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Musculoskeletal Injuries in US Air Force Security Forces, January 2009 to December 2018

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Abstract

Objective: To determine the incidence, types, and risk factors of musculoskeletal injuries in a military security forces population.

Methods: Demographic and diagnostic data were retrieved on enlisted US Air Force security forces personnel who served on active duty between January 2009 and December 2018. Incidence rates and ratios were calculated using Poisson regression.

Results: During 251,787 person-years of exposure, 62,489 personnel served on active duty. Of these, 40,771 (65.2%) were diagnosed with at least one musculoskeletal injury. The majority (60.1%) of the 164,078 unique musculoskeletal injuries were inflammation and pain secondary to overuse. After adjusting for other factors, women had a 31% higher injury rate than men, and those who were overweight and obese had 15% and 30% higher rates, respectively, than normal-weight peers.

Conclusions: Modifiable and non-modifiable factors contribute to musculoskeletal injuries in the security forces career field.

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Keywords

law enforcement; military personnel; musculoskeletal injuries; overuse injuries; police

BACKGROUND

Security forces, known colloquially as “military police,” is the largest career field in the US Air Force. Of its 38,000 total force, 98% are enlisted and nearly 70% are on active duty.[1] Security forces personnel conduct installation and asset protection missions, nuclear munitions security, law and order operations, combat arms training and maintenance, and military working dog support—both at home station and in support of worldwide contingency operations.[2] During training, stateside assignment, and expeditionary tasking, they encounter significant physical stressors, including protracted duty days, shift-work schedules, prolonged standing, environmental exposures, and heavy loads from gear and weapons.

Musculoskeletal injuries are problematic across the US Armed Forces. Non-combat injuries are the most common reason for ambulatory healthcare visits both in-garrison[3] and in deployed settings[4] and are responsible for two-thirds of all limited duty days.[3] They were the leading cause of medical evacuation from Iraq and Afghanistan during the peak of hostility,[5] and over a quarter of veterans from Operations Enduring Freedom, Iraqi Freedom, and New Dawn had a prevalent musculoskeletal injury at their first visit to a Veterans Affairs healthcare facility.[6] Although some injury prevention principles apply military-wide,[7] optimal mitigation strategies should be tailored to each military subpopulation based on its unique occupational demands, sociodemographic characteristics, and operational tempo.[8]

Since descriptive epidemiology is the bedrock of any population-specific health intervention, this study was designed to determine musculoskeletal injury rates, trends, types, and host risk factors in US Air Force security forces. These data may inform strategies for improving musculoskeletal health and may encourage additional research in this critical military career field.

METHODS

Study Design and Data Sources

This retrospective descriptive study included all enlisted US Air Force security forces personnel who served on active duty between January 1, 2009 and December 31, 2018, identified by the duty Air Force Specialty Code of 3P0X. The Air Force Personnel Center database was utilized to identify security forces personnel, based on monthly recorded duty codes, and to retrieve age, sex, self-reported race and ethnicity, marital status, rank, and duty level. Age was modeled categorically as less than 22, 22 to 24, 25 to 28, and more than or equal to 29 years (based on natural cutoff points using quartiles of person-time); sensitivity analyses were performed with age as a continuous variable. Race was stratified as White, Black, Asian, Hawaiian and Pacific Islander, American Indian and Alaskan Native, multi-racial, and unknown. Ethnicity was dichotomized as Hispanic/Latino

or non-Hispanic/Latino. Marital status was categorized as single; married; and divorced, separated, or widowed. Duty level was defined according to specialty code specification as helper (3P011), apprentice (3P031), journeyman (3P051), craftsman (3P071), superintendent (3P091), and chief enlisted manager (3P000). Rank was stratified as E-1 (most junior) through E-9 (most senior). When inconsistencies were found across an individual's monthly records for sex, race, or ethnicity, the modal finding was applied. To account for the time-sensitive variables of age, marital status, duty level, rank, fitness level, and body mass index (BMI), person-months were assigned to each category of the variable; for example, an individual who was promoted twice during the surveillance period would contribute person-time to three rank categories.

