it is very likely that all potentially severe knee injuries are included. The specific diagnoses and procedures used to classify hospitalizations as knee-related, coded according to the ninth revision of the International Classification of Diseases, Clinical Modification (ICD-9-CM), are listed in the Appendix.

Up to eight diagnoses and eight procedures are recorded in the database for each hospital stay. One diagnosis is identified as the primary reason for the admission, and all other diagnoses are recorded without regard to importance. Cases were identified by the presence of at least one knee-related diagnosis or procedure code recorded in any position. Records were then sorted by admission date for each person, and the first admission for a knee-related diagnosis or procedure retained as the case-defining event.

A total of 1,767,365 hospital records were included in the TAIHOD between January 1, 1980 and December 31, 1998. Of these, 102,410 were for first occurrence of a knee-related hospital stay. After linking hospital and occupational records to identify active duty enlisted persons, a total of 97,768 (11% women) cases were eligible to be included in the analysis.

Controls. We used incidence density sampling to identify potential controls in proportion to the number of cases recorded in each calendar year. Controls were drawn from the pool of enlisted personnel on active duty with no recorded knee-related hospitalization as of a given calendar year. The sampling was stratified by gender, using a ratio of 1.5 controls per case for men and six controls per case for women, yielding a pool of 140,559 potential controls for the analysis (115,899 men and 24,660 women).

Analytical sample. A preliminary review of the hospital data file indicated fewer admissions than expected between 1980 and 1984, suggesting incomplete data acquisition into the TAIHOD. There was also a steep decline in the number of admissions for 1997 and 1998, either indicating another episode of incomplete data acquisition or corresponding to the general shift towards outpatient care that became the norm in the late 1990s. Because of these unusual patterns, we restricted the study period to 1985 through 1996. From the pool of potential cases and controls, we selected self-weighted random samples of 2,000 male and 2,000 female cases and 4,000 male and 4,000 female controls. The weights corresponded to the proportion of cases, within gender, recorded for each calendar year in the study period.

Analysis methods

We used SAS version 6.8 [13] for data management and analysis. Once the relevant data for the members of the analytic subset were compiled from the various source files in the TAIHOD, we evaluated univariate and bivariate frequency distributions to assess data quality and completeness, to

assess the scale of continuous covariates and to create categorical variables. Statistical methods for aim one are described in the enclosed publication (pp 17-18).

For specific aim two, we used single predictor logistic regression models to identify candidate terms to be included in multivariable regression models. In some cases, the single predictor models also enabled us to identify categories within multi-level covariates that could be collapsed due to the similarity of their point estimates. Any term with an odds ratio (OR) that had $p \leq 0.25$ for at least one of its categories was considered a candidate for inclusion in the multivariable model. Terms that were statistically significant in the multivariable setting at the conventional level of $p \leq 0.05$ for at least one of the associated categories were retained in the final model.

We assessed the possible confounding effects of excluded terms by calculating the relative change in the regression coefficients and odds ratios of all other terms in the model, and by conducting likelihood ratio tests. A change in coefficient of at least 20% or a change in OR of at least 10% was taken as evidence of confounding, and the associated covariate was reinstated into the model.[14]

Since our goal was to evaluate occupational risk factors for knee injury while taking into account demographic characteristics, we first identified the best multivariable model for the demographic factors in addition to age and race, then added individual work-related covariates. The "best" sociodemographic model was determined based on the highest proportion of concordant and lowest proportion of discordant observations compared with values predicted by the model; the amount of variability explained by the model based on the magnitude of the p-values associated with each estimate; and the Hosmer-Lemeshow goodness of fit test.[14] We used the same techniques to identify which of the work-related covariates should be considered as candidates for inclusion in a multivariable model that included both demographic and occupational information.

We conducted all analyses separately for men and women, since we expected risk factors to operate differently for men and women based on earlier findings regarding knee-related disability discharge from the Army.[15-18] Also based on previous work, we evaluated effect modification by re-running the gender-specific final models separately for categories of age, race, and duration of service.[15] Since the baseline risks captured by the referent categories in the various strata are expected to differ, it would be inappropriate to directly compare the magnitudes of specific risk estimates across strata. However, examining differences in patterns of estimates across strata may be informative, especially when the point estimates indicated opposite effects for one group compared to another.

Finally, we theorized that risk factors might operate differently depending on the type of injury being considered. To investigate this possibility, we conducted subgroup analyses based on the tissue type (soft tissue vs. bone) and chronicity of the condition (acute vs. chronic).

For specific aim three, we compared the main effects models developed for aim one and aim two, by gender and outcome. The goal was to identify differences in 1) the particular covariates included in the injury and disability models, separately for men and women; 2) the patterns of estimates associated with each term included in the injury and disability models, separately for men and women; 3) the covariates included in the models for each outcome, within gender; and 4) the patterns of estimates associated with each term included in the models for each outcome, within gender.

Results, Aim Two

Women

Table 1 shows the demographic and occupational characteristics of all female cases and controls included in the analyses. The cut points for the age and duration of service categories are the quintile cut-points for those variables using all 24,660 female controls in the research database.

Among women, cases were more likely to be white than controls. They were also slightly older, and, although the distribution of marital status categories was nearly identical for the two groups, cases were likely to have a larger number of dependents than controls. The educational attainment of cases and controls was nearly identical, whether assessed at entry into the Army (not shown) or at the end of the study period. Cases and controls were distributed fairly equally across categories of duration of service and of pay grade, and, with the exceptions of Support/Administration (29.9% of cases, 38.9% of controls) and Electrical/Mechanical Equipment repair (10.6% of cases, 7.4% of controls), they fell into similar job categories as defined by Career Management Fields (CMF).

Cases were more likely than controls to be in jobs with physical demands rated as light or moderately heavy, but not very heavy. Similarly, cases were less likely than controls to be in jobs that entailed long distance running/walking, climbing, lifting/carrying, kneeling, or sitting.

Multivariable modeling

Age and race were forced into all multivariable models, and number of dependents was the only additional demographic characteristic associated with odds of knee-related hospitalization. Among work

characteristics, the physical demand ratings associated with individual jobs was the only one that appeared to be independently associated with risk of knee-related hospitalization. However, several of the other work characteristics evaluated exerted a confounding effect on one or more of the terms in the base model, so these were also included in the final model. The final multivariable model for women consisted of quintiles of age; an indicator for nonwhite race; number of dependents (0-1 vs. 2-3 or 4-7); CMF; physical demand ratings (light, medium or moderately heavy vs. heavy or very heavy); distance running/walking (none vs. 1-25 feet, 25-50, 50-100 and 100-500 feet and 0.25-1 mile); and indicators for any climbing, kneeling, sitting or standing (table 2). A total of 917 female cases and 1,996 female controls had complete data for all terms included in the final model.

Table 2 shows that adjusted odds ratios (OR) for knee-related hospitalization among women were fairly stable across the first three quintiles of age. Compared to 18-20 year olds, the odds for knee-related hospitalization were 20% higher for the 26-29 year olds (OR=1.20, 95% confidence interval (CI) 0.89, 1.62), and 46% higher for those aged 30 years and older (OR=1.46, CI 1.10, 1.95). White women had odds of hospitalization 34% higher than nonwhite women (OR=1.34, CI 1.13, 1.59). Even after adjustment for age and other covariates, women with four or more dependents had 30% higher odds of hospitalization compared to women with fewer dependents (OR=1.30, CI 0.97, 1.73).

Nearly all of the CMF were associated with lower odds of knee-related hospitalization than Support/Administration (defined as the referent group), but these estimates had with rather wide confidence intervals. Women with jobs associated with heavy or very heavy physical demands had 12% lower odds of knee-related hospitalization compared to women with less physically demanding jobs (OR=0.88, CI 0.50, 1.54), but this estimate was also quite imprecise. There were no clear patterns of increasing or decreasing odds of hospitalization associated with specific job tasks; these terms were included in the model due to their apparent confounding effects on other covariates.

Evaluation of effect modification

Race. There was some evidence of effect modification by white vs. non-white race (table 2). In particular, when compared with women in the youngest age group, the odds of knee-related hospitalization were higher for each quintile of increasing age among white women, whereas there were no differences in odds across categories of age for nonwhite women. For white women, a larger number of dependents was not associated with a change in odds of hospitalization compared to having no

dependents or one dependent, but nonwhite women with four or more dependents had 58% higher odds than the referent group (OR=1.58, CI 1.08, 2.32).

Compared with Support/Administration, other CMF were generally associated with lower odds of knee-related hospitalization for both white and nonwhite women. However, the patterns for two CMF looked substantially different for the racial groups, with possible reversals in the direction of effects: For the Technical Specialties, OR=0.41 (CI: 0.13, 1.29) for white women and OR=0.98 (CI: 0.15, 6.31) for nonwhite women. For white women classed as Craftworkers, OR=0.78 (CI: 0.25, 2.38), while for nonwhite women in these jobs, OR=1.30 (CI: 0.26, 6.75). Note, however, that wide confidence intervals indicate substantial lack of precision in these estimates.

There were no clear patterns in the ORs associated with specific work tasks for either white or nonwhite women. The directions of the estimates for several of the running/walking distance categories (1-25 feet, 101-500 feet and 0.25-1 mile) changed across strata of race, but the associated confidence intervals were too wide for these to be easily interpreted. Jobs associated with climbing had higher odds of knee-related hospitalization for both white and nonwhite women. White women had higher odds of hospitalization if their jobs were associated with kneeling, and lower odds if in jobs associated with sitting. These patterns were the opposite for nonwhite women.

The Hosmer-Lemeshow goodness of fit test indicated a good fit of the model to the data for white women (p=0.69), but questionable fit for the nonwhite women (p=0.25).

Age. We stratified the population into three groups, corresponding to the first and second quintiles (18-22 years; 279 cases and 650 controls); the third and fourth quintiles (23-29 years; 365 cases and 859 controls) and the fifth quintile of age (30-59 years; 273 cases, 487 controls). Confidence intervals in this analysis tended to be very wide, indicating substantial imprecision in point estimates (table 3).

The odds of knee-related hospitalization associated with demographic characteristics other than age showed substantial differences across categories of age. Among the youngest women, nonwhites had 29% higher odds of being hospitalized than whites (CI: 0.95, 1.76), similar to the estimate derived for the study population as a whole. In the middle age group, however, odds were 48% higher for nonwhite compared to white women (CI: 1.13, 1.94), and the oldest nonwhite women had 19% higher odds of knee-related hospitalization compared to the oldest white women (CI: 0.86, 1.65).

The higher odds of knee-related hospitalization noted for women with larger numbers of dependents seemed to be concentrated among the women in the youngest age group. In this category, women with at least four dependents had more than five times higher odds of knee-related hospitalization compared to women with up to one dependent (OR=5.27, CI: 0.94, 29.40). For women in the middle age group, the same contrast yielded OR=1.07 (CI: 0.67, 1.71), and for the oldest women, OR=1.63 (CI: 1.05, 2.54).

There were too few women in the Mechanical Equipment Repair and Service/Supply CMF to include in the analysis stratified by age. As observed for the main contrasts using all cases and controls, the odds of knee-related hospitalization tended to be less than one compared to the Support/Administration CMF for most of the CMF that we were able to evaluate. The Health Care CMF offered a notable exception, with an increase in odds compared to women in Support/Administration for the oldest age group (OR=1.26, CI: 0.44, 3.56).

