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Original research

Using causal energy categories to report the distribution of injuries in an active population: An approach used by the U.S. Army

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ABSTRACT

Objectives: To describe the etiologic distribution of all injuries among U.S. Army Active Duty soldiers by causal energy categories.
Design: Retrospective cohort, descriptive analysis.
Methods: Injury was defined as the interruption of tissue function caused by an external energy transfer (mechanical, thermal, radiant, nuclear, chemical, or electrical energy). A comprehensive injury matrix standardized categories by causal energies, body locations, and injury types. Categories differentiated acute (ACT) from cumulative micro-traumatic (CMT) overuse injuries, and musculoskeletal injuries (MSKI) from those affecting other or multiple body systems (non-MSKI). International Classification of Diseases (ICD) diagnoses codes were organized into established categories. The matrix was applied to electronic health records for U.S. Army soldiers in 2017.
Results: Mechanical energy transfers caused most injuries (97%, n = 809,914): 76% were CMT overuse and the remaining were ACT (<21%). The majority (83%) were MSKI (71% CMT, 12% ACT). While almost one-half (47%) were to lower extremities (38% CMT, 9% ACT) the most frequently injured anatomical sites were the knee and lower back (16% each, primarily CMT).
Conclusions: For the first time all soldiers' injuries have been presented in the same context for consistent comparisons. Findings confirm the vast majority of injuries in this physically-active population are MSKI, and most are CMT MSKI. A very small portion are non-MSKI or injuries caused by non-mechanical energy (e.g., heat- or cold-weather). Most Army injuries are to the lower extremities as a grouped body region, but additional matrix specificity indicates the most injured anatomical locations are the knee, lower back, and shoulder.

Practical implications

- Injury prevention campaigns often focus on severe acute and fatal injuries which can underrepresent the injury problem in physically-active populations.
- Overuse injuries are predominant type of injury among soldiers and other physically active populations.
- Understanding the distribution of all injuries in a population, including acute and overuse injuries, helps direct the prioritization, design, and evaluation of injury prevention strategies.
- The distribution of injuries by causal categories, specific body locations, and type of injury can be consistently reported with a comprehensive injury matrix.

1. Introduction

Injuries are commonly cited as a leading health problem among civilians,[1–4] workers,[1,5] athletes,[6–8] and military populations.[9–13] Injury has conceptually been defined as bodily damage caused by transfers of energy or the absence of energy.[2,14–16] In theory, this is broadly inclusive of a vast array of outcomes (types of bodily damage) and countless causal activities or events (e.g., vehicle crashes, falls, sports and exercise, occupational tasks, intentional violence, environmental or weather-related conditions, and poisonings). In

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practice, however, the injuries identified in surveillance and investigative studies often reflect only a limited set of acute outcomes (e.g., fatalities, emergency department visits) and associated causes (e.g., vehicle crashes, falls, sports, extremes of temperature, poisonings, and intentional acts of violence).[1–4,17] The assumption that injuries are limited to these severe trauma conditions can mislead public health and community leaders' understanding of injuries within their population.

As an example, efforts to reduce injuries among U.S. Army soldiers have been complicated by differing definitions of injury.[16–18] The U.S. Army assigns high importance to reducing fatal and severe traumatic injuries and ensures that causal incidents are thoroughly investigated and reported through safety channels.[18] These same types of injuries parallel those emphasized by national public health injury prevention campaigns.[2–4] Yet U.S. Army medical surveillance and investigative studies have shown that these severe incidents are not representative of the entire military injury problem.[11–13,19] Military studies in the U.S.[19–22] and several international countries[23–25] have indicated that injuries with greatest adverse impact to military readiness are musculoskeletal injuries (MSKI). MSKI refers to damage to bone, muscle, tendon, ligaments, joints, cartilage, bursa, or synovium caused by either sudden trauma (e.g., fractures, dislocations, sprain, strains, etc) or by the accumulation of repeated microtrauma (e.g., stress fractures, Achilles tendinopathy, patellofemoral pain and "runner's knee," and dorsalgia).[6,9,16] The magnitude of the MSKI problem in military populations is significant, as they have been described as the leading cause of medical visits, medical discharges in basic training, and medical evacuations from deployment settings.[11,13,19] Impacts of MSKI have been described in terms of millions of dollars lost annually to direct medical costs, even greater indirect costs from lost training and restricted duty days, disrupted physical performance and non-deployability, medical discharges, and risks for subsequent injury.[21,22,26]