Physical fitness and anthropometric data were retrieved from official measurements obtained at the Air Force fitness assessment and recorded in the Air Force Fitness Management System II. Because the database began in January 2012, these data are limited to the last 7 years of the study period (2012 to 2018). The fitness assessment includes three components: body composition assessed by height, weight, and abdominal circumference; muscular fitness assessed by number of push-ups and sit-ups completed in a minute; and aerobic fitness assessed by a timed 1.5-mile run or 2-km walk. Points are assigned for abdominal circumference (up to 20), push-ups (10), sit-ups (10), and aerobic fitness (60)—for a maximum score of 100. The Air Force scoring system accounts for sex and age, in 10-year increments, and defines the overall fitness level as excellent (more than or equal to 90.0 points), satisfactory (75.0 to 89.9), or unsatisfactory (less than 75.0).[9] Individuals exempted from the fitness assessment by a healthcare professional were excluded due to missing data. In the rare case of multiple scores on the same day, the higher fitness level was utilized. BMI was calculated as weight divided by height squared and stratified as underweight (less than 18.5), normal (18.5 to 24.9), overweight (25.0 to 29.9), and obese (more than or equal to 30.0).[10]

Musculoskeletal injuries were defined as receiving an International Classification of Diseases, Ninth or Tenth Revision (ICD-9 or ICD-10) code during an inpatient visit or outpatient encounter within the military healthcare network, either at a military treatment facility or an outside facility reimbursed by TRICARE. Injuries may have occurred at home station or during deployment. The Military Health System transitioned from ICD-9 to ICD-10 in October 2015. Diagnostic codes were retrieved from the US Air Force Epidemiology Consult Service Division database, which assigns codes to the first of each month in order to correspond with personnel records; the database is described elsewhere.[11]

Injuries were categorized, according to an established ICD-based matrix,[12,13] by type and by broad and specific anatomic site. The nexus of each injury type and specific site reflects a unique matrix cell. Applying the case definition published by the Defense Health Agency,[14] all diagnostic positions were included and incident injuries were restricted to one per matrix cell per 60days. The incidence date of each injury was considered the date of the first case-defining inpatient or outpatient encounter.

Statistical Analysis

To determine the morbidity burden, each month of person-time was dichotomized as injured (if at least one musculoskeletal injury code was received during the month) or non-injured. Injured months were further stratified by the number of injuries—where number reflects the total of unique type-site matrix cells, as described above.

Poisson regression was used to calculate incidence rates (IR) and crude and adjusted incidence rate ratios (IRR) with 95% confidence intervals (CI). IRRs were adjusted for all covariables in the model. The partially adjusted IRR model, which did not include fitness level and BMI, incorporated data for the entire study period. The fully adjusted IRR model, including those variables, was restricted to the 7-year period. Sensitivity analyses were conducted to assess potential collinearity between age and duty level and between age and rank, and to assess age as a continuous variable, rather than categorical.

Data were analyzed using Stata SE version 16.1 (StataCorp, College Station, TX). This study was approved as exempt research by the Committee for Protection of Human Subjects of The University of Texas Health Science Center at Houston (#HSC-SPH-19–0729).

RESULTS

During the surveillance period, 62,489 enlisted security forces personnel served on active duty, accruing 251,787 person-years of exposure. The age range was 17 to 54years, with a mean (standard deviation) of 25.5 (5.6) years. Most were men (80.8%), White (71.8%), and non-Hispanic/Latino (97.2%). The majority of person-time was spent in the duty levels of apprentice (47.8%) or journeyman (37.9%) and at the ranks of E-3 (26.5%), E-4 (28.7%), or E-5 (23.3%) (Table 1). Demographics are largely consistent with the broader population of enlisted active duty Air Force personnel, of whom most are men (80.0%), White (70.0%), and aged 30years and under (68.3%).[15]