The odds of knee-related hospitalization associated with specific job tasks showed different patterns in the age-stratified analyses compared to the main analysis. Women aged 18-22 years who had heavy or very heavy job demands had odds of hospitalization nearly 60% higher than their counterparts in jobs with low to moderate demands (OR=1.55, CI: 0.58, 4.16). The odds associated with heavy job demands were 0.77 (CI: 0.32, 1.86) and 0.62 (CI: 0.20, 1.98) for women in the middle and older age categories, respectively. In the main analysis, there were no clear patterns in the odds of hospitalization for women in jobs associated with running or walking. However, the youngest women in jobs associated with any amount of running or walking had lower odds of knee-related hospitalization compared to those in jobs not associated with running or walking, whereas women in the two older age groups had higher odds of knee trouble if they had jobs associated with any of the three longest running and walking distances.

The slight increase in odds of knee-related hospitalization noted for women in jobs associated with climbing seemed to be concentrated in the youngest age group. Compared to women in jobs not associated with climbing, OR=1.95 (CI: 0.69, 5.57) for this group. The patterns of ORs for women in jobs associated with kneeling also depended on age. Women in either of the two youngest age categories who had jobs associated with kneeling had odds of knee-related hospitalization about 40% higher than women in jobs not associated with kneeling (OR=1.42, CI: 0.42, 4.79 for ages 18-22 years, and OR=1.35, CI: 0.37, 4.91 for ages 23-29 years), while women in the oldest age group had reduced odds of knee injury if their jobs were associated with kneeling (OR=0.78, CI: 0.18, 3.37). The patterns of

odds ratios across age strata were similar for women in jobs associated with sitting and for those in jobs requiring standing. For both activities, 18-22 year old women had somewhat reduced odds of knee-related hospitalization compared to the referent group (OR=0.58, CI: 0.10, 3.42 for sitting and OR=0.36, CI: 0.31, 1.53 for standing), while women in the two older age groups had OR not substantially different than one.

The model fit the data for all three of the age strata, with p-values from the Hosmer-Lemeshow goodness of fit test of 0.98, 0.94 and 0.34, respectively.

Duration of service. We grouped the study population according to the quintiles of duration of service observed for all women in the study database, then created analytical groups using the first and second quintiles (one to two years; 368 cases and 757 controls) and the third and fourth quintiles (three to seven years; 327 cases and 781 controls) and the fifth quintile of duration of service (eight to 34 years, 22 cases and 458 controls). The Spearman correlation coefficient for quintiles of age and duration of service was 0.74, and the Pearson correlation for the continuous versions of these variables was 0.80, so we removed age from the model for this analysis. In spite of the high correlation between these two time-related covariates, the patterns of the results of models stratified by categories of age and stratified by duration of service were quite different for many covariates, as follows (table 4):

The higher odds of knee-related hospitalization noted for the youngest women with the largest number of dependents was not as pronounced in the model stratified by duration of service. Compared to those with up to one dependent, women with four to seven dependents had OR=1.91 (CI: 1.15, 3.17); 1.48 (CI: 0.92, 2.38); and 1.18 (CI: 0.71, 1.94) for the three categories of duration of service. Note also that the confidence intervals were reasonably narrow for these estimates.

As in the age-stratified analysis, odds of hospitalization associated with most CMF compared to the Support/Administration CMF were less than one for women in the first two categories of duration of service. Among women with eight to 34 years in the military, however, ORs ranged from 2.3 (Electrical and Mechanical Equipment Repair vs. Support/Administration) to 7.3 (Communications vs. Support/Administration). These estimates had extremely wide confidence intervals, so their importance should not be overemphasized.

There were similar, minor differences in patterns of ORs across strata of duration of service for the other work-related characteristics included in the model. These estimates, too, had extremely wide confidence intervals, so their meaning is difficult to evaluate.

Subgroup analyses. Sixty-two cases of knee-related hospitalization could be categorized as "acute" based on their diagnoses and procedures, and 254 cases could be categorized as "chronic". Similarly, 560 cases involved damage to soft tissue, only, while 242 cases involved bone, only. We considered the remaining cases to be of mixed chronicity or tissue type, respectively, primarily due to the presence of multiple diagnosis and procedure codes on a single record (Appendix).

In general, the patterns in ORs observed for the acute, chronic, or mixed type cases were similar to those we observed for the risk of hospitalization for any knee problem (table 5). Where there were differences, the confidence intervals tended to be so wide as to preclude any firm inference. The notable exception was for non-white women, who experienced 70% higher odds of hospitalization for chronic knee problems compared to white women (OR=1.71, CI: 1.28, 2.27).

When the cases were stratified by soft, hard or mixed tissue type, the overall patterns were similar to those of the analyses stratified by chronicity, but the confidence intervals associated with the estimates were even wider (not shown).

Men

The demographic and occupational characteristics of male cases and controls are shown in Table 6. The cut points for the age and duration of service categories are the quintile cut-points for of those variables using all 115,899 male controls in the research database.

Among men, cases were slightly more likely to be white (67%) than nonwhite (64%). Male cases were somewhat older than male controls, and more likely to be married and to have three or more dependents. The educational attainment of cases and controls was very similar, whether assessed at entry into the Army (not shown) or at the end of follow-up.

In contrast to our findings for the women, the distributions of a number of work characteristics differed for male cases compared to controls. Cases were more likely to be in the middle category of pay grade (E4-E6), to have longer duration of service than controls, and to be in the Infantry/Gun Crew CMF (32% of cases, 28% of controls). The likelihood of being in jobs associated with heavy physical demands, long running/walking distances, kneeling or sitting was not different for cases and controls. However, cases were generally less likely than controls to be in jobs associated with lifting/carrying and pushing/pulling tasks, and more likely to be in jobs associated with climbing and standing.

Multivariable modeling

After excluding observations with missing values for one or more terms included in the final model, there were 1,165 male cases and 2,166 male controls available for the analysis. Age and race were forced in to all multivariable models, but no other sociodemographic characteristics appeared to be predictive of knee-related hospitalization. Among work characteristics, pay grade, duration of service, the physical demand ratings associated with individual jobs, as well as CMF, pushing/pulling, kneeling, climbing, lifting/carrying, sitting and standing were included in the final model, either for their independent or their confounding effects on the odds of hospitalization for a knee problem.

Table 7 shows that adjusted ORs for knee-related hospitalization among men were fairly consistently doubled for each quintile of age compared to the youngest group. White men had odds of hospitalization 22% higher than nonwhite men (OR=1.22, CI 1.04, 1.42). Relative to the lowest pay grade category, men ranked E4-E6 had OR=0.78 (CI: 0.60, 1.00) for knee-related hospitalization, and those in the E7-E9 ranks had OR=0.68 (CI: 0.46, 1.00). Even after controlling for age and pay grade,

longer duration of service was associated with a 38% higher odds of being hospitalized for knee trouble (CI: 1.05, 1.82). The Spearman correlations among these three covariates all exceeded 0.6 (not shown).

Relative to men in jobs rated as having light or medium physical demands, the odds of knee-related hospitalization for those with moderate or heavy demands were 1.36 (CI: 0.95, 1.95); men in jobs with the heaviest physical demands had OR=2.27 (CI: 0.82, 6.24) The wide confidence interval precludes the inference of a linear increase in odds with increasing demands, however.

Several of the CMF were associated with higher odds of knee-related hospitalization compared to the Support/Administration CMF, but these estimates were imprecise. The highest ORs were for men in the Craft Worker (OR=1.70, CI: 0.65, 4.47) and Infantry/Gun Crews (OR=1.47, CI: 0.83, 2.60) CMFs. The patterns of increasing or decreasing odds of hospitalization associated with specific job tasks do not lend themselves to easy interpretation. There were small increases in odds for men in jobs associated with any amount of kneeling (OR=1.22, CI: 0.95, 1.56) or sitting (OR=1.55, CI: 0.95, 2.52), and small decreases for men in jobs associated with pushing/pulling less than 130 pounds (OR=0.64, CI: 0.44, 0.94), any amount of lifting/carrying (OR=0.60, CI: 0.35, 1.05), and there was no particular relation with standing (OR=1.05, CI: 0.64, 1.73).

Evaluation of effect modification

Race. There was little evidence of effect modification by white vs. non-white race (table 7). The higher odds of hospitalization observed for men with at least two years of military service appears to be concentrated among the nonwhite men (OR=2.79 CI: 1.63, 4.77); the effect was attenuated among white men (OR=1.05, CI: 0.76, 1.45). Compared to those in jobs associated with pushing/pulling less than 130 pounds, nonwhite men in jobs associated with pushing/pulling more than 130 pounds had OR= 0.71 (CI: 0.31, 1.35) for knee-related hospitalization, while white men had OR=1.33 (CI: 0.90, 1.95). The decreased odds of hospitalization seen for those in jobs associated with lifting/carrying appeared to be limited to white men: OR=0.43 (CI: 0.21, 0.89). The OR for nonwhite men in these jobs was 0.95 (CI: 0.39, 2.33).

Age. We divided the population into three groups, corresponding to the first and second quintiles (18-22 years; 345 cases and 833 controls); the third and fourth quintiles (23-31 years; 574 cases and 903 controls) and the fifth quintile of age (32-59 years; 246 cases, 430 controls). To obtain models with adequate fit and numerical stability, pay grade and duration of service, both highly correlated with age, were dropped from this analysis (table 8).

There were a number of differences in the patterns of odds of knee-related hospitalization across categories of age. The increased odds of knee-related hospitalization noted for white compared to non-white men appeared to be largely confined to those in the youngest group (OR=1.36, CI: 1.00, 1.83). In the middle and oldest age groups, ORs were 1.17 (CI: 0.94, 1.47) and 1.05 (CI: 0.78, 1.45), respectively, for white vs. nonwhite race.

In the main analysis, most CMF were associated with higher odds of hospitalization compared to the Support/Administration CMF. This was also the case for men in the youngest age group, and the magnitude of the odds ratios were larger in this stratum than observed in the main analysis. The stronger effect estimates are balanced by the wider confidence intervals in the stratified analysis. Among 18-22 year old men, those in the Craft Worker and Infantry/Gun Crews CMFs had the highest odds of knee-related hospitalization (OR=3.86, CI: 0.76, 20 and OR=2.48, CI: 0.92, 6.73, respectively). For men aged 23-31 years, the ORs are all much closer to 1.0; the two highest ORs are for men in the Infantry/Gun Crews (OR=1.56, CI: 0.68, 3.59) and the Health Care (OR=1.46, CI: 0.40, 5.29) compared to the Support/Administration CMF. In the oldest age group, all ORs were less than one and had very wide confidence intervals.

Men aged 18-22 years who had moderately heavy job demands had odds of hospitalization nearly twice as high as their counterparts in jobs with low to moderate demands (OR=1.85, CI: 0.97, 3.53). There were too few men in this age group classified as having very heavy job demands to analyze. Among 23-31 year olds, the OR for knee-related hospitalization for those in jobs with very heavy physical demands relative to light or medium demand jobs was 1.74 (CI: 0.41, 7.44), whereas very heavy physical demand jobs were associated with lower risk among the men in the oldest age group (OR=0.80, CI: 0.10, 7.70).

