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This is the first annual assessment of longitudinal injury studies and surveillance conducted by the Injury Prevention Division (IPD), U.S. Army Public Health Center (APHC) and the U.S. Army Medical Command (MEDCOM) in support of the U.S. Army's implementation plan for gender integration. This assessment summarizes: (1) studies that provided the foundation for gender-neutral physical standards, (2) systematic musculoskeletal injury surveillance with baseline injury rates for women and men in the operational Active Army and Initial Entry Training (IET) from fiscal years 2011 to 2015, (3) physical fitness levels of Soldiers in IET, and (4) gaps in data access that may negatively affect future longitudinal studies and injury surveillance for gender integration.

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**Annual Assessment of Longitudinal Studies
and Injury Surveillance for Gender Integration
in the Army, 2016**

PHR No. S.0047231-16

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EXECUTIVE SUMMARY
Annual Assessment of Longitudinal Studies and
Injury Surveillance for Gender Integration in the Army, 2016

1 Purpose

This is the first annual assessment of longitudinal studies and surveillance conducted by the Injury Prevention Division (IPD), U.S. Army Public Health Center (APHC) and the U.S. Army Medical Command (MEDCOM) in support of the U.S. Army's implementation plan for gender integration.

This assessment summarizes: (1) studies that provided the foundation for gender-neutral physical standards, (2) systematic musculoskeletal injury surveillance with baseline injury rates for women and men in the operational Active Army and Initial Entry Training (IET), (3) physical fitness levels of Soldiers in IET, and (4) gaps in data access that may negatively affect future longitudinal studies and injury surveillance for gender integration. .

2 Findings

2.1 Studies for Gender Integration

One of the Department of Defense's primary concerns for gender integration was to ensure physical demands and physiological differences are addressed between women and men. Towards this end, the U.S. Army Training and Doctrine Command (TRADOC), supported by U.S. Army Research Institute for Environmental Medicine (USARIEM) conducted the Physical Demands Study to determine physical requirements for the seven combat occupational specialties that will open to women during gender integration. Next, they developed a battery of four fitness tests with gender-neutral standards (i.e., Occupational Physical Assessment Test) that will predict new recruits' ability to meet these physical requirements.

The IPD is collaborating with TRADOC and USARIEM on the Occupational Occupation Physical Assessment Test (OPAT) Longitudinal Validation Study to validate the OPAT testing procedures and identify appropriate cut-scores for new recruits. Data collection in IET will be completed in December 2016. Next, the IPD will evaluate the long-term relationship of accession OPAT scores with physical fitness and injuries during the first 2 years of service.

Based on recommendations from the Soldier 2020 Injury Rates/Attritions Rates Work Group, a multivitamin with iron is now offered to women in IET. Studies suggest this may positively impact physical performance and attrition in women with low iron levels. The IPD will evaluate the effectiveness of this program in 2017.

2.2 Injury Surveillance

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During all phases of gender integration, assessment of key indicators, outcomes, and metrics will be critical to inform leaders and serve as a basis for adjusting or modifying the implementation plan when needed. The IPD conducts systematic injury surveillance of the operational Army and IET and will provide annual assessments of key injury metrics. The IET surveillance includes all basic combat training (BCT) and one station unit training (OSUT) as well as the advanced individual training courses (AIT) that opened to women in 2013.

Musculoskeletal injuries are one of the greatest challenges to Soldier and unit readiness, affecting nearly 275,000 Soldiers each year and responsible for 76 percent of all medically non-deployable Soldiers. At any given time, 15 percent of Active Army, 12 percent of National Guard, and 10 percent of Reserve Soldiers have an activity-limiting musculoskeletal injury profile.

Injury rates for female Soldiers in the operational Active Army and IET are consistently higher than rates for male Soldiers. In 2015, the injury rate for female Soldiers (1,702 per 1,000 person-years) was 1.3 times higher than the rate for male Soldiers (1,287 per 1,000 person-years). For the occupational fields being opened to women, it is expected to take several years for adequate numbers of women to be assigned in combat operational units before their injury rates can be reliably compared to those of men.