A total of 40,771 (65.2%) personnel were diagnosed with at least one musculoskeletal injury, accumulating 164,078 unique injuries. The most common type was inflammation and pain secondary to overuse (60.1%), followed by dislocations, sprains, and strains (29.4%). The population sustained 6314 fractures (3.9% of injuries) and 254 stress fractures (0.2%). Predominant injury sites were the knee (16.0%); lumbar spine (15.1%); lower leg (14.2%); ankle, foot, and toes (13.0%); and shoulder (10.6%) (Table 2). As a career field, 119,532 person-months of service (3.8% of the total time) occurred in an injured state. Of injured time, 33,696 (29.0%) person-months were spent with two or more concomitant injuries.

The overall crude incidence of all-cause musculoskeletal injury was 5.4 per 100 person-months. Incidence increased incrementally by age category, with those aged more than or equal to 29 years having a 40% higher rate than those aged less than or equal to 22 years (IRR=1.40; 95% CI: 1.36, 1.45) in the partially adjusted model, and a 22% higher rate (IRR=1.22; 95% CI: 1.16, 1.28) in the fully adjusted model, incorporating fitness level and BMI. The partially and fully adjusted rates were higher by 36% (IRR=1.36; 95% CI: 1.33, 1.39) and 31% (IRR=1.31; 95% CI: 1.27, 1.35) in women than in men. Incidence rate differences were less pronounced or non-significant for race, ethnicity, marital status,

and rank. Rates were fairly consistent over the surveillance period, with the exception of a markedly lower rate in 2016 compared with the 2009 baseline. In the subset of data from 2012 through 2018 (N=46,112), compared with those with an “excellent” fitness level, personnel with an “unsatisfactory” level had a 61% higher adjusted injury rate (IRR=1.61; 95% CI: 1.55, 1.67), and those with a “satisfactory” level had a 9% lower rate (IRR=0.91; 95% CI: 0.90, 0.93). Compared with those with a BMI in the normal range, overweight, and obese personnel had 15% (IRR=1.15; 95% CI: 1.13, 1.18) and 30% (IRR=1.30, 95% CI: 1.26, 1.34) higher injury rates, respectively (Table 3).

Sequentially removing rank and duty level from the final model did not significantly alter these findings. When assessed continuously, each additional year of age was associated with a 3% greater rate of incident injury (crude IRR=1.03; 95% CI: 1.03, 1.04); adjusted IRRs with continuously-assigned ages were similar to those with categorically-assigned ages.

DISCUSSION

Enlisted security forces personnel who served on Air Force active duty accrued 164,078 unique musculoskeletal injuries between 2009 and 2018, for a rate of 5.4 per 100 person-months. This is the first published study of musculoskeletal epidemiology in this population since a cohort of male security forces personnel served as a comparison group for Battlefield Airmen (the appellation formerly given to Air Force special operators). Musculoskeletal disorders and injuries, according to that study, accounted for 43% of hospital days and 38% of outpatient healthcare costs among security forces personnel who served between 2000 and 2005.[16] In addition to using a more recent cohort, the current study provides actionable information regarding types and risk factors of injuries.

Enlisted security forces personnel were more likely to be diagnosed with overuse than acute injuries, predominantly to the lumbar spine, knee, lower leg, and ankle and foot. This replicates findings from across the US Armed Forces[17] and in specific US Air Force subpopulations, including basic training recruits[12] and drill instructors,[13] suggesting military-wide dynamics. Previous studies have cited heavy load burdens, prolonged standing, postural imbalances, and altered gait mechanics as plausible explanations for these injury patterns.[18,19] While this study was not designed to implicate or exonerate any specific occupational task, its findings pertain to many physically demanding tasks. Individuals with an unsatisfactory fitness level had a 61% higher injury rate than their peers with excellent fitness, even when adjusted for BMI category. Transitioning from an unsatisfactory to an excellent fitness level may seem unrealistic to many security forces members, particularly within a short time. Encouragingly, the adjusted injury rate difference was similar, and even slightly greater, between those with an unsatisfactory and a satisfactory fitness level (67%), meaning that significant injury risk reduction may be achievable by more modest improvements in physical fitness. When adjusted for fitness level, those who were overweight and obese had 15% and 30% higher injury rates, compared with their normal-weight peers. Together, these findings suggest that physical fitness and body weight may be independently associated with musculoskeletal injuries. For musculoskeletal pathology intervention, these common host factors may be preferable targets than the proximate task-specific factors postulated in the literature.