The odds of knee-related hospitalization associated with several of the specific job tasks showed different patterns in the age-stratified analyses compared to those in the main analysis. Specifically, the increased OR seen in the main analysis for men whose jobs were associated with kneeling was concentrated in the youngest age group, with OR=1.49 (CI: 0.96, 2.33). For 23-31 year olds OR=1.19 (CI: 0.73, 1.73), and for those 32 and older, OR=1.0 (CI: 0.60, 1.80). Similarly, the increased odds of knee trouble among men whose jobs were associated with sitting was greatest in the youngest men, whose OR=3.08 (CI: 1.10, 8.64); sitting seemed not to be associated with knee trouble for the men in the two older groups compared to the youngest age group (OR=1.26, CI: 0.61, 2.59 and OR=1.4, CI: 0.50, 4.00, respectively).

We also stratified the model according to categories of duration of service, after dropping the correlated covariates age and pay grade. Results are not shown, since the patterns of increasing and decreasing ORs were similar to those reported for the main analysis.

Subgroup analyses. One hundred thirty-four cases of knee-related hospitalization could be categorized as "acute" based on their diagnoses and procedures, and 285 cases could be categorized as "chronic". Similarly, 630 cases involved damage to soft tissue, only, while 360 cases involved bone, only. We considered the remaining cases to be of mixed chronicity or tissue type, respectively (Appendix).

In general, the patterns in ORs observed for the acute, chronic, or mixed chronicity cases were similar to those we observed for the risk of hospitalization for any knee problem (table 9). Where there were differences, the confidence intervals tended to be very wide, making interpretation of the results difficult. Two differences in patterns are highlighted here. In the main analysis, most CMFs seemed to be associated with slight increases in odds of knee-related hospitalization compared to the Support/Administration CMF, with ORs ranging from 0.90 for Health Care to 1.47 for Infantry/Gun Crews. For acute knee injury cases, all ORs were elevated relative to Support/Administration, and the two highest were 3.90 (CI: 0.49, 31) for Craft Workers and 2.56 (CI: 0.46, 14) for Technical Specialties. Results were similar for the mixed chronicity cases. In contrast, the ORs for hospitalization for chronic knee conditions were all less than one, with the smallest magnitudes observed for Health Care (OR=0.18, CI: 0.03, 1.24) and the Technical Specialties (OR=0.20, CI: 0.04, 1.08).

The second notable difference from the main analysis was in the odds of hospitalization among those whose jobs were associated with standing. When all cases were considered in the main analysis, the effect of having a job associated with standing was negligible (OR=1.05, CI: 0.30, 3.31, table 6). A similar null effect was evident for the subset of acute knee injury cases. For chronic knee injury cases, however, the odds of hospitalization for those in jobs associated with standing was 2.49 (CI: 0.70, 8.79) compared to those in jobs not associated with standing. In addition to the wide confidence intervals, it is important to note that the Hosmer-Lemshow test indicated poor fit for this model (p=0.12).

When the cases were stratified by soft, hard or mixed tissue type, the overall patterns were similar to those observed in the main analyses (not shown).

Results, Aim Three

Table 10 shows a summary of the key results from the main analyses. This table allows a comparison of the risk factors for the events of knee-related injury and knee-related disability discharge within gender groups, and also facilitates a comparison of the gender-specific models for each of the outcomes (knee-related injury and disability) investigated.

For women, the models for disability discharge and for knee-related hospitalization contained only three terms in common: age, nonwhite race and CMF. Among all potential predictors, CMF was the only job-related characteristic that correlated with knee-related disability discharge; sociodemographic characteristics were more important than work factors as predictors of this outcome. In contrast, knee-related hospitalization was correlated with several specific job tasks.

Whereas increased age was associated with higher odds of both injury and disability, the other two terms that correlated with both injury and disability showed different patterns in their effect estimates: Nonwhite women were at lower risk of disability but higher risk of injury compared to white women, and the Administration/Support CMF was associated with lower risk of disability but higher risk of injury compared to other CMF.

The injury and disability models for men contained a number of sociodemographic and occupational factors in common, although more occupational characteristics were correlated with odds of injury than of disability. The patterns of higher and lower ORs were generally similar for all of the common covariates except CMF (Administration/Support associated with higher odds of disability; the relation with knee injury was mixed) and lifting/carrying (higher weights associated with higher odds of disability and lower odds of injury).

Duration of service was positively correlated with odds of disability discharge and was not associated with knee injury. Having a job associated with greater physical demands was positively correlated with odds of knee-related hospitalization, and this factor was not associated with disability. Pushing/pulling weights, climbing heights and sitting were work-related characteristics that were confounders of other terms in the model. These covariates had associations with knee injury of negligible magnitude, and did not seem at all associated with risk of disability discharge.

The covariates included in the model of knee-related disability discharge for women were similar to those included in the model for men, but there were several additional work-related factors included in the model for the men. Differences between models were observed for marital status (married women

had lower odds of disability compared to non-married women; marital status was not a correlate of disability for men); kneeling (positively correlated with disability for men; not related to disability for women); lifting/carrying weights (positively correlated with disability for men; not related to disability for women); and standing (negatively correlated with disability for men; not related to disability for women). For those covariates that were included in both the model for women and that for men, the patterns of odds of knee-related disability discharge were generally quite similar. The notable exception was CMF; compared with Administration/Support, most CMF were correlated with higher odds of knee-related disability discharge for women, and lower odds for men.

There was less consistency among predictors of knee-related hospitalization for women compared to men. Three of the sociodemographic characteristics (age; nonwhite race; and number of dependents) were positively associated with odds of knee injury for women; number of dependents was not associated with knee injury for men. Among the work-related factors, men in higher pay grades had lower odds of injury, whereas this factor was not associated with injury among women. Compared with Administration/Support, all CMF were correlated with odds of injury less than one for women; for men, the odds of injury associated with some of the CMF were greater than 1, and less than one for the rest of the CMF. The model for the women included several additional work-related covariates based on their apparent confounding effects on the other terms in the model; the ORs associated with these terms were all around 1.0. For men, physical demand ratings were positively correlated with odds of knee injury, as was being in a job associated with sitting. Pushing/pulling weights; climbing heights; kneeling; lifting/carrying and standing all had very modest associations with odds of knee-related hospitalization.

Discussion

For both men and women, demographic characteristics were the main predictors of both knee-related injury and disability. Work-related factors were less correlated with disability than with injury for both genders. This observation has some intuitive appeal, insofar as possible work-related exposures and the outcome of injury are likely to be closer together in time than is the case for disability. Because of the possibly long interval between initial injury and eventual disability discharge, it could be that some accommodation was made with respect to duties carried out within each job title once an injury has been recognized. This amounts to speculation, however, since we found very low rates of job changes over the follow-up intervals, and similar rates of job changes for cases and controls.

In these analyses, we used ecological level measures for work exposures, mapping from Primary Military Occupational Specialty (PMOS) to Career Management Field (CMF), physical demands, and job tasks. The use of ecological measures may have led to substantial exposure misclassification, since there is latitude in the assignment of tasks within PMOS. The mapping was based on Army procedure manuals,[19] and occurred without regard to case or control status. Since the mapping from PMOS to work exposures was performed in a consistent manner for all records, and without consideration of the eventual outcome, the resulting exposure misclassification is likely to be nondifferential, resulting in a bias towards the null.[20] Therefore, the effects associated with specific job tasks that we reported are most likely underestimates of the true effects. In the many instances where we report null effects, there may be true differences in risk associated with work exposures or job titles.

Pay grade, duration of service and CMF were measured individually, and these were the only work-related variables associated with odds of knee-related disability discharge for both men and women. These parameters may well be surrogates for other factors, such as age or job exposures. If pay grade and/or duration of service are standing in for job exposures, these might also vary with age, seniority and experience, further complicating the interpretation of our findings.

Other data problems result from the administrative origins of these files. The data were collected, coded and entered by hundreds of individuals in hundreds of locations around the world. As far as we are aware, there is little standardization of data coding or entry procedures, and little or no quality assurance. Therefore, there may be undetectable errors in the information analyzed.

Apart from characteristics of the information included, we encountered some problems with sparse data, especially when cross-classifying the population by many characteristics to evaluate effect modification or to identify special subgroups at risk. In spite of these problems, we were able to identify occupational and sociodemographic determinants of knee injury and knee-related disability discharge from the U.S. Army.

Use of related case-control studies to answer time-dependent questions

Time dependent questions are most typically addressed in cohort studies. However, when the outcome is rare, or when one wishes to evaluate the effects of several exposures on a single outcome, then cohort studies are both logistically and statistically inefficient. It can be shown that relative risks calculated from a cohort analysis are mathematically identical to the odds ratios calculated from case-control analysis when the sampling fractions are known.[15] The approach used here, of carrying out

related case-control analyses embedded in the same population, is highly efficient, both logistically and statistically, and yields the same results as would have been obtained had we carried out a cohort study.

We were able to identify differences between the models for injury and disability. The differences in the sets of risk factors we identified implies that we have successfully partitioned time into pre-event (risk factors for injury) and post-event (risk factors for disability) phases.[15] Furthermore, the difference between the final models for injury and disability suggests that the technique of using separate case-control analyses to address related research questions is a viable option for identifying differences in risks for dependent outcomes. We therefore propose that this technique may prove a useful addition to the collection of epidemiology research methods.

Use of administrative data for research purposes

Since the data included in TAIHOD were not subjected to quality assurance during their collection and entry, we encountered some problems related to data quality. One type of problem includes those that arise during data entry, such as missing information and the possibility of entry errors. Other issues are associated with the content of the database, and related to the administrative purposes for which the data were collected. For example, we found that, in some instances, too many possible codes were included in the data files, leading to too great a level of detail (e.g., there are thousands of job codes used by the Army). In other instances, the lack of detail in codes hampered our ability to accurately classify individuals with respect to either exposures or outcome (e.g., the VASRD codes group reasons for disability discharge into broad categories). We also identified some information lacking from the TAIHOD that would have been useful (e.g., Which knee is affected? Is it the first occurrence of a problem in that knee? Were there any outpatient encounters related to that knee problem?)

Several strengths of this research should also be mentioned. Unlike civilian populations, the U.S. Army offers a structured social and work environment. It is reasonable to assume that medical care is equally available to all Army personnel, thus removing variability in access to care as an alternative explanation for observed differences in reported injury rates. We did not face the problem of ensuring an initially disease-free cohort that is often encountered in cohort and nested case-control studies, since enlistment in the U.S. Army entails passing a physical examination. Reasons for being found ineligible for enlistment include internal derangement of the knee, instability of the knee, and history of knee

surgery or injury.[21] Therefore, injuries detected during a tour of active duty are more likely to have occurred during that tour of duty, and not prior to enlistment in the Army.

Conclusion

The fact that we were able to identify occupational risk factors for knee injury suggests that, eventually, the risk of knee injury and disability among Army personnel may be modifiable by implementing changes to work tasks, training, equipment or job assignments. The interaction between occupational and demographic characteristics that we observed suggests that there may be subgroups within certain jobs that are more susceptible to injury or disability than others. If so, then changes to equipment, training or job assignments may prove fruitful in the effort to reduce the occurrence of knee injury and related disability. Furthermore, in spite of data problems outlined above, we were able to identify risk factors for each of the outcomes under consideration, and to identify differences in the sets of predictors for the two outcomes. That we were able to develop models suggests that the TAIHOD, and other administrative databases, represent useful resources that ought to be exploited for research. However, because of the problems outlined above, and because a major aim of this project was to explore the utility of the TAIHOD for analytical epidemiological studies, the results reported herein should be considered preliminary.

Table 1: Potential risk factors for knee-related hospitalization among enlisted women in the US Army.