Military reports have long indicated that most MSKI are overuse injuries.[9,12,13,27–29] Studies have also have suggested that MSKI among soldiers are most frequently in the lower extremities and spine or back.[19,21,23,29] Yet methods for grouping injury pathology by cause, type, and injured body locations have not been uniform. For example, since the standardized Barell matrix[30] only addresses acute trauma injuries, other studies have used different approaches to group or characterize overuse injuries.[12,19,21] As a result, studies have not always reported the same injuries, or categorized injury types and injured body regions in the same way – including distinguishing between acute and overuse MSKI. These inconsistencies undermine efforts to monitor injury trends, compare studies, and evaluate prevention strategies that should be directed at causal activities. To best support prevention goals, injury surveillance could include these distinctions through the routine analysis of causal information.[14,15] Unfortunately, due to the lack of injury cause documentation by providers in military medical records, causal data for non-fatal injuries that do not require hospitalization or emergency department visits has not been available for routine surveillance.[11,14,31] Past U.S. military studies have found that International Classification of Diseases (ICD)[32] external cause codes that attribute causes to the diagnoses are too infrequently documented (< 2–10% records) to be of use.[11,31] Instead, the causes of common military injuries have often been determined through medical and public health field studies and self-report surveys.[13,22,27,33] For example, studies of military MSKI have attributed lower body overuse injuries to running and foot marching.[21,23,27,33]

The inclusion of overuse MSKI in Army injury surveillance has been an important step in describing the magnitude of the military's injury problem. However, the relative distribution of overuse MSKI compared to all other types of injuries by causal mechanism (i.e., acute MSKI and non-MSKI) has not previously been investigated. The present study addresses this notable gap in the literature. The comprehensive injury matrix developed for this study encourages consistent monitoring of the etiologic distribution of all injuries in a population by the causal categories, injury type, and injured body regions. While this application emphasizes the benefits for physically active populations, the approach can be applied to any desired population.

2. Methods

The goal of this study was to identify all of the medically diagnosed injuries (outcomes) to U.S. Army soldiers during one calendar year and describe the distribution of those injuries based on the type of causal energy transfer (exposures). This analysis included the development of a comprehensive injury definition and corresponding taxonomy to categorize causal energy groups.[16] The taxonomic categories were operationalized with the assignment of ICD-10-CM clinical diagnosis codes.[32] The process involved iterative discussions among a team of military public health subject matter experts with a variety of skillsets and expertise (preventive and occupational medicine, physical therapy, epidemiology, kinesiology, physical sciences, physiology, and safety). The team used both literature reviews and Army case examples to make decisions. The taxonomy and applicable ICD-10-CM codes were used to create the standardized injury reporting matrix that was applied to soldiers' medical records.

Injury was universally defined as physical damage or interruption to normal tissue function caused by an external energy transfer that exceeded the threshold of tissue tolerance (e.g., mechanical, thermal, radiant, chemical, or electrical energy).[2,14–16] Energy transfers to the body included those from animate or inanimate sources, from intentional or unintentional events, and included single sudden (high intensity) transfers and repeated lower intensity transfers. The inhibition of an energy or essential element needed for normal tissue function was also included (e.g., lack of oxygen from drowning or asphyxiation). Illness or disease associated with infectious agents, genetic conditions or the normal degenerative aspects of aging (particularly in an Active Duty soldier) were excluded. Injuries were taxonomically organized by categories and sub-categories as follows:

Mechanical energy transfers, which occur when kinetic energy is exchanged between an object (e.g., a car, another person, or the ground) and the body. Mechanical energy transfers were subcategorized as acute traumatic (ACT) injuries that occur instantaneously from a single, sudden high intensity force and cumulative microtraumatic (CMT) injuries that occur gradually over minutes to months from repetitive lower intensity forces.[6,9,16] ACT and CMT injuries were further subcategorized as MSKI and non-MSKI, depending on whether the injury occurred to tissues of the musculoskeletal system or to other or multiple body systems.

Non-mechanical energy transfers were sub-categorized based on environmental sources (e.g., radiant energy, cold weather, altitude and pressure, and lightning), poisonings (medicinal and recreational drugs, toxins, and chemicals), and non-environmental thermal, electric, and nuclear sources. Common military environmental injuries included heat stroke, sunburns, frostbite. The selected poisoning diagnoses were based on previously established injury coding determinations.[1,16] Non-environmental injuries included burns from fires, radiation, and electrocutions.