Embedding musculoskeletal experts within military operational units—akin to the collegiate or professional athletics model—is a potential solution.[20] A cluster-randomized trial in Air Force basic training found that an embedded sports medicine prototype was associated with reduced injury morbidity and injury-related discharge. The embedded athletic trainers focused on early identification and rehabilitation of overuse injuries, correction of biomechanical abnormalities, and culture-building in partnership with unit leadership.[21] These principles should translate to the security forces career field, where overuse injuries also predominate.

Whether in an embedded care model or the traditional healthcare model, clinicians caring for security forces personnel should understand the injury risk factors within that population. Injury rates were higher in women and those who were older, less physically fit, and overweight or obese. The demographic risk factors, though non-modifiable, are not irrelevant. For example, functional movement screening and modification may be especially beneficial for older and female personnel. The primary targets, however, should be physical fitness and body weight—factors that have been associated with musculoskeletal injuries in other military[22–25] and law enforcement[26–29] cohorts. In this study, the IRRs for older age groups and female sex were lower in the fully adjusted model (ie, incorporating fitness level and BMI) than in the partially adjusted model (ie, without these covariables), suggesting that physical fitness and healthy weight may partially offset the injury risk posed by these non-modifiable factors.

Security forces leadership should consider population-wide interventions that disrupt upstream determinants of weight gain and physical inactivity—such as the food culture, built environment, and fitness policies—as well as intrinsic motivators of behavior change. Considering the dose–response relationship between BMI category and musculoskeletal injuries found in this study, it reasons that even moderate weight reduction could decrease injury rates, even if the prevalence of overweight and obesity remains constant. In light of other research demonstrating that cardiorespiratory fitness, irrespective of BMI, is inversely related with military discharge,[30] musculoskeletal injury,[31] and mortality,[32] strategies should prioritize physical activity over diet-based weight loss. It is not immediately clear why personnel with a “satisfactory” fitness level had a slightly lower incidence of injury relative to their peers with an “excellent” fitness level, although it may reflect overtraining in the latter group. This should be explored more thoroughly to ascertain injury risk factors within the highly fit cohort.

Several limitations should be considered when interpreting these findings. First, musculoskeletal injury rates may have been higher than reported, as injuries that were self-treated or diagnosed outside the military healthcare network could not be identified. Under-capture would likely be non-differential by the variables considered. Second, the provided injury dates reflected the first of the month, not the actual diagnosis dates, which may have resulted in either over- or under-counting incident injuries using the 60-day rule. Third, race and ethnicity were self-reported and not always uniform across monthly personnel records; the modal value was used in the event of inconsistencies. Fourth, the statistically lower injury rate in 2016 cannot be readily explained, so further examination of the source data would be warranted. Fifth, the study relied on the Air Force fitness assessment for

physical fitness and anthropometric data, which were unavailable before 2012 and may contain inaccuracies due to inter-site variation in scales, subjectivity in assessing push-ups and situps, and manual entry of scores into the fitness database. Sixth, individuals who were medically exempted from the assessment, often due to musculoskeletal conditions or pregnancy, were excluded; although their exclusion was unavoidable because of missing data, their inclusion may have introduced confounding by indication, which could bias results toward or away from the null. Seventh, since this study was restricted to enlisted active duty Airmen, caution should be exercised when generalizing the findings to other law enforcement personnel, such as military officers, reservists, sister service military police, and civilian police forces.