	Cases (n=2,000)		Controls (n=4,000)		
	n	%	n	%	p-value[a]
Race					
Unknown	1	0.1	1	0.03	
White	1139	57.0	1976	49.4	
Black	758	37.9	1778	44.5	
Other	101	5.1	243	6.1	<0.0001
Age quintiles[b]					
18-20 years	282	14.1	633	15.91	
21-22 years	322	16.1	708	17.7	
23-25 years	419	21.0	905	22.7	
26-29 years	374	18.8	727	18.2	
≥ 30 years	598	30.0	1017	25.5	0.003
Marital status					
Unknown	24	1.2	51	1.3	
Single	908	45.4	1833	45.9	
Married	888	44.4	1795	44.2	
Divorced/separated	179	9.0	349	8.7	0.98
Dependents					
0-1	1086	54.3	2274	56.9	
2-3	684	34.2	1367	34.2	
4-7	229	11.5	357	8.9	0.006
Education					
≤ 4 years high school	9	0.5	13	0.3	
Completed high school, GED, Alt.	1702	85.4	3413	85.7	
Any college	274	13.8	546	13.7	
Any post-graduate	8	0.4	11	0.3	
Pay grade					
E1-E3	603	30.2	1157	28.9	
E4-E6	1289	64.5	2616	65.4	
E7-E9	107	5.4	225	5.6	0.59
Duration of service					
0-1 year	553	27.7	1034	25.9	
2 years	296	14.8	581	15.5	
3-4 years	399	20.0	817	20.5	
5-7 years	316	15.8	655	16.4	
8 years	435	21.8	909	22.8	0.61
Missing	2				

Continued

Table 1, continued

	Cases (n=2,000)		Controls (n=4,000)		
	n	%	n	%	p-value[a]
CMF[c]					
Admin	596	29.9	1552	38.9	
Infantry	23	1.2	34	0.9	
Electrical	116	5.8	213	5.3	
Communications	252	12.6	465	11.7	
Health care	392	19.7	722	18.1	
Technical	63	3.2	103	2.6	
Mechanical	211	10.6	296	7.4	
Crafts	30	1.5	37	0.9	
Service	310	15.5	562	14.1	
Missing					<0.0001
Physical demand rating					
Light	550	36.6	1029	33.3	
Medium	117	7.8	232	7.5	
Moderately heavy	447	29.8	824	26.7	
Heavy	292	19.4	807	26.1	
Very heavy	96	6.4	200	6.5	<0.0001
Missing	1403				
Distance running/walking					
None	164	15.4	349	14.7	
1-25 feet	308	28.9	650	27.4	
26-50 feet	176	16.5	296	12.5	
51-100 feet	86	8.1	189	8.0	
101-500 feet	44	4.1	115	4.9	
0.25-1 mile	288	27.0	773	35.6	0.003
Missing	2559				
Climbing height					
None	1206	90.7	2561	93.5	
3 feet	34	2.6	47	1.7	
9 feet	1	0.1	0	0.0	
10 feet	20	1.5	19	0.7	
11 feet	3	0.2	6	0.2	
40 feet	20	1.5	33	1.2	
50 feet	45	3.4	72	2.6	0.02
Missing	1930				

Continued

Table 1, continued

	Cases (n=2,000)		Controls (n=4,000)		
	n	%	n	%	p-value[a]
Lift/carry					
None	103	7.0	208	6.8	
1-25 pounds	294	20.1	825	27.1	
26-50 pounds	187	12.8	404	13.3	
51-75 pounds	235	16.1	422	13.9	
76-100 pounds	418	28.6	828	27.2	
101-125 pounds	131	9.0	190	6.3	
126-150 pounds	0	0.0	0	0.0	
151-175 pounds	69	4.7	123	4.0	
Raises 267 pounds	27	1.8	41	1.4	<0.0001
Missing	1492				
Pushing/pulling					
None	1080	73.8	2271	74.7	
<130 pounds	241	16.5	498	16.4	
130 pounds	113	7.7	200	6.6	
Foot/pound of force	30	2.1	72	2.4	0.49
Missing	1492				
Kneeling					
None	882	60.6	1566	52.0	
Prolonged	417	28.7	1092	36.3	
While shoveling, lifting	130	8.9	279	9.3	
While filing	26	1.8	72	2.4	<0.0001
Missing	1533				
Sitting					
None	318	21.7	886	29.1	
Any	1146	78.3	2155	70.9	<0.0001
Missing	1492				
Standing					
None	678	46.3	1617	53.2	
Any	786	53.7	1424	46.8	<0.0001
Missing	1492				

a. p-value from χ^2 comparing proportions among cases and controls.
b. Quintile cut points derived from distribution of controls in data library.
c. CMF groups: Admin=support/administration; Infantry=infantry and gun crew; Electrical=electrical equipment repair; Communications=communications/intelligence; Health care=health care; Technical=technical/allied specialties; Mechanical=electrical/mechanical equipment repair; Crafts=craft workers; Service=service/support; Non-occupational=patients, prisoners.

Table 2: Adjusted[a] relative odds of knee-related hospitalization among women enlisted the US Army. Overall and stratified by white/nonwhite race.

	All (917 cases, 1996 controls)		White (466 cases, 865 controls)		Nonwhite (451 cases, 1131 controls)	
	OR[b]	95% CI[b]	OR[b]	95% CI[b]	OR[b]	95% CI[b]
Race						
White	1.00	--	--	--	--	--
Nonwhite	1.34	1.13, 1.59	--	--	--	--
Age (years)						
18-20	1.00	--	1.00	--	1.00	--
21-22	1.12	0.84, 1.49	1.24	0.85, 1.79	0.95	0.60, 1.50
23-25	1.02	0.78, 1.34	1.29	0.90, 1.86	0.76	0.50, 1.17
26-29	1.20	0.89, 1.62	1.33	0.88, 2.02	1.03	0.67, 1.61
30-59	1.46	1.10, 1.95	1.61	1.08, 2.39	1.23	0.80, 1.90
Dependents						
0 to1	1.00	--	1.00	--	1.00	--
2 to 3	1.02	0.85, 1.24	0.97	0.73, 1.28	1.10	0.84, 1.43
4 to 7	1.30	0.97, 1.73	0.98	0.62, 1.56	1.58	1.08, 2.32
CMF[c]						
Admin	1.00	--	1.00	--	1.00	--
Infantry	0.32	0.09, 1.16	0.28	0.06, 1.40	0.52	0.05, 4.98
Electrical	0.59	0.35, 0.99	0.55	0.29, 1.05	0.68	0.24, 1.89
Communications	0.56	0.16, 1.98	0.51	0.11, 2.47	0.90	0.10, 8.40
Health Care	0.97	0.54, 1.73	0.87	0.37, 2.03	1.13	0.49, 2.63
Technical	0.50	0.19, 1.33	0.41	0.13, 1.29	0.98	0.15, 6.31
Crafts workers	0.79	0.34, 1.80	0.78	0.25, 2.38	1.30	0.26, 6.57

Continued

Table 2, continued

	All (917 cases, 1996 controls)		White (466 cases, 865 controls)		Nonwhite (451 cases, 1131 controls)	
Demands[d]						
Light-Moderate	1.00	--	1.00	--	1.00	--
Heavy, Very Heavy	0.88	0.50, 1.54	0.88	0.44, 1.76	0.78	0.28, 2.14
Distance running/walking						
None	1.00	--	1.00	--	1.00	--
1-25 feet	0.95	0.35, 2.59	0.85	0.24, 3.00	1.60	0.25, 10.24
26-50 feet	0.70	0.23, 2.10	0.71	0.18, 2.78	0.85	0.11, 6.54
51-100 feet	1.14	0.64, 2.01	1.17	0.59, 2.31	1.09	0.37, 3.24
101-500 feet	1.30	0.51, 3.31	2.57	0.68, 9.68	0.56	0.11, 2.71
0.25-1mile	0.95	0.50, 1.77	0.88	0.37, 2.11	1.20	0.43, 3.37
Climbing						
None	1.00	--	1.00	--	1.00	--
Any	1.24	0.66, 2.33	1.25	0.56, 2.79	1.39	0.44, 4.42
Kneeling						
None	1.00	--	1.00	--	1.00	--
Any	1.04	0.50, 2.16	1.25	0.50, 3.11	0.60	0.15, 2.45
Sitting						
None	1.00	--	1.00	--	1.00	--
Any	0.90	0.32, 2.55	0.86	0.23, 3.22	1.36	0.20, 9.33
Standing						
None	1.00	--	1.00	--	1.00	--
Any	0.94	0.61, 1.46	0.98	0.56, 1.72	0.76	0.36, 1.63
Goodness of fit[e]	0.64		0.69		0.25	

a. Each estimate adjusted for all other parameters.
b. OR: Odds ratio. 95% CI: 95% confidence interval.
c. CMF: Career management field (job groupings based on primary military occupational specialty (PMOS)). Admin=support/administration; infantry=infantry/gun crews; electrical=electrical equipment repair; communications=communications/intelligence; health care=health care; technical=technical and allied specialties; crafts workers=crafts workers (e.g., electrician, plumber).
d. Demands=physical demand ratings, based on PMOS. Light--mod includes jobs rated as having light, medium and moderate demands.
e. Goodness of fit: p-value from Hosmer-Lemeshow statistic

Table 3: Adjusted[a] relative odds of knee-related hospitalization among women enlisted the US Army, stratified by age group.

	Age group					
	18-25 years (279 cases, 650 controls)		23-29 years (365 cases, 859 controls)		30-59 years (273 cases, 487 controls)	
	OR[b]	95% CI[b]	OR[b]	95% CI[b]	OR[b]	95% CI[b]
Race						
White	1.00	--	1.00	--	1.00	--
Nonwhite	1.29	0.95, 1.76	1.48	1.13, 1.94	1.19	0.86, 1.65
Dependents						
Up to 1						
Two -three	0.91	0.61, 1.37	1.05	0.80, 1.37	1.17	0.79, 1.72
Four-seven	5.27	0.94, 29.40	1.07	0.67, 1.71	1.63	1.05, 2.54
CMF[c]						
Admin	1.00	--	1.00	--	1.00	--
Infantry	0.06	0.01, 0.62	0.87	0.10, 7.56	0.20	0.01, 2.88
Electrical	0.54	0.22, 1.33	0.39	0.16, 0.93	1.05	0.37, 2.98
Communications	0.39	0.05, 3.21	0.40	0.05, 3.56	0.73	0.06, 9.07
Health Care	0.63	0.19, 2.15	1.02	0.39, 2.65	1.26	0.44, 3.56
Technical	0.55	0.12, 2.48	0.25	0.04, 1.47	0.75	0.10, 5.67
Mechanical	--	--	--	--	--	--
Craftsworkers	0.47	0.11, 2.11	0.69	0.19, 2.53	1.10	0.19, 6.39
Service/supply	--	--	--	--	--	--
Demands[d]						
Light—Mid	1.00	--	1.00	--	1.00	--
Heavy, Very Heavy	1.55	0.58, 4.16	0.77	0.32, 1.86	0.62	0.20, 1.98