Other diagnoses were consistent with the injury definition and recognized in the literature as injuries, but could not logically be grouped into one of the previous categories.[14–16] As an example, the lack of an essential element (e.g., oxygen) included subcategories including diagnoses for asphyxiation from drowning and strangulation. Additional groups included injuries caused by: operative

or post-operative accidents or complications; food or other foreign bodies in natural orifices; other reactions to external causes; unspecified injuries from intentional abuse or neglect, and other unspecified or multiple injuries without a clear mechanism.

Specific injuries were operationalized with 12,889 selected ICD-10-CM diagnosis codes.[16] The injury diagnosis codes that met the injury definition were primarily (91% of all injury codes) from the ICD-10-CM Chapter 19 "Injuries and Poisonings." Though these codes were applied across all of the causal energy categories, most were categorized as mechanical energy injuries. These were all ACT MSKI and non-MSKI with the exception of friction blisters which were CMT non-MSKI injuries. The selected codes from Chapter 13 "Diseases of the Musculoskeletal System and Connective Tissue" (approximately 7% of all of the injury codes) included both ACT and CMT MSKI. The remaining codes were from Chapter 6 "Diseases of the Nervous System," Chapter 7 "Diseases of the Eye and Diseases of the Ear," and Chapter 12, "Diseases of the Skin." To complete the matrix, all identified injury diagnosis codes were categorized by injured body region and specific anatomical site, and nature of injury types based on an adaptation of previously used injury matrices.[19,30]

The resulting comprehensive injury matrix[16] was applied to electronic health records for Active Duty U.S. Army soldiers during 2017. This effort was approved by the U.S. Army Public Health Center Public Health Review Board as public health practice so did not require individuals' consent. The ICD-10-CM injury diagnosis codes were used to capture both inpatient and outpatient medical encounter data from the Defense Medical Surveillance System, the centralized system for U.S. military healthcare records. Encounters included those at military medical facilities and at civilian facilities reimbursed through the Military Health System (i.e., purchased care). Data were collected for primary diagnosis for initial injury encounters. For many ICD-10-CM codes, initial encounters were specified by a seventh digit. Follow-ups and sequela visits were excluded since this study was characterizing the distribution of incident injuries. For ICD-10-CM codes that did not specify whether a visit was an initial encounter, a 60-day gap rule between encounters was to avoid counting repeated visits for the same injury. Distributions were reported for overall injuries, by causal energy category, injured body regions, and nature of injury, and for demographic groups (gender, age, and rank).

3. Results

There were 809,914 injuries documented in the medical records for 469,973 soldiers in 2017 (85% men, 15% women). On average, women experienced 2.3 injuries per soldier, compared to 1.6 injuries per soldier among men. Less than one percent of the incident injuries required hospitalization. Fifty percent of all of the identified injuries (n = 407,293) were diagnosed by just twenty of the identified ICD-10-CM injury diagnosis codes. Eighteen of these twenty most frequent diagnoses were ICD-10-CM Chapter 13 diagnoses of pain to a body region (e.g., pain in knee (M55.6), pain in lower back (M54.5), cervicalgia (M54.2), and dorsalgia (M54.9)).

The majority of soldier injuries (97%) were caused by the transfer of mechanical energy (Fig. 1, and Supplemental Table 1). Most injuries (76%) were CMT injuries which were primarily MSKI (71%). The ACT and CMT MSKI together comprised 83% of all injuries. Environmental, non-environmental, and poisoning causal categories combined produced 1.3% of all injuries. Of these, the most notable sub-category was thermal/radiant (e.g., heat/sun related) injuries (0.4%, Supplemental Table 1). The remaining 2.3% of injuries were the result of other causes, most notably unintentional physical damage resulting from medical complications (0.9%). Distributions

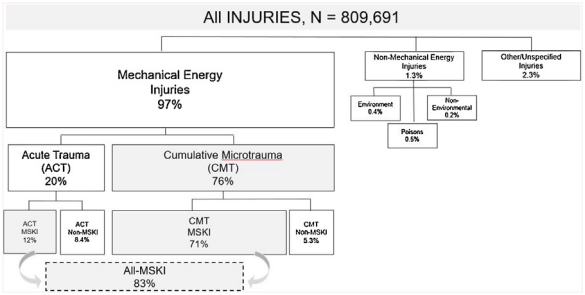

Fig. 1. Distribution of incident injuries based on causal energy categories, Active Duty Army, 2017.

by demographic subpopulations followed similar distributions (Supplemental Table 1).