A final limitation is the lack of data on injury circumstances and place of occurrence, duty limitations inflicted by musculoskeletal injuries, and person-level occupational risk factors, such as work schedules and load carriages. Three avenues of future research should be considered: assessing the contextual factors surrounding injuries; quantifying the impact of injuries in terms of duty days lost or affected; and evaluating the impact of specific job duties on injury burden. These follow-on studies may be facilitated by the Air Force Safety Automated System, an archive of occupational, recreational, and combat-related mishap data, as prescribed by federal policy.[33] Although future research may seek to distinguish between occupational and non-occupational injuries, it should be noted that both compromise military readiness. In its Total Worker Health approach, the National Institute for Occupational Safety and Health affirms that worksite and recreational factors may synergistically contribute to worker illness and injury.[34]

Musculoskeletal injuries can impede mission success of any military unit,[8] but they are particularly counterproductive in physically demanding occupations like security forces. Four percent of time served by enlisted active duty Air Force security forces personnel is spent injured. For a career field that is regularly featured on the Air Force “stressed list,” reflecting a critical staffing shortfall,[35] efforts should be made to recapture this time through injury prevention and early intervention. Reducing injury burden by a quarter would recoup 3000 months of healthy worker time each year. To keep security forces in the fight, senior leaders should consider embedding sports medicine assets within their training squadron and operational units, focusing resources on high-risk individuals, and implementing more comprehensive population-wide fitness and body weight programs.

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Ethical Considerations & Disclosures: The study was approved as exempt research by The University of Texas Health Science Center at Houston Committee for the Protection of Human Subjects (#HSC-SPH-19–0729). The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Air Force, the Department of Defense, or the U.S. Government. These results were first presented as a

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Clinical Significance:

Musculoskeletal injuries are common in U.S. Air Force security forces personnel. Most injuries are related to overuse and afflict the lower extremities and lumbar spine. Tailored physical fitness programs, human performance optimization interventions, and weight loss strategies are potential targets for musculoskeletal injury risk mitigation.

TABLE 1.

Sociodemographic Characteristics, US Air Force Security Forces Enlisted Personnel, January 2009 to December 2018 (*N*=62,489)

	Personnel	%	Person-Years	%
Age, yrs				
<22	38,401	61.45	66,394	26.37
22–24	37,523	60.05	72,197	28.67
25–28	25,627	41.01	55,142	21.90
≥29	15,475	24.76	58,055	23.06
Sex				
Male	50,485	80.79	210,958	83.78
Female	12,004	19.21	40,829	16.22
Race				
White	44,883	71.83	179,282	71.20
Black	11,673	18.68	46,974	18.66
Asian	1,080	1.73	4,184	1.66
Hawaiian/PI	684	1.09	3,035	1.21
AI/AN	447	0.72	1,707	0.68
Multi-racial	2,593	4.15	11,000	4.37
Unknown	1,129	1.81	5,606	2.23
Ethnicity				
Non-Hispanic/Latino	60,717	97.16	242,533	96.32
Hispanic/Latino	1,772	2.84	9,255	3.68
Marital status				
Single	45,739	73.20	119,653	47.52
Married	32,947	52.72	117,734	46.76
DSW	7,012	11.22	14,400	5.72
Rank				
E-1	24,595	39.36	7,947	3.16
E-2	12,902	20.65	8,114	3.22
E-3	43,248	69.21	66,746	26.51
E-4	36,724	58.77	72,242	28.69
E-5	21,637	34.63	58,538	23.25
E-6	8,154	13.05	23,002	9.14
E-7	4,348	6.96	11,957	4.75
E-8	906	1.45	2,222	0.88
E-9	404	0.65	1,018	0.40
Duty level				
Helper	3,470	5.55	1,851	0.74
Apprentice	49,986	79.99	120,425	47.83
Journeyman	33,328	53.33	95,355	37.87
Craftsman	9,454	15.13	31,160	12.38

	Personnel	%	Person-Years	%
Superintendent	959	1.53	2,087	0.83
Chief enlisted manager	368	0.59	909	0.36

AI, American Indian; AN, Alaskan Native; DSW, divorced, separated, or widowed; PI, Pacific Islander.