Continued

Table 3, continued

	Age group					
	18-25 years (279 cases, 650 controls)		23-29 years (365 cases, 859 controls)		30-59 years (273 cases, 487 controls)	
	OR[b]	95% CI[b]	OR[b]	95% CI[b]	OR[b]	95% CI[b]
Distance running/walking						
None	1.00	--	1.00	--	1.00	--
1-25 feet	0.69	0.12, 3.87	1.15	0.22, 6.09	0.78	0.10, 6.05
26-50 feet	0.42	0.06, 2.70	0.76	0.11, 5.22	0.63	0.07, 5.80
51-100 feet	0.71	0.23, 2.17	1.41	0.58, 3.39	1.52	0.51, 4.52
101-500 feet	0.78	0.14, 4.23	1.47	0.30, 7.31	2.53	0.41, 15.44
0.25-1mile	0.55	0.16, 1.93	1.16	0.42, 3.16	1.09	0.34, 3.55
Climb						
None	1.00	--	1.00	--	1.00	--
Any	1.95	0.69, 5.57	0.90	0.30, 2.72	1.06	0.31, 3.66
Kneel						
None	1.00	--	1.00	--	1.00	--
Any	1.42	0.42, 4.79	1.35	0.37, 4.91	0.78	0.18, 3.37
Sit						
None	1.00	--	1.00	--	1.00	--
Any	0.58	0.10, 3.42	1.01	0.18, 5.57	0.98	0.11, 8.53
Stand						
None	1.00	--	1.00	--	1.00	--
Any	0.69	0.31, 1.53	0.97	0.48, 1.96	1.11	0.47, 2.64
Goodness of fit[e]	0.99		0.95		0.85	

a. Each estimate adjusted for all other parameters.
b. OR: Odds ratio. 95% CI: 95% confidence interval.
c. CMF: Career management field (job groupings based on primary military occupational specialty (PMOS)). Admin=support/administration; infantry=infantry/gun crews; electrical=electrical equipment repair; communications=communications/intelligence; health care=health care; technical=technical and allied specialties; crafts workers=crafts workers (e.g., electrician, plumber).
d. Demands=physical demand ratings, based on PMOS. Light--mod includes jobs rated as having light, medium and moderate demands.
e. Goodness of fit: p-value from Hosmer-Lemeshow statistic

Table 4: Adjusted[a] relative odds of knee-related hospitalization among women enlisted the US Army, stratified by duration of service.

	Duration of Service					
	0-4 years (368 cases, 757 controls)		5-12 years (327 cases, 781 controls)		13-34 years (222 cases, 458 controls)	
	OR[b]	95% CI[b]	OR[b]	95% CI[b]	OR[b]	95% CI[b]
Race						
Nonwhite	1.00	--	1.00	--	1.00	--
White	1.37	1.04, 1.80	1.37	1.03, 1.83	1.16	0.81, 1.66
Dependents						
Up to 1	1.00	--	1.00	--	1.00	--
Two -three	1.25	0.90, 1.72	1.05	0.79, 1.39	0.99	0.66, 1.48
Four-seven	1.91	1.15, 3.17	1.48	0.92, 2.38	1.18	0.71, 1.94
CMF[c]						
Admin	1.00	--	1.00	--	1.00	--
Infantry	0.16	0.02, 1.08	0.52	0.06, 4.95	4.50	0.15, 140.28
Electrical	0.64	0.27, 1.49	0.41	0.17, 1.00	2.34	0.49, 11.26
Communications	0.40	0.06, 2.70	0.48	0.05, 4.45	7.35	0.25, 213.43
Health Care	0.68	0.24, 1.94	1.18	0.44, 3.15	6.29	0.91, 43.71
Technical	0.45	0.11, 1.89	0.32	0.05, 1.93	5.76	0.40, 82.19
Mechanical	--	--	--	--	--	--
Craftsworkers	0.56	0.15, 2.11	0.59	0.15, 2.39	3.93	0.34, 45.31
Service/supply	--	--	--	--	--	--
Demands[d]						
Light—Mid	1.00	--	1.00	--	1.00	--
Heavy, Very Heavy	1.17	0.48, 2.82	0.84	0.34, 2.06	0.61	0.15, 2.48
Distance running/walking						
None	1.00	--	1.00	--	1.00	--
1-25 feet	0.80	0.17, 3.81	1.03	0.19, 5.70	2.62	0.23, 29.28
26-50 feet	0.53	0.10, 2.91	0.80	0.12, 5.59	1.15	0.09, 14.50
51-100 feet	1.05	0.46, 2.42	1.10	0.40, 3.02	1.68	0.45, 6.26
101-500 feet	2.28	0.47, 10.94	0.88	0.17, 4.65	0.49	0.07, 3.29
0.25-1mile	0.98	0.32, 3.00	0.93	0.34, 2.53	0.93	0.22, 3.89

Continued

Table 4, continued

	Duration of Service					
	0-4 years (368 ca, 757 ct)		5-12 years (327 ca, 781 ct)		13-34 years (222 ca, 458 ct)	
	OR[b]	95% CI[b]	OR[b]	95% CI[b]	OR[b]	95% CI[b]
Climb						
None	1.00	--	1.00	--	1.00	--
Any	0.94	0.35, 2.52	1.56	0.51, 4.75	3.48	0.69, 17.57
Kneel						
None	1.00	--	1.00	--	1.00	--
Any	1.86	0.59, 5.87	1.02	0.28, 3.73	0.23	0.04, 1.21
Sit						
None	1.00	--	1.00	--	1.00	--
Any	0.43	0.08, 2.18	1.26	0.22, 7.26	4.04	0.32, 51.32
Stand						
None	1.00	--	1.00	--	1.00	--
Any	0.60	0.29, 1.26	1.23	0.60, 2.53	1.34	0.54, 3.31
Goodness of fit[e]	0.98		0.94		0.36	

a. Each estimate adjusted for all other parameters.
b. OR: Odds ratio. 95% CI: 95% confidence interval.
c. CMF: Career management field (job groupings based on primary military occupational specialty (PMOS)). Admin=support/administration; infantry=infantry/gun crews; electrical=electrical equipment repair; communications=communications/intelligence; health care=health care; technical=technical and allied specialties; crafts workers=crafts workers (e.g., electrician, plumber).
d. Demands=physical demand ratings, based on PMOS. Light--mod includes jobs rated as having light, medium and moderate demands.
e. Goodness of fit: p-value from Hosmer-Lemeshow statistic

Table 5: Adjusted[a] relative odds of knee-related hospitalization among women enlisted the US Army. Cases stratified, by chronicity of injury, compared to 1,996 controls

	Acute 62 cases		Chronic 254 cases		Mixed type 529 cases	
	OR[b]	95% CI[b]	OR[b]	95% CI[b]	OR[b]	95% CI[b]
Age						
18-20 years	1.00	--	1.00	--	1.00	--
21-22 yrs	1.50	0.66, 3.43	0.93	0.59, 1.47	1.16	0.80, 1.68
23-25 yrs	1.27	0.56, 2.89	0.69	0.44, 1.10	1.21	0.86, 1.72
26-29 yrs	0.84	0.31, 2.27	1.10	0.68, 1.77	1.40	0.96, 2.03
≥ 30 yrs	0.98	0.37, 2.54	1.35	0.86, 2.13	1.66	1.15, 2.39
Race						
White	1.00	--	1.00	--	1.00	--
Nonwhite	1.51	0.88, 2.59	1.71	1.28, 2.27	1.15	0.93, 1.42
Dependents						
Up to 1	1.00	--	1.00	--	1.00	--
Two -three	0.53	0.27, 1.05	0.93	0.67, 1.29	1.04	0.83, 1.31
Four-seven	1.30	0.51, 3.28	1.22	0.75, 1.97	1.28	0.90, 1.82
CMF[c]						
Admin	1.00	--	1.00	--	1.00	--
Infantry	0.52	0.01, 34.69	0.91	0.08, 10.23	0.19	0.04, 0.91
Electrical	0.65	0.12, 3.45	0.82	0.35, 1.96	0.47	0.25, 0.89
Communications	1.17	0.02, 64.28	2.12	0.21, 21.76	0.27	0.06, 1.26
Health Care	--	--	1.47	0.61, 3.52	0.75	0.37, 1.52
Technical	0.87	0.04, 19.64	1.14	0.20, 6.35	0.28	0.08, 0.93
Mechanical	--	--	--	--	--	--
Craftsworkers	0.83	0.04, 16.87	1.22	0.33, 4.54	0.56	0.20, 1.55
Service/supply	--	--	--	--	--	--
Demands[d]						
Light—Mid	1.00	--	1.00	--	1.00	--
Heavy, Very Heavy	0.90	0.17, 4.76	0.43	0.14, 1.32	1.28	0.67, 2.47

Continued

Table 5, continued

	Acute 62 cases		Chronic 254 cases		Mixed type 529 cases	
	OR[b]	95% CI[b]	OR[b]	95% CI[b]	OR[b]	95% CI[b]
Distance running/walking						
None	1.00	--	1.00	--	1.00	--
1-25 feet	0.46	0.02, 14.15	2.75	0.43, 17.45	0.63	0.19, 2.10
26-50 feet	0.77	0.03, 23.59	2.20	0.27, 18.16	0.42	0.11, 1.62
51-100 feet	--	--	1.02	0.41, 2.58	1.37	0.69, 2.70
101-500 feet	1.65	0.08, 35.25	1.46	0.31, 6.94	1.25	0.38, 4.08
0.25-1mile	0.31	0.05, 1.97	1.78	0.53, 5.95	0.80	0.37, 1.72
Climb						
None	1.00	--	1.00	--	1.00	--
Any	1.85	0.27, 12.89	1.83	0.66, 5.07	0.94	0.44, 2.03
Kneel						
None	1.00	--	1.00	--	1.00	--
Any	0.75	0.07, 7.59	0.61	0.18, 2.10	1.52	0.61, 3.76
Sit						
None	1.00	--	1.00	--	1.00	--
Any	1.00	0.03, 31.55	2.84	0.42, 19.33	0.50	0.14, 1.74
Stand						
None	1.00	--	1.00	--	1.00	--
Any	4.32	0.80, 23.23	0.86	0.43, 1.72	0.92	0.53, 1.58
Goodness of fit[e]	0.25		0.38		0.40	

a. Each estimate adjusted for all other parameters.
b. OR: Odds ratio. 95% CI: 95% confidence interval.
c. CMF: Career management field (job groupings based on primary military occupational specialty (PMOS)). Admin=support/administration; infantry=infantry/gun crews; electrical=electrical equipment repair; communications=communications/intelligence; health care=health care; technical=technical and allied specialties; crafts workers=crafts workers (e.g., electrician, plumber).
d. Demands=physical demand ratings, based on PMOS. Light--mod includes jobs rated as having light, medium and moderate demands.
e. Goodness of fit: p-value from Hosmer-Lemeshow statistic

Table 6: Potential risk factors for knee-related hospitalization among enlisted men in the US Army.