Almost one half of all soldier injuries (47%) were to the lower extremities, most of which were CMT injuries (Table 1). Injuries to the knee and lower back were the most common specific body sites injured (16% each). The largest proportion of injuries caused by mechanical energy were characterized as musculoskeletal tissue damage (72%, Table 2).

4. Discussion

The concept that injury is damage to the body caused by the transfer of external energy is not new, and has been widely accepted for many years.[2,14–16] However, this definition has not been uniformly interpreted in injury surveillance. Historically, public health injury surveillance has been limited to certain severe ACT injuries caused by the instantaneous transfer of mechanical energy, especially those that result in fatalities or ED visits.[3,4,17] This narrow injury definition can result in significant under-counting of preventable injuries. This is especially true of overuse (CMT) injuries in physically active populations. Yet CMT injuries have long been acknowledged as having a substantial impact to military populations,[9,13,19–29] to civilians especially in certain occupational settings[1,2,5,34] and in athletic communities.[6–8,35] For example, in 1995 the sports medicine community noted "*a dramatic rise in what is called 'overuse injury'. . .from the accumulation of repetitive 'microtrauma' to the tissues.*"[8]

Prior studies have indicated that the injuries which most commonly impair soldiers' abilities and require medical evaluation are MSKI and that CMT overuse injuries are the primary type of MSKI.[9,11,13,21,27] For example, in the U.S., CMT MSKI have been described as "the single most significant impediment to military readiness."[22,28] When surveyed, soldiers have also recognized several CMT MSKI such as tendonitis, stress fractures, and back and knee pain syndromes as common injuries.[36,37] Military studies have indicated that overuse injuries are a leading military medical burden, annually costing millions in medical treatment and lost duty time.[19,21–23,26–28,38] Inclusion of these injuries in military injury surveillance is therefore critical to ensure a full understanding of their impact to force readiness. However, MSKI and especially CMT MSKI, have not been consistently defined or reported – or compared in the context of injuries from all other external causes. For example, MSKI are not presented in the context of other military injuries of concern, such as heat-related or noise – induced hearing injuries.[16,27,39] In addition, though MSKI studies generally identify the back and lower extremities as the body regions most commonly injured, neither the nature (ACT or CMT) or specific anatomical locations have consistently been described. For instance, some studies report all injuries combined,[10] while others describe a separation of overuse injuries without clearly distinguishing between ACT and CMT diagnoses.[23,25] Other studies have

Table 1
Injuries caused by mechanical energy by body region and site, Active Army, CY 2017.

Body region	# injuries	% all mechanical injuries	% ACT	% CMT	Specific anatomical site	% All	% ACT	% CMT
Head & neck	45,065	5.8	3.3	0.0	TBI	0.7	0.7	0.0
					Other head	1.0	1.0	0.0
					Face	0.4	0.3	0.0
					Eye	0.7	0.7	0.0
					Ear	2.5	0.1	0.0
					Neck	0.5	0.5	0.0
					Head/neck, other	0.0	0.0	0.0
Spine & back	185,126	23.6	1.1	22.5	Back, upper	4.3	0.2	4.1
					Back, middle	1.3	0.1	1.2
					Back, lower	15.8	0.9	14.9
					Back, other	2.3	0.0	2.3
Torso	10,374	1.3	1.2	0.1	Chest	0.8	0.7	0.1
					Abdomen	0.2	0.2	0.0
					Pelvis	0.3	0.3	0.1
					Trunk, other	0.0	0.0	0.0
Upper extremity	165,875	21.2	6.7	14.4	Shoulder	9.7	1.7	7.9
					Arm, upper	0.5	0.4	0.1
					Elbow	1.7	0.2	1.5
					Arm, lower	0.9	0.7	0.2
					Wrist	2.4	0.5	1.9
					Hand, finger	4.6	2.7	1.9
					Arm, other	1.3	0.5	0.8
Lower extremity	365,513	46.7	8.7	37.6	Hip	6.0	0.7	5.1
					Leg, upper	1.4	0.7	0.8
					Knee	16.1	1.9	14.2
					Leg, lower	5.3	1.8	3.4
					Ankle	8.0	2.1	5.8
					Foot, toe	7.8	1.5	6.3
					Leg, other	2.1	0.0	2.1
Other	11,538	1.5	0.1	1.4	System-wide	0.0	0.0	0.0
					Multiple	0.0	0.0	0.0
					Unspecified	1.4	0.1	1.4
TOTALS	783,491	100	21	76				