*Totals do not sum to 62,489 for some variables due to changes in status during the surveillance period.

TABLE 2.

Musculoskeletal Injuries by Type and Site, US Air Force Enlisted Security Forces Personnel, January 2009 to December 2018 (*N*=62,489)

	Dislocation, Sprain and Strain		Fracture		Inflammation and Pain (Overuse)		Joint Derangement		Stress Fracture		Multiple and Unspecified		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Vertebral column and torso														
Cervical	1,618	0.99	24	0.01	6,397	3.90	110	0.07					8,149	4.97
Thoracic	1,928	1.18	68	0.04	168	0.10	124	0.08	1	0.00			2,289	1.40
Ribs and sternum	558	0.34	207	0.13									765	0.47
Spine unspecified			23	0.01	5,903	3.60	563	0.34	36	0.02			6,525	3.98
Lumbar	3,402	2.07	82	0.05	20,157	12.29	1,094	0.67			4	0.00	24,739	15.08
Sacrum and coccyx	133	0.08	42	0.03	478	0.29							653	0.40
Other and unspecified	1	0.00			218	0.13					20	0.01	239	0.15
Subtotal	7,640	4.66	446	0.27	33,321	20.31	1,891	1.15	37	0.02	24	0.01	43,359	26.43
Upper extremity														
Head	17	0.01	206	0.13	3	0.00							226	0.14
Neck	353	0.22	9	0.01									362	0.22
Nose			11	0.01									11	0.01
Shoulder	6,038	3.68	188	0.11	9,926	6.05	1,213	0.74					17,365	10.58
Upper arm and elbow	3,659	2.23	56	0.03	1,855	1.13	1	0.00					5,571	3.40
Forearm and wrist	3,013	1.84	498	0.30	5,110	3.11	164	0.10					8,785	5.35
Hand and fingers	2,629	1.60	1,841	1.12	3,108	1.89	128	0.08					7,706	4.70
Other and unspecified	8	0.00											8	0.00
Subtotal	15,717	9.58	2,809	1.71	20,002	12.19	1,506	0.92					40,034	24.40
Lower extremity														
Pelvis	1,154	0.70	29	0.02	2,208	1.35							3,391	2.07
Hip and thigh	2,423	1.48	91	0.06	3,472	2.12	192	0.12	22	0.01			6,200	3.78
Lower leg	5,955	3.63	842	0.51	14,646	8.93	1,667	1.02	124	0.08	127	0.08	23,361	14.24
Knee	7,310	4.46	283	0.17	14,617	8.91	3,975	2.42					26,185	15.96
Ankle, foot, and toes	8,085	4.93	1,814	1.11	10,343	6.30	992	0.60	71	0.04	9	0.01	21,314	12.99
Other and unspecified					29	0.02							29	0.02

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	Dislocation, Sprain and Strain		Fracture		Inflammation and Pain (Overuse)		Joint Derangement		Stress Fracture		Multiple and Unspecified		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Subtotal	24,927	15.19	3,059	1.86	45,315	27.62	6,826	4.16	217	0.13	136	0.09	80,480	49.05
Multiple and unspecified	165	0.10	7	0.00	30	0.02					3	0.00	205	0.12
Total	48,284	29.43	6,314	3.85	98,638	60.12	10,223	6.23	254	0.15	160	010	164,078	100.00

TABLE 3.

Incidence Rates and Crude and Adjusted Incidence Rate Ratios of Musculoskeletal Injuries by Sociodemographic, Fitness, and Anthropometric Characteristics, U.S. Air Force Security Forces Enlisted Personnel, January 2009 to December 2018