	Cases (n=2,000)		Controls (n=4,000)		
	n	%	n	%	p-value[a]
Race					
Unknown	1	0.1	2	0.1	
White	1336	66.8	2539	63.5	
Black	538	26.9	1156	29.0	
Other	125	6.3	300	7.5	0.06
Age quintiles[b]					
18-20 years	202	10.1	650	16.3	
21-22 years	334	16.7	720	18.0	
23-26 years	527	26.4	914	22.9	
27-31 years	431	21.6	746	18.7	
≥ 32 years	502	25.2	965	24.2	<0.0001
Marital status					
Unknown	33	1.7	83	2.1	
Single	732	36.6	1664	41.6	
Married	1164	58.2	2120	53.0	
Divorced/separated	71	3.6	133	3.33	0.001
Dependents					
0-2	1099	55.0	2380	59.5	
3-9	901	45.1	1620	40.5	0.001
Education					
≤ 4 years high school	38	1.9	78	2.0	
Completed high school, GED/Alt.	1782	89.3	3529	88.5	
≥ 1 year college	139	7.0	262	6.6	
Completed college, any post-graduate	37	1.9	120	3.0	0.06
Page grade					
E1-E3	457	22.9	1044	26.1	
E4-E6	1301	65.1	2470	61.8	
E7-E9	242	12.1	486	12.2	0.02

Continued

Table 6, continued

	Cases (n=2,000)		Controls (n=4,000)		
	n	%	n	%	p-value[a]
Duration[d]					
0-1 year	318	15.9	881	22.0	
2 years	274	13.7	513	12.8	
3-4 years	480	24.0	899	22.5	
5-7 years	503	25.2	875	21.9	
8-35 years	424	21.2	830	20.8	<0.0001
Missing (n=3)					
CMF[c]					
Admin	238	11.9	522	13.1	
Infantry	643	32.2	1103	27.6	
Electrical	130	6.5	325	8.1	
Communications	200	10.0	446	11.2	
Health care	138	6.9	222	5.6	
Technical	62	3.1	116	2.9	
Mechanical	323	16.2	686	17.2	
Crafts	53	2.7	86	2.2	
Service	209	10.5	472	11.8	
Non-occupational	1	0.1	14	0.4	
Missing (n= 11)					0.0003
Demands[e]					
Light	1037	69.8	1956	67.5	
Medium	78	5.3	189	6.5	
Moderately heavy	248	16.7	490	16.9	
Heavy	93	6.3	192	6.6	
Very heavy	30	2.0	73	2.5	0.33
Missing (n=1614)					
Distance running/walking					
None	145	12.0	259	10.9	
1-25 feet	279	23.1	580	24.4	
26-50 feet	277	23.0	592	24.9	
51-100 feet	50	4.1	130	5.5	
101-500 feet	81	6.7	167	7.0	
0.25-1 mile	375	31.1	647	27.2	0.08
Missing (n=2418)					

Continued

Table 6, continued

	Cases (n=2,000)		Controls (n=4,000)		
	n	%	n	%	p-value[a]
Climbing height					
None	978	71.4	1925	73.1	
3 feet	6	0.4	30	1.1	
9 feet	100	7.3	187	7.1	
10 feet	8	0.6	34	1.3	
11 feet	16	1.2	39	1.5	
30 feet	227	16.6	326	12.4	
40 feet	13	1.0	26	1.0	
50 feet	22	1.6	68	2.6	0.001
Missing (n=1995)					
Lift/carry					
None	65	5.0	101	4.1	
1-25 pounds	55	4.2	133	5.3	
26-50 pounds	74	5.7	168	6.7	
51-75 pounds	126	9.7	265	10.6	
76-100 pounds	230	17.8	535	21.5	
101-125 pounds	251	19.4	518	20.8	
126-150 pounds	61	4.7	108	4.3	
151-175 pounds	398	30.7	611	24.5	
Raises 267 pounds	36	2.8	55	2.2	0.001
Missing (n=2210)					
Pushing/pulling					
None	1028	75.2	1963	74.0	
<130 pounds	120	8.8	310	11.7	
130 pounds	185	13.5	312	11.8	
Foot/pound of force	23	1.7	52	2.0	0.03
Missing (n=1980)					
Kneeling					
None	749	55.4	1494	57.2	
Prolonged	130	9.6	295	11.3	
While shoveling, lifting	464	34.3	800	30.6	
While filing	10	0.7	22	0.8	0.08
Missing (n=2036)					

Continued

Table 6, continued

	Cases (n=2,000)		Controls (n=4,000)		
	n	%	n	%	p-value[a]
Sitting					
None	75	5.5	179	6.8	
Any	1292	94.5	2474	93.3	0.12
Missing (n=1980)					
Standing					
None	276	20.2	658	24.8	
Any	1091	79.8	1995	75.2	0.001
Missing (n=1980)					

a. p-value from χ^2 comparing proportions among cases and controls.
b. Quintile cutpoints derived from distribution of controls in data library.
c. CMF groups: Admin=support/administration; Infantry=infantry and gun crew; Electrical=electrical equipment repair; Communications=communications/intelligence; Health care=health care; Technical=technical/allied specialties; Mechanical=electrical/mechanical equipment repair; Crafts=craftworkers; Service=service/support; Non-occupational=patients, prisoners.
d. Service: duration of service.
e. Demand rating: physical demand rating.

Table 7: Adjusted[a] relative odds of knee-related hospitalization among men enlisted the US Army. Overall and stratified by white/nonwhite race.

	All (1,165 cases, 2, 166 controls)		Nonwhite (751 cases, 1,312 controls)		White (414 cases, 854 controls)	
	OR	95% CI	OR	95% CI	OR	95% CI
Race						
Nonwhite	1.00	--	--	--	--	--
White	1.22	1.04, 1.42	--	--	--	--
Age						
18-20 years	1.00	--	1.00	--	1.00	--
21-22 yrs	1.52	1.15, 2.01	1.53	0.87, 2.71	1.58	1.14, 2.19
23-26 yrs	2.03	1.53, 2.70	1.83	1.04, 3.21	2.17	1.55, 3.05
27-31	2.02	1.48, 2.75	1.94	1.09, 3.46	2.07	1.42, 3.03
$\geq$ 32 yrs	1.94	1.39, 2.73	1.94	1.07, 3.53	1.88	1.21, 2.91
Pay grade						
E1-E3	1	--	1.00	--	1.00	--
E4-E6	0.78	--	0.72	0.45, 1.13	0.81	0.60, 1.10
E7-E9	0.68	--	0.62	0.33, 1.18	0.74	0.45, 1.23
Service						
0-1 year	1.00	--	1.00	--	1.00	--
2-35 years	1.38	1.05, 1.82	2.79	1.63, 4.77	1.05	0.76, 1.45
Demands						
Light/med	1.00	--	1.00	--	1.00	--
Mod/heavy	1.36	0.95, 1.95	1.30	0.75, 2.27	1.51	0.93, 2.46
Very heavy	2.27	0.82, 6.24	1.63	0.33, 8.20	3.43	0.91, 12.98
CMF[c]						
Admin	1.00	--	1.00	--	1.00	--
Electrical	0.97	0.48, 1.99	1.24	0.38, 4.07	0.60	0.23, 1.57
Communications	1.02	0.60, 1.71	0.86	0.35, 2.11	1.01	0.52, 1.96
Health Care	0.90	0.38, 2.16	1.24	0.29, 5.27	0.58	0.19, 1.82
Technical	1.42	0.68, 2.98	2.17	0.62, 7.64	1.11	0.43, 2.86
Infantry	1.47	0.83, 2.60	1.21	0.45, 3.30	1.44	0.70, 2.96
Mechanical	1.19	0.66, 2.12	1.08	0.39, 2.96	1.13	0.54, 2.36
Craftsworkers	1.71	0.65, 4.47	2.02	0.41, 10.05	1.29	0.38, 4.45
Service/supply	1.21	0.62, 2.36	1.09	0.34, 3.53	1.28	0.55, 2.98

Continued

Table 7, continued

	All (1,165 cases, 2, 166 controls)		Nonwhite (751 cases, 1,312 controls)		White (414 cases, 854 controls)	
	OR	95% CI	OR	95% CI	OR	95% CI
Push/pull						
None	1.00	--	1.00	--	1.00	--
<130 lbs	0.64	0.44, 0.94	0.50	0.27, 0.93	0.73	0.45, 1.18
>=130 lbs	1.12	0.80, 1.55	0.71	0.37, 1.35	1.33	0.90, 1.95
Kneeling						
None	1.00	--	1.00	--	1.00	--
Any	1.22	0.95, 1.56	1.20	0.75, 1.90	1.23	0.91, 1.66
Climb						
None	1.00	--	1.00	--	1.00	--
Any	0.95	0.77, 1.16	1.22	0.84, 1.78	0.88	0.69, 1.11
Lift/carry						
None	1.00	--	1.00	--	1.00	--
Any	0.60	0.35, 1.05	0.95	0.39, 2.33	0.43	0.21, 0.89
Sit						
None	1.00	--	1.00	--	1.00	--
Any	1.55	0.95, 2.52	1.69	0.79, 3.61	1.60	0.83, 3.08
Stand						
None	1.00	--	1.00	--	1.00	--
Any	1.05	0.64, 1.73	1.20	0.52, 2.75	1.05	0.55, 2.01
Goodness of fit[e]	0.56		0.87		0.78	

a. Each estimate adjusted for all other parameters.
b. OR: Odds ratio. 95% CI: 95% confidence interval.
c. CMF: Career management field (job groupings based on primary military occupational specialty (PMOS)). Admin=support/administration; infantry=infantry/gun crews; electrical=electrical equipment repair; communications=communications/intelligence; health care=health care; technical=technical and allied specialties; crafts workers=crafts workers (e.g., electrician, plumber).
d. Demands=physical demand ratings, based on PMOS. Light--mod includes jobs rated as having light, medium and moderate demands.
e. Goodness of fit: p-value from Hosmer-Lemeshow statistic

Table 8: Adjusted[a] relative odds of knee-related hospitalization among men enlisted the US Army, stratified by age group.

	18-22 years (345 cases, 833 controls)		23-31 years (564 cases, 903 controls)		≥ 32 years (246 cases, 430 controls)	
	OR[b]	95% CI[b]	OR[b]	95% CI[b]	OR[b]	95% CI[b]
Race						
Nonwhite	1.00	--	1.00	--	1.00	--
White	1.36	1.00, 1.83	1.17	0.94, 1.47	1.05	0.75, 1.45
CMF[c]						
Admin	1.00	--	1.00	--	1.00	--
Electrical	1.42	0.41, 4.88	1.01	0.36, 2.87	0.43	0.08, 2.41
Communications	1.32	0.53, 3.29	1.03	0.48, 2.21	0.56	0.16, 1.93
Health Care	0.57	0.11, 2.90	1.46	0.40, 5.29	0.64	0.08, 5.01
Technical	1.94	0.51, 7.35	1.12	0.37, 3.40	0.89	0.18, 4.48
Infantry	2.48	0.92, 6.73	1.56	0.68, 3.59	0.47	0.12, 1.76
Mechanical	2.09	0.76, 5.73	1.19	0.50, 2.83	0.42	0.11, 1.58
Craftsworkers	3.86	0.76, 19.59	1.19	0.32, 4.46	--	--
Service/supply	2.27	0.71, 7.30	1.30	0.49, 3.44	0.3	0.1, 1.5
Demands[d]						
Light/med	1.00	--	1.00	--	1.00	--
Mod/heavy	1.85	0.97, 3.53	1.15	0.68, 1.94	1.5	0.6, 3.5
Very heavy	--	--	1.74	0.41, 7.44	0.8	0.1, 7.7
Push/pull						
None	1.00	--	1.00	--	1.00	--
<130 lbs	0.62	0.34, 1.12	0.58	0.33, 1.03	0.9	0.4, 2.2
>=130 lbs	1.37	0.79, 2.40	0.96	0.60, 1.55	1.4	0.6, 3.1
Kneeling						
None	1.00	--	1.00	--	1.00	--
Any	1.49	0.96, 2.33	1.19	0.83, 1.73	1.0	0.6, 1.8
Climb						
None	1.00	--	1.00	--	1.00	--
Any	0.98	0.70, 1.39	0.79	0.59, 1.06	1.3	0.8, 2.1
Lift/carry						
None	1.00	--	1.00	--	1.00	--
Any	0.68	0.16, 2.87	0.75	0.31, 1.82	0.8	0.3, 2.5