Integrated BCT, OSUT, and AIT provide the best comparisons of injury rates for women and men exposed to the same injury risks. In 2015, injury rates for women in BCT, OSUT, and the six AITs recently opened to women were 2.0 to 2.4 times higher than rates for men. The injury rates for women ranged from 19.9 to 21.7 per 100 person-months of training; rates for men ranged from 9.2 to 10.3 per 100 person-months of training.

For both genders, injury rates during IET were similar for the three Army components, but beyond IET, there is very little information on injuries for the National Guard and Reserve components. The medical and training data required for systematic surveillance after IET are not available for these components.

Previous studies have shown that Soldiers with lower levels of physical fitness have a higher injury risk compared to Soldiers that are more physically fit. For this reason, the IPD tracks Soldiers' performance on the Army Physical Fitness Test. In 2015, compared to men in the same OSUT, women on average did 18 to 21 fewer push-ups and ran 2.4 to 2.8 minutes slower for 2 miles. Similar differences in fitness were found for women in the six newly opened AITs. Lower average performance by women on these fitness assessments is primarily related to physiologic differences for the genders, but women's lower average level of physical activity before joining the Army and training to achieve lower gender-adjusted standards for these assessments may also be factors.

This first annual assessment of the IPD's longitudinal studies and surveillance does not: (1) distinguish between injuries that occurred on duty versus off duty, (2) report causes of injury for the operational Army, overall, or IET, or (3) report injury rates or causes for the National Guard or Reserve. The data required for this level of surveillance are not currently available from any Army data system.

The IPD and MEDCOM will expand the longitudinal studies and injury surveillance in Fiscal Year 2017. They will continue their collaborations with USARIEM, TRADOC, and Army Research Institute for the Behavioral and Social Sciences on studies and surveillance. They will also continue to work through the Headquarters, Department of the Army (HQDA) G-1 Integrated Studies Work Group and Soldier 2020 Injury Rates/Attrition Rates Work Group to set priorities, address identified gaps in data required to monitor for injury metrics, and coordinate future studies and surveillance efforts. Their participation in the North Atlantic Treaty Organization work group for "Combat Integration: Implications for Physical Employment Standards" and the International Congress of Soldiers' Physical Performance will provide valuable forums for sharing and learning from the experiences of the militaries that are implementing gender integration in combat.

3 Recommendations

To reduce the injury risk for all Soldiers, it is imperative that Soldiers have the requisite level of physical fitness to perform the physically demanding tasks of their occupational specialty. Beginning 3 January 2017, all new recruits must meet the pre-accession OPAT standard established for their occupational specialty. The OPAT standards (i.e., heavy, moderate, and significant) reflect the physical demand rating of each occupational specialty. For example, since combat and other "high physical demand" occupational specialties have the highest OPAT standard (i.e., heavy), recruits for these specialties must pass the OPAT at the "heavy" standard. Thus, the OPAT will ensure that new recruits have the baseline fitness required for their occupational specialty. Next, it is imperative that physical training programs provide the appropriate training stimulus that allows Soldiers to achieve their highest possible level of physical fitness while also minimizing the injury risks associated with physical training.

The future success of the longitudinal studies and injury surveillance will partially depend on access to additional medical, physical fitness, and performance data that are not currently available. It is imperative that the IPD and MEDCOM work through the HQDA G-1 Integrated Longitudinal Studies Work Group and the Soldier 2020 Injury Rates/Attrition Rates Work Group to describe these data shortfalls and coordinate efforts to ensure data systems are improved or developed that can provide these data.

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1 REFERENCES

Appendix A provides the references cited within this document.

2 AUTHORITY

The Injury Prevention Division (IPD), U.S. Army Public Health Center (APHC) prepared this report according to APHC's responsibility under Army Regulation (AR) 40-5, Section 2-19 to provide support to U.S. Army Medical Command (MEDCOM) for comprehensive medical surveillance to identify, prevent, and control evolving health problems. This annual assessment meets the requirement described in Headquarters, Department of the Army (HQDA) Execution Order (EXORD) 097-16 to the U.S. Army Implementation Plan 2016-01 (Army Gender Integration) for MEDCOM to provide annual assessments of longitudinal studies and injury surveillance.