	IR (95% CI)*	Crude IRR (95% CI)	Partially Adjusted IRR (95% CI)†	Fully Adjusted IRR (95% CI)‡
Age				
<22	4.20 (4.15, 4.26)	1 [referent]	1 [referent]	1 [referent]
22–24	5.56 (5.49, 5.63)	1.32 (1.30, 1.34)	1.14 (1.12, 1.16)	1.07 (1.04, 1.10)
25–28	6.46 (6.37, 6.55)	1.54 (1.51, 1.56)	1.27 (1.24, 1.30)	1.17 (1.12, 1.21)
≥29	7.63 (7.50, 7.75)	1.81 (1.78, 1.85)	1.40 (1.36, 1.45)	1.22 (1.16, 1.28)
Sex				
Male	5.40 (5.34, 5.45)	1 [referent]	1 [referent]	1 [referent]
Female	6.76 (6.63, 6.90)	1.25 (1.22, 1.28)	1.36 (1.33, 1.39)	1.31 (1.27, 1.35)
Race				
White	5.62 (5.56, 5.68)	1 [referent]	1 [referent]	1 [referent]
Black	5.86 (5.74, 5.97)	1.04 (1.02, 1.07)	1.06 (1.03, 1.08)	1.06 (1.03, 1.10)
Asian	4.43 (4.12, 4.74)	0.79 (0.73, 0.85)	0.82 (0.76, 0.88)	0.93 (0.85, 1.02)
Hawaiian/PI	4.40 (4.03, 4.78)	0.78 (0.72, 0.85)	0.76 (0.70, 0.83)	0.84 (0.76, 0.92)
AI/AN	5.51 (4.93, 6.08)	0.98 (0.88, 1.09)	0.98 (0.88, 1.09)	1.02 (0.88, 1.18)
Multi-racial	5.19 (4.97, 5.41)	0.92 (0.88, 0.96)	0.97 (0.92, 1.01)	1.01 (0.96, 1.07)
Unknown	6.92 (6.50, 7.34)	1.23 (1.16, 1.31)	0.99 (0.93, 1.06)	1.10 (1.00, 1.20)
Ethnicity				
Non-Hispanic/Latino	5.60 (5.55, 5.65)	1 [referent]	1 [referent]	1 [referent]
Hispanic/Latino	6.78 (6.46, 7.11)	1.21 (1.15, 1.27)	1.04 (0.99, 1.09)	1.06 (0.99, 1.13)
Marital status				
Single	4.70 (4.65, 4.76)	1 [referent]	1 [referent]	1 [referent]
Married	6.65 (6.57, 6.72)	1.41 (1.39, 1.43)	1.15 (1.13, 1.17)	1.12 (1.09, 1.15)
DSW	7.38 (6.95, 7.31)	1.52 (1.48, 1.56)	1.16 (1.13, 1.20)	1.17 (1.12, 1.22)
Rank				
E-1	1.34 (1.26, 1.41)	0.27 (0.25, 0.29)	0.28 (0.27, 0.31)	0.40 (0.34, 0.46)
E-2	4.41 (4.27, 4.55)	0.90 (0.87, 0.93)	0.93 (0.90, 0.96)	0.95 (0.90, 1.01)
E-3	4.91 (4.85, 4.98)	1 [referent]	1 [referent]	1 [referent]