Continued

Table 8, continued

	18-22 years (345 cases, 833 controls)		23-31 years (564 cases, 903 controls)		≥ 32 years (246 cases, 430 controls)	
Sit						
None	1.00	--	1.00	--	1.00	--
Any	3.08	1.10, 8.64	1.26	0.61, 2.59	1.4	0.5, 4.0
Stand						
None	1.00	--	1.00	--	1.00	--
Any	0.63	0.28, 1.43	1.21	0.57, 2.57	1.9	0.6, 6.1
Goodness of fit[e]	0.42		0.58		0.99	

a. Each estimate adjusted for all other parameters.
b. OR: Odds ratio. 95% CI: 95% confidence interval.
c. CMF: Career management field (job groupings based on primary military occupational specialty (PMOS)). Admin=support/administration; infantry=infantry/gun crews; electrical=electrical equipment repair; communications=communications/intelligence; health care=health care; technical=technical and allied specialties; crafts workers=crafts workers (e.g., electrician, plumber).
d. Demands=physical demand ratings, based on PMOS. Light--mod includes jobs rated as having light, medium and moderate demands.
e. Goodness of fit: p-value from Hosmer-Lemeshow statistic

Table 9: Adjusted[a] relative odds of knee-related hospitalization among men enlisted the US Army. Cases stratified, by chronicity of injury, compared to 2,166 controls

	Acute 134 cases		Chronic 285 cases		Mixed type 631 cases	
	OR	95% CI	OR	95% CI	OR	95% CI
Race						
Nonwhite	1.00	--	1.00	--	1.00	--
White	1.03	0.71, 1.51	1.51	1.14, 2.00	1.12	0.92, 1.36
Age						
18-20 years	1.00	--	1.00	--	1.00	--
21-22 yrs	2.17	1.09, 4.33	2.28	1.38, 3.78	1.14	0.80, 1.63
23-26 yrs	2.72	1.35, 5.48	2.84	1.70, 4.76	1.58	1.10, 2.26
27-31	2.59	1.20, 5.59	2.69	1.53, 4.73	1.64	1.12, 2.40
$\geq$ 32 yrs	1.98	0.83, 4.72	2.96	1.61, 5.46	1.56	1.02, 2.37
Pay grade						
E1-E3	1.00	--	1.00	--	1.00	--
E4-E6	0.68	0.38, 1.19	0.53	0.35, 0.80	0.91	0.66, 1.25
E7-E9	0.17	0.05, 0.67	0.31	0.15, 0.62	1.03	0.65, 1.66
CMF[c]						
Admin	1.00	--	1.00	--	1.00	--
Electrical	1.86	0.33, 10.53	0.24	0.05, 1.20	1.21	0.51, 2.89
Communications	1.45	0.37, 5.64	0.33	0.09, 1.21	1.37	0.75, 2.52
Health Care	1.43	0.16, 12.69	0.18	0.03, 1.24	1.25	0.43, 3.67
Technical	2.56	0.46, 14.39	0.20	0.04, 1.08	2.28	0.95, 5.50
Infantry	2.14	0.50, 9.09	0.54	0.14, 2.10	1.90	0.97, 3.73
Mechanical	1.95	0.46, 8.30	0.38	0.10, 1.53	1.54	0.77, 3.07
Craftsworkers	3.90	0.49, 30.98	0.65	0.11, 3.80	1.60	0.44, 5.84
Service/supply	1.39	0.26, 7.60	0.39	0.09, 1.69	1.68	0.75, 3.78
Demands[d]						
Light/med	1.00	--	1.00	--	1.00	--
Mod/heavy	1.26	0.52, 3.03	1.19	0.61, 2.32	1.39	0.88, 2.18
Very heavy	1.98	0.18, 22.28	3.70	0.53, 25.79	2.36	0.65, 8.61
Duration of service						
0-1 year	1.00	--	1.00	--	1.00	--
2-35 years	1.32	0.70, 2.47	1.54	0.97, 2.44	1.38	0.97, 1.97
Push/pull						
None	1.00	--	1.00	--	1.00	--
<130 lbs	0.96	0.41, 2.25	0.62	0.31, 1.25	0.52	0.32, 0.85
>=130 lbs	1.33	0.62, 2.85	1.11	0.65, 1.91	1.04	0.69, 1.57

Continued

Table 9, continued

	Acute 134 cases		Chronic 285 cases		Mixed type 631 cases	
Kneeling						
None	1.00	--	1.00	--	1.00	--
Any	1.28	0.68, 2.39	0.97	0.63, 1.50	1.23	0.90, 1.67
Climb						
None	1.00	--	1.00	--	1.00	--
Any	1.08	0.67, 1.74	0.74	0.53, 1.05	1.01	0.79, 1.29
Lift/carry						
None	1.00	--	1.00	--	1.00	--
Any	0.71	0.14, 3.60	0.37	0.13, 1.02	0.60	0.31, 1.18
Sit						
None	1.00	--	1.00	--	1.00	--
Any	1.68	0.40, 7.04	1.61	0.65, 3.97	1.45	0.80, 2.63
Stand						
None	1.00	--	1.00	--	1.00	--
Any	1.00	0.30, 3.31	2.49	0.70, 8.79	0.80	0.45, 1.45
Goodness of fit[e]	0.94		0.12		0.84	

a. Each estimate adjusted for all other parameters.
b. OR: Odds ratio. 95% CI: 95% confidence interval.
c. CMF: Career management field (job groupings based on primary military occupational specialty (PMOS)). Admin=support/administration; infantry=infantry/gun crews; electrical=electrical equipment repair; communications=communications/intelligence; health care=health care; technical=technical and allied specialties; crafts workers=crafts workers (e.g., electrician, plumber).
d. Demands=physical demand ratings, based on PMOS. Light--mod includes jobs rated as having light, medium and moderate demands.
e. Goodness of fit: p-value from Hosmer-Lemeshow statistic

Table 10: Comparison of adjusted odds ratios of knee-related injury vs. disability[15] discharge among Army enlisted personnel, stratified by gender.

	Women		Men	
	Disability	Injury	Disability	Injury
Risk factor:				
Increased age (oldest vs. youngest quintile)	2.4	1.5	4.7	1.9
Nonwhite vs. white race	0.5	1.3	0.8	1.2
Number of dependents (most vs. least)	na*	1.3	na*	na*
Married vs. not married	0.7	na*	na*	na*
Pay grade (E7-E9 vs. E1-E3)	0.2	na*	0.2	0.7
Duration of service (longest vs. shortest quintile)	1.4	na*	1.4	na*
CMF (vs. Administration/Support)	Most OR > 1.0	All OR < 1.0	All OR < 1.0, except for Craft workers	Some OR < 1.0, some OR > 1.0
Physical demands (highest vs. lowest)	na*	0.9	na*	2.3
Run/walk distance (highest vs. lowest)	na*	Some OR < 1.0, some OR > 1.0	na*	na*
Pushing/pulling weights (most vs. least)	na*	na*	na*	1.1
Cimbing height (most vs. least)	na*	1.2	na*	0.95
Kneeling (most vs. least)	na*	1.0	3.0 (Filing)	1.2
Lift/carry weight (most vs. least)	na*	na*	1.2	0.6
Sitting (any vs. none)	na*	0.9	na*	1.6
Standing (any vs. none)	na*	0.9	0.8	1.1

* na: Not applicable. Term was not included in that model.

Acknowledgements

This project would not have been possible without the support of many others. In particular, I would like to recognize and thank from the U.S. Army Research Institute of Environmental Medicine (USARIEM): Michelle Yore for assistance with preparing research data files; LTC Charles Scoville for assistance in identifying ICD-9-CM diagnosis and procedure codes related to knee troubles; and LTC Paul Amoroso for access to the TAIHOD, his colleagues at USARIEM, and for his assistance with understanding the subtleties of military data. From the University of Massachusetts, thanks to Dr. Maria Heimisdottir for assisting with categorizing clinical data, and from Applied Epidemiology, Inc., my gratitude to Dr. Kenneth Mundt for his guidance.

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Appendix: Knee-related ICD-9 procedure and diagnosis codes.

Use the most specific code recorded under each category.

Diagnosis codes

		Chronicity	Tissue type
ICD-9 code	Definition	Acute - A Chronic - C Both -B	Soft –S Bony - B
355.2	Other lesion of the femoral nerve	(B)more likely A[1]	S
355.3	Lesion of lateral popliteal nerve	(B) more likely A[1]	S
355.4	Lesion of medial popliteal nerve	(B) more likely A[1]	S
712.16	Chondrocalcinosis due to dicalcium phosphate crystals	C	S
712.26	Chondrocalcinosis due to pyrophosphate crystals	C	S
712.36	Chondrocalcinosis, unspecified	C	S
712.86	Other specified crystal arthopathies of the lower limb, knee	C	S
712.96	Unspecified crystal arthropathy of the lower limb, knee	C	S
715.16 715.26	Osteoarthritis, localized, primary, of the lower limb, knee Osteoarthritis, localized, secondary, of the lower limb, knee	C	B
715.36	Osteoarthritis, localized, not specified whether primary or secondary, of the lower limb, knee	C	B
715.96	Osteoarthritis, not specified whether generalized or localized, of the lower limb, knee	C	B
716.06	Kaschin-Beck disease, endemic polyarthritis of lower limb, knee	C	B
716.16	Traumatic arthropathy of lower limb, knee	A	S
716.26	Allergic arthritis of lower limb, knee	A	S
716.36	Climacteric arthritis of lower limb, knee	C	S
716.46	Transient arthropathy of lower limb, knee	B	S
716.56	Unspecified polyarthropathy or polyarthritis of lower limb, knee	C	S
716.66	Unspecified monoarthritis of lower limb, knee; coxitis	C	S
716.86	Other specified arthropathy of lower limb, knee	C	S
716.96	Arthopathy, unspecified, of lower limb, knee	C	S
717	Internal derangement of knee (old)	C	S

717.0	Old bucket handle tear of medial meniscus	C	S
717.1	Derangement of anterior horn of medial meniscus	B	S
717.2	Derangement of posterior horn of medial meniscus	B	S
717.3	Other and unspecified derangement of medial meniscus	B	S
717.4	Derangement of lateral meniscus	B	S
717.5	Derangement of meniscus, not elsewhere classified	B	S
717.6	Loose body in knee	B	S (occas. B)[3]
717.7	Chondromalacia of patella	B	S
717.8	Other internal derangement of knee	B	S
717.9	Unspecified internal derangement of knee	B	S
718.26	Pathological dislocation of knee	B	S
718.36	Recurrent dislocation knee	C	S
718.45	Contracture of pelvic region and thigh	C	S
718.46	Contracture of lower limb, knee	C	S
718.56	Ankylosis of lower limb, knee	C	S (rarely B)[3]
718.85	Instability of pelvic region and thigh	C	S
718.86	Instability of knee	(B frequently) A[1]	S
719.06	Effusion of knee joint	(B)normally A[1]	S
719.16	Hemarthrosis of knee	A	S
719.26	Villondular synovitis, knee	C	S
719.36	Palindromic rheumatism, knee	C	S
719.46	Pain in joint, arthralgia of knee	C	S
719.56	Stiffness of knee joint, NEC	C	S
719.66	Other symptoms referable to knee joint, crepitus	C	S
719.86	Other specified disorders of joint, calcification, fistula (knee)	C	S
719.96	Unspecified disorder of joint, knee	B	S
726.6	Enthesopathy of the knee (burstitis)	(B normally) C[2]	S
727.51	Synovial cyst of popliteal space (Baker's cyst)	C	S
727.65	Quadriceps tendon rupture	A	S
727.66	Rupture of patellar tendon	A	S
727.86	Other disorders of synovium, tendon and bursa (lower limb, knee)	C (occasionally A on C)[2]	S
727.89	Abscess of bursa or tendon	A	S
727.9	Unspecified disorder of synovium, tendon and bursa	(B normally)C[2]	S
728.12	Traumatic myostitis ossificans	A	S
729	Other disorders of soft tissues		
729.0	Rheumatism, unspecified, and fibrositis	C	S
729.1	Myalgia amd myositis, unspecified	(B normally) C[2]	S
729.2	Neuralgia, neuritis and radiculitis, unspecified	C	S
729.3	Panniculitis, unspecified	C	S
729.4	Fasciitis, unspecified	B	S