3 INTRODUCTION

3.1 Purpose

This is the first annual assessment of longitudinal studies and injury surveillance conducted by the IPD, APHC for MEDCOM during implementation of the Army's gender integration plan (i.e., Army Implementation Plan 2016-01 [Gender Integration]) (HQDA EXORD 097-16, 2016). This assessment summarizes: (1) participation in studies that provided the foundation for gender-neutral physical standards for accessions, (2) systematic injury surveillance with baseline musculoskeletal injury rates for women and men in the operational Active Army and Initial Entry Training (IET), (3) physical fitness levels of Soldiers in IET, and (4) gaps in data access that may negatively affect the longitudinal studies and injury surveillance being conducted for the gender integration plan.

3.2 Scope

This assessment describes injury rates and rate comparisons between genders for the operational Active Army and IET (i.e., Basic Combat Training (BCT), One Station Unit Training (OSUT), and six Advanced Individual Training (AIT) courses newly opened to women in FY 2013). Reported injury rates include musculoskeletal injuries for which Soldiers sought medical care, whether the injuries occurred on duty or off duty. Due to constraints imposed by available medical data, this report does not: (1) distinguish between injuries that occurred on-duty versus off-duty, (2) report limited duty time required to recover from injuries, or (3) report injury rates or causes for the Army National Guard (NG) or Reserve.

3.3 Summary of Directives from the Secretary of Defense on Gender Integration

On 24 January 2013, the Secretary of Defense (SECDEF) rescinded the 1994 Direct Ground Combat Definition and Assignment Rule (DGCDAR) and directed the integration of women into currently closed units and positions (SECDEF, 2013). To achieve this, SECDEF directed each Service to develop and implement validated, occupation-specific physical performance requirements (i.e., gender-neutral occupational standards).

On 3 December 2015, the SECDEF directed full integration of women in the Armed Forces (SECDEF, 2015). He noted that studies and analyses conducted since elimination of the 1994 DGCDAR had increased the understanding of physical and physiological demands on Service members and the cultural currents that influence unit cohesion and morale. The SECDEF described seven broad areas of concern (**Table 1**) that the Military Departments must consider as they finalize their implementation plans for gender integration.

Table 1. SECDEF's Areas of Concern for Gender Integration^a

1	Transparent standards
2	Population size
3	Physical demands and physiologic differences
4	Conduct and culture
5	Talent management
6	Operating abroad
7	Assessment and adjustment

Note: ^a SECDEF, 2015

On 18 March 2016, the Undersecretary of Defense for Personnel and Readiness issued guidance on the “Annual Assessment Regarding the Full Integration of Women in the Armed Forces” (Undersecretary of Defense for Personnel and Readiness, 2016). Each Military Department must provide an annual assessment of its implementation efforts toward full integration that will be submitted through the Chairman of the Joint Chiefs of Staff and Secretary of Defense for Personnel and Readiness to the SECDEF. This assessment must include information and data on the seven areas of concern (**Table 1**). For example, studies by the Army and Marine Corps found that women participating in ground combat training sustained injuries at higher rates than men, especially in occupational fields requiring load-bearing. The relationship of such findings to the specific *physical demands and physiologic differences* must be addressed prior to the full integration of women. Likewise, it is critical that the Services “embark on integration with a commitment to monitoring, assessment, and in-stride adjustment that enables sustainable success.” This *assessment and adjustment* includes tracking injuries rates among female Soldiers in newly opened positions and adjusting standards or tasks accordingly.

3.4 The Army's Implementation of Gender Integration and MEDCOM's Role

On 6 April 2013, in response to the SECDEF's 2013 directive for gender integration, the HQDA issued EXORD 112-13 directing Army actions to integrate women into all occupational fields (HQDA, 2013). The Army initiated a deliberate service-wide effort called Soldier 2020 to open

previously closed positions and occupational specialties to women, while maintaining combat effectiveness and ensuring units are filled with the best-qualified Soldiers (HQDA, 2013). This EXORD specifically directed MEDCOM to support the development and execution of gender-neutral physical standards and to conduct a longitudinal assessment of the physical demands and injury rates in newly opened occupational fields.

MEDCOM developed two major lines of effort to support the Army's Soldier 2020 campaign:

- Physical Demands Study. The U.S. Army Research Institute of Environmental Medicine (USARIEM) provided support to the U.S. Training and Doctrine Command (TRADOC) to conduct the Physical Demands Study. The main study objective was to develop occupation-specific accession standards