Acute = acute traumatic (ACT) injury; Cumulative = cumulative micro-traumatic (CMT) injury; TBI = traumatic brain injury.

used terms such as injury-related musculoskeletal conditions or training-related injuries to refer to certain overuse injuries, though these categories may include some acute injuries.[19,22] Studies have found more lower extremity injuries than other body regions compared to back, have not always evaluated more specific anatomic sites such as the knee.[19,21,23]

For the first time, a systematic approach to comprehensively define and categorize all injuries experienced within a physically-active population has been used to quantify injury distribution based on causal energy. This approach captures and categorizes both ACT and CMT injuries caused by mechanical energy transfers (i.e., MSKI and the non-MSKI that affect other body systems and tissues) in addition to injuries from all other external energies (i.e., radiant, thermal, chemical, electrical, and nuclear). This study found that, for both men and women of any age group, the vast majority of injuries were caused by mechanical energy transfers. In comparison, all other injuries, including those caused by poisons, environmental sources such as heat and cold weather–related injuries, drownings, medical operative incidents, and intentional acts, comprised less than 4% of all injuries. Though literature has suggested that most injuries are due to mechanical energy transfer,[2] this is the first study to provide supporting evidence and systematically categorize all injury diagnoses in one matrix for efficient prevention planning.

In the current study, it was observed that over 80% of the soldiers' injuries were MSKI and that over two-thirds of these were CMT overuse injuries. This is in line with prior U.S. and international military studies that have indicated MSKI, and especially overuse injuries, represent 60 to over 80 percent of the injuries experienced by active military personnel.[9,12,21,22] For example, Rosendal et al. all found 65% of MSKI were overuse injuries, compared to a previously found 86% from overuse.[9] The resulting distribution also indicates that lower extremities were the most commonly injured body region. This is generally consistent with some military studies,[12,13,27] though other studies have found the back and spine to be more frequently injured.[12,19,21] Direct comparisons have been complicated, since body regions and individual anatomical sites have been categorized in varying ways. Though in this study the lower extremities were observed to be the body region with the largest portion of MSKI, the actual anatomical location of injuries provides more specificity. This study found the two most frequently injured unique anatomical sites were the lower back (lumbar and sacral area) and the knee. Most injuries to each of these sites was from CMT overuse, which included many non-specific diagnoses such as a symptomatic pain syndrome. This finding helps to clarify and strengthen other studies that have also found lower back and knee injuries to be prevalent in other military and physically-active populations.[19,21,23] Even more unique in this study's findings, the shoulder was the next most commonly injured anatomical site. While running and marching have been described as the primary activities causing repetive stress to the lower extremities,[13,23,33] shoulder injuries are unlikely to be caused from these activities. By more consistently defining the nature and anatomical location of injuries, specific causes and interventions can be targeted for future evaluation.

This study broadly defined injuries to ensure completeness of Army injury surveillance. The approach ensures the inclusion of injuries treated through non-emergency outpatient services that are often not recognized as injuries in safety incident reporting. It also establishes definitive limits on the universe of medical diagnoses that constitute injuries, organized in standardized reporting categories. This helps to delineate different types of injuries and clarify conditions that are not included as injuries (e.g. degenerative or chronic conditions).[6,16] The method ensures the thousands

Table 2
MSKI by primary nature of injury types,[a] Active Army, 2017.