729.5	Pain in limb	B	S
729.6	Residual foreign body in soft tissue	C	S
729.8	Other musculoskeletal symptoms referable to limbs	C	S
729.9	Other and unspecified disorders of soft tissue	B	S
730	Osteomyelititis, periostitis, and other infections involving bone	(B normally)C[2]	B
730.06	Acute osteomyelitis, lower leg	A	B
730.16	Chronic osteomyelitis, lower leg	C	B
730.26	Unspecified osteomyelitis, lower leg	C	B
730.36	Periostitis without mention of osteomyelitis, lower leg	C	B
730.76	Osteopathy resulting from poliomyelitis, lower leg	C	B
730.86	Other infections involving bone in diseases classfied elsewhere, lower leg	B	B
730.96	Unspecified infection of bone, lower leg.	B	B
732.4	Juvenile osteochondrosis of lower extremity, excluding foot; Osgood-Schlatters syndrome	C	B
732.7	Osteochondritis dissecans	C (or A on C)[2]	B
733.10	Stress fracture	A (becomes C)[1]	B
733.81	Malunion of fracture	C	B
733.82	Nonunion of fracture/pseudoarthrosis	C	B
733.9	Other and unspecified disorders of bone and cartilage	B	B
736.4	Acquired genu valgum or varum	C	B
736.5	Acquired genu recurvatum	C	B
736.6	Other acquired deformities of the knee NOS	C	B
821.01	Closed fracture of femoral shaft	A	B
821.11	Open fracture of femoral shaft	A	B
821.21	Fracture of femoral condyle	A	B
821.3	Open fracture of lower end of femur	A	B
821.31	Open fracture of femoral condyle	A	B
822	Fracture of patella	A	B
823.0	Fracture of proximal tibia, closed	A	B
823.1	Fracture of proximal tibia, open	A	B
836	Dislocation of knee	A	B
843.8	Sprain/strain of hip/thigh	B	B
844	Sprains of the knee and leg	B	B
897.0	Amputation below the knee	B	B
897.2	Amputation above the knee	B	B
905.6	Late effect of dislocation (no body part specified?)	C	S
905.7	Late effect of sprain or strain (no body part specified?)	C	S
905.8	Late effect of tendon injury (no body part specified?)	C	S
924.00	Contusion: thigh	A	S
924.11	Contusion: knee	A	S

928.11	Crushing injury of knee	A	S (code bony as fracture elsewhere)[3]

1: Code as acute; 2: Code as chronic; 3: Code as soft tissue injury

Procedure codes in the range 77-81, "Operations on the musculoskeletal system".

		Tissue type
77	Incision, excision and division of other bones	
77.0	Sequestrectomy	
77.05	of femur	B
77.06	of patella	B
77.07	of tibia and fibula	B
77.1	Other incision of bone without division	
77.15	of femur	B
77.16	of patella	B
77.17	of tibia and fibula	B
77.2	Wedge osteotomy	
77.25	of femur	B
77.26	of patella	B
77.27	of tibia and fibula	B
77.3	Other division of bone	
77.35	of femur	B
77.36	of patella	B
77.37	of tibia and fibula	B
77.4	Biopsy of bone	
77.45	of femur	B
77.46	of patella	B
77.47	of tibia and fibula	B
77.6	Local excision of lesion or tissue of bone	
77.65	of femur	B
77.66	of patella	B
77.67	of tibia and fibula	B
77.7	Excision of bone for graft	
77.75	of femur	B
77.76	of patella	B
77.77	of tibia and fibula	B
77.8	Other partial ostectomy	
77.85	of femur	B
77.86	of patella	B
77.87	of tibia and fibula	B
77.9	Total ostectomy	
77.95	of femur	B
77.96	of patella	B
77.97	of tibia and fibula	B
78.0	Bone graft	
78.05	of femur	B
78.06	of patella	B
78.07	of tibia and fibula	B
78.1	Periosteal suture	

78.15	of femur	B
78.16	of patella	B
78.17	of tibia and fibula	B
78.4	Other repair or plastic operations on bone	
78.45	of femur	B
78.46	of patella	B
78.47	of tibia and fibula	B
78.5	Internal fixation of bone without fracture reduction	
78.55	of femur	B
78.56	of patella	B
78.57	of tibia and fibula	B
78.6	Removal of internal fixation device	
78.65	of femur	B
78.66	of patella	B
78.67	of tibia and fibula	B
78.7	Osteoclasis	
78.75	of femur	B
78.76	of patella	B
78.77	of tibia and fibula	B
78.8	Diagnostic procedures on bone, NEC	
78.85	of femur	B
78.86	of patella	B
78.87	of tibia and fibula	B
78.9	Insertion of bone growth stimulator	
78.95	of femur	B
78.96	of patella	B
78.97	of tibia and fibula	B
79.76	Closed reduction of dislocation of knee	B
79.86	Open reduction of dislocation of knee	B
80.06	Arthrotomy for removal of prosthesis (knee)	M
80.16	Other arthrotomy (knee)	M
80.26	Arthroscopy (knee)	M
80.36	Biopsy of joint structure (knee)	M
80.46	Division of joint capsule, ligament or cartilage (knee)	S
81.22	Arthrodesis of knee	B
81.41	Total knee replacement	B
81.42	5-in-1 knee repair	B
81.43	Triad knee repair	B
81.44	Patellar stabilization	B
81.45	Other repair of cruciate ligaments	S
81.46	Other repair of collateral ligaments	S
81.47	Other knee repair	M

84.10	Lower limb amputation, NOS	M
84.15	Other amputation below knee	M
84.16	Disarticulation of knee	M
84.17	Amputation above knee	M
84.27	Lower leg or ankle reattachment	M
84.40	Implantation or fitting of prosthetic limb device, NOS	M
84.45	Fitting of prosthesis above the knee	M
84.46	Fitting of prosthesis below the knee	M
84.47	Fitting of prosthesis of leg, NOS	M

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service
Centers for Disease Control
and Prevention (CDC)

Memorandum

Date: December 14, 2001

From: Michael J. Galvin, Jr., Ph.D., Lead Program Activity Lt M Galvin for M.J.
Office of Extramural Programs, NIOSH, D30

Subject: Final Report for Awareness of Publications for Grant 5 R03 OH003787-02.

To: William D. Bennett
Data Systems Team, Information Resources Branch, EID, NIOSH, P03/C18

The attached final report has been received from the principal investigator (PI) on the subject NIOSH grant. Since the PI allowably elected to provide an annotated list of publications, rather than a technical report, this material may not be suitable for forwarding to the National Technical Information Services (NTIS). However, if any portion is sent to NTIS, please let us know when a document number is known so that we can inform anyone who inquires about this final report. Any publications that are included with this report are highlighted on the list below.

Attachment
cc: Sherri Diana, EID, P03/C13 w/attachments

List of Publications

Sulsky SI, Mundt KA, Bigelow C, Amoroso PJ, Fisher D: Knee-Related Injuries and Disabilities in the U.S. Army, 1980-1997. U.S. Army Medical Research and Materiel Command, Technical Report No. T00-24, 2000

women, OR=1.2 for men) than whites. For both genders, those in the oldest age quintile had higher odds of both injury and disability compared to those in the youngest age quintile. Even controlling for age and other factors, duration of service was positively associated with odds of knee injury (OR=1.4 for fifth quintile vs. first quintile for each gender). Pay grade was negatively associated with odds of disability (OR=0.2 for E7-E9 vs. E1-E3, men and women) and with odds of injury for men (OR=0.7), in spite of its positive correlation with both age and duration of service. Patterns of odds ratios for other occupational and demographic factors differed for men and women by outcome. Exploratory analyses of possible effect modification suggested interactions between demographic and occupational factors including race/ethnicity, age, and duration of service. We also assessed the adequacy of the final outcome- and gender-specific models for different types of injuries and disabilities.

These analyses were possible because of the availability of a large database containing occupational, demographic and health information for a cohort of Army personnel. The wide range of data elements and the large, relatively diverse population enabled the evaluation of the separate and combined influence of sociodemographic and occupational characteristics on the risk of occupational injury and disability. The differences between the final injury and disability models suggests that the use of separate case-control comparisons to identify risk factors for related outcomes is a viable research method.

Publications

Sulsky SI, Mundt KA, Bigelow C, Amoroso PJ, Fisher D: Knee-Related Injuries and Disabilities in the U.S. Army, 1980-1997. U.S. Army Medical Research and Materiel Command, 2000

NIOSH Extramural Award Final Report Summary

Title: Occupational Knee Injury and Disability in the U.S. Army
Investigator: Sandra I. Sulsky, MPH
Affiliation: University of Massachusetts
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Award Number: 5 R03 OH003787-02
Start & End Date: 9/1/1999–8/31/2001
Total Project Cost: $58,074
Program Area: Traumatic Injuries
Key Words:

Abstract:
We studied knee-related occupational disability and associated injuries using information recorded in the Total Army Injury and Health Outcomes Database (TAIHOD). Of interest were two different, but related events: hospitalization for severe knee injury and knee-related disability discharge from the Army. The overall objective was to investigate the nature of and differences among the risk factors for these two events. The data source, the TAIHOD, is a relational database containing occupational and selected health information for all individuals on active duty in the U.S. Army, beginning January 1, 1980. The source population for this study consists of all enlisted personnel in the U.S. Army on active duty at any time between 1980 and 1998, about 2.7 million individuals (11% women). We analyzed selected sub-samples of the TAIHOD to address three specific aims:

1. What are the risk factors for knee-related disability discharge?
2. What are the risk factors for severe knee injury defined by hospitalization for a knee-related diagnosis or procedure?
3. How do risk factors for injuries that lead to disability compare to risk factors for injuries that do not lead to disability?

For each aim, an appropriate analysis sample of the TAIHOD was constructed using standard methods of incidence density sampling. For aim one, this yielded a sample size numbering 6,810, of whom 1,703 were discharged for knee related disability. For aim two, the analysis sample numbered 12,000, of whom 4,000 were hospitalized for severe knee injury. Aim three entailed a comparison of the results of analyses for the other two aims, with particular attention to ways in which the model for each outcome differed.

Analysis results suggested that predictors of knee-related disability discharge from the Army and predictors of knee-related hospitalization were different. For knee-related disability discharge, occupational characteristics were less potent correlates of the outcome than were sociodemographic characteristics. This was especially true for women, for whom no specific work task was associated with odds of knee-related disability discharge.

Among both men and women, non-whites had reduced odds of knee-related disability (OR=0.5 for women and OR=0.8 for men), but higher odds of knee injury (OR=1.3 for