	IR (95% CI)[*]	Crude IRR (95% CI)	Partially Adjusted IRR (95% CI)[†]	Fully Adjusted IRR (95% CI)[‡]
E-4	5.95 (5.87, 6.02)	1.21 (1.19, 1.23)	1.06 (1.04, 1.08)	1.03 (1.00, 1.06)
E-5	6.49 (6.39, 6.58)	1.32 (1.30, 1.34)	1.00 (0.97, 1.03)	0.94 (0.91, 0.98)
E-6	7.23 (7.07, 7.39)	1.47 (1.44, 1.51)	0.96 (0.92, 1.00)	0.90 (0.85, 0.96)
E-7	8.67 (8.42, 8.92)	1.76 (1.71, 1.82)	1.11 (1.05, 1.17)	1.06 (0.98, 1.14)
E-8	9.48 (8.88, 10.07)	1.93 (1.81, 2.06)	1.15 (1.03, 1.27)	1.11 (0.94, 1.30)
E-9	10.53 (9.52, 11.54)	2.14 (1.94, 2.36)	1.08 (0.88, 1.32)	1.02 (0.75, 1.39)
Duty level				
Helper	3.09 (2.84, 3.33)	0.29 (0.26, 0.33)	0.60 (0.48. 0.75)	0.74 (0.50, 1.08)
Apprentice	4.88 (4.83, 4.93)	0.46 (0.42, 0.51)	0.67 (0.54, 0.82)	0.72 (0.52, 0.99)
Journeyman	6.29 (6.21, 6.36)	0.59 (0.54, 0.66)	0.70 (0.57, 0.86)	0.74 (0.54, 1.02)
Craftsman	7.72 (7.57, 7.87)	0.73 (0.66, 0.81)	0.78 (0.63, 0.95)	0.80 (0.58, 1.09)
Superintendent	9.01 (8.45, 9.57)	0.85 (0.77, 0.95)	0.82 (0.69, 0.99)	0.81 (0.61, 1.07)
Chief enlisted manager	10.56 (9.52, 11.61)	1 [referent]	1 [referent]	1 [referent]
Calendar year				
2009	5.49 (5.40, 5.58)	1 [referent]	1 [referent]	–
2010	5.19 (5.11, 5.28)	0.95 (0.93, 0.97)	0.93 (0.92, 0.95)	–
2011	5.23 (5.14, 5.31)	0.95 (0.93, 0.97)	0.91 (0.89, 0.93)	–
2012	5.36 (5.27, 5.45)	0.98 (0.96, 1.00)	0.91 (0.89, 0.93)	1 [referent]
2013	5.36 (5.27, 5.46)	0.98 (0.96, 1.00)	0.89 (0.87, 0.91)	1.01 (1.00, 1.04)
2014	5.52 (5.43, 5.62)	1.01 (0.98, 1.03)	0.89 (0.87, 0.92)	1.02 (1.00, 1.05)
2015	6.94 (6.81, 7.05)	1.26 (1.23, 1.29)	1.09 (1.07, 1.12)	1.08 (1.05, 1.12)
2016	3.47 (3.39, 3.55)	0.63 (0.62, 0.65)	0.53 (0.52, 0.55)	0.49 (0.48, 0.52)
2017	6.99 (6.87, 7.12)	1.27 (1.24, 1.30)	1.07 (1.05, 1.10)	1.03 (1.00, 1.07)
2018	6.94 (5.15, 7.07)	1.26 (1.24, 1.29)	1.06 (1.03, 1.08)	1.07 (1.04, 1.11)
Fitness level				
Excellent	5.26 (5.19, 5.33)	1 [referent]	–	1 [referent]
Satisfactory	4.97 (4.89, 5.04)	0.95 (0.93, 0.96)	–	0.91 (0.90, 0.93)
Unsatisfactory	8.77 (8.48, 9.07)	1.67 (0.61, 1.73)	–	1.61 (1.55, 1.67)
Body mass index				
<18.5	5.12 (4.62, 5.62)	1.09 (0.99, 1.21)	–	1.04 (0.94, 1.16)

	IR (95% CI)*	Crude IRR (95% CI)	Partially Adjusted IRR (95% CI)†	Fully Adjusted IRR (95% CI)‡
18.5–24.9	4.68 (4.60, 4.76)	1 [referent]	–	1 [referent]
25.0–29.9	5.46 (5.38, 5.54)	1.17 (1.14, 1.19)	–	1.15 (1.13, 1.18)
≥30.0	6.46 (6.31, 6.62)	1.38 (1.34, 1.42)	–	1.30 (1.26, 1.34)

AI, American Indian; AN, Alaskan Native; CI, confidence interval; DSW, divorced, separated, or widowed; IR, incidence rate; IRR, incidence rate ratio; PI, Pacific Islander.

*Crude incidence rate per 100 person-months (*N*=62,489).

†Adjusted for all other variables listed in the table, other than fitness level and body mass index, January 2009 to December 2018 (*N*=62,489).

‡Adjusted for all other variables listed in the table, restricted to January 2012 to December 2018 (*N*=46,112).