General body region	Specific anatomical site	Fracture		Dislocation	Sprain/joint damage		Strain/tear		Other MSK tissue damage[c]	
		ACT	CMT[b]	ACT	ACT	CMT	ACT	CMT	ACT	CMT
Head & neck	TBI	285	0	0	0	0	0	0	0	0
	Other head	0	0	0	2	0	114	0	15	0
	Face	1,125	0	49	12	0	0	0	0	0
	Eye	177	0	0	0	0	0	0	0	0
	Ear	0	0	0	0	0	0	0	0	0
	Neck	12	0	0	0	0	2,329	0	12	0
	Head/neck, other	0	0	0	0	0	0	0	0	0
Spine & back	Back, Upper	192	2	8	959	0	0	0	3	28,498
	Back, middle	212	0	0	210	0	0	0	1	9,297
	Back, lower	502	20	19	1,235	0	3,329	0	50	104,832
	Back, other	0	3	0	0	1	0	0	1	17,392
Torso	Chest	476	0	43	601	0	1,495	0	40	0
	Abdomen	0	0	0	0	0	731	0	14	1
	Pelvis	282	424	8	225	0	74	0	3	0
	Trunk, other	0	0	0	0	0	0	0	0	0
Upper extremity	Shoulder	790	1	1,242	3,260	384	3,328	3,227	2,593	59,007
	Arm, upper	276	1	303	0	0	1,299	81	187	676
	Elbow	0	0	100	363	37	0	0	60	11,775
	Arm, lower	1,562	4	22	0	0	382	216	176	1,153
	Wrist	943	0	0	2,213	123	0	0	68	15,024
	Hand, finger	5,693	7	682	1,674	37	742	771	382	14,109
	Arm, other	0	0	0	0	0	0	0	0	3,493
Lower extremity	Hip	158	310	27	3,206	1,639	1,112	0	103	39,726
	Leg, upper	228	521	0	0	0	3,354	6	162	5,357
	Knee	371	0	417	10,885	671	0	0	1,130	110,935
	Leg, lower	1,759	1223	0	0	0	4,594	3	2,901	25,595
	Ankle	1,245	50	115	12,233	373	120	2	2,213	45,363
	Foot, toe	3,377	399	170	1,447	43	0	0	1,468	45,908
	Leg, other	0	0	0	0	0	0	0	0	15,196
Other	System-wide	0	0	0	0	0	0	0	62	0
	Multiple	0	0	0	0	0	0	0	11	169
	Unspecified	0	81	0	51	26	36	5	61	10,603
Total injuries		19,665	3,046	3,205	38,576	3,334	23,039	43,11	11,716	564,109
% of all mechanical injuries (n = 783,491)		2.5%	0.4%	0.4%	4.9%	0.4%	2.9%	0.6%	1.5%	72.0%

[a] Other injury types included amputations (<0.1% of all injuries), injuries to non-MSK systems: crush (0.1%), internal organs/blood vessels (0.8%), open wounds (2.0%), burns (0%), corrosions (0%), nerve (3.2%), contusion/superficial (3.2%), and other non-MSK tissues(<5%), and multiple or unspecified body regions or system-wide conditions (<3%).

[b] Fractures identified as CMT injuries are stress fractures (ICD-10-CM Chapter 13 diagnoses).

[c] Includes ICD-10-CM Chapter 13 diagnoses e.g., "spontaneous" ligament ruptures, tendonitis, dorsalgia and body region specified pain.

of injury diagnoses are each aligned with general causal characteristics, as well as specific injured anatomical locations in order to better target future interventions and studies. The causal information addresses a recognized gap in how injury has historically been defined and reported in the study and surveillance of injury.[14,15] The taxonomical injury matrix is a transparent tool now being used to ensure the repeatability and consistency of U.S. Army injury studies.

As with any approach that is used to analyze large datasets, assumptions are required and various limitations are recognized. Inherent to the approach used in this study is that an injury requires a medical encounter. As a result, injuries experienced by soldiers who did not seek medical care were not captured. In addition, when assigning ICD-10-CM codes, it is recognized that providers may not always use the same diagnosis code. Finally, since only initial injury incidents were included, this study only hints at the full implications of the Army's MSKI problem. Many injuries might require multiple medical visits for diagnosis and treatment, including physical therapy sessions and follow-up visits. Also no reflected is the extensive costs of lost duty time due to the physical activity restrictions required for injury rehabilitation.

5. Conclusion

Disparate definitions of injuries, and the medical diagnoses that are included or are not included as injuries, often complicate direct comparisons between scientific studies. Application of the comprehensive taxonomically-based injury matrix used in this study provides a more complete and comparative display of the injury etiology of this military population. Using the systematic, repeatable approach, the current study confirms prior findings that most military injuries are MSKI, and that the majority are CMT injuries are to the lower extremities. Further investigation of causes and prevention strategies for injuries to the knee, lower back, and shoulder are warranted. Consistent use of the injury taxonomy will enhance the prioritization of prevention strategies, the identification of specific military injuries or causes that require further study, and the development and evaluation of specific actionable intervention programs. This approach may be applied in other settings for consistent injury surveillance and straightforward comparisons of injury distributions across populations.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jsams.2019.04.001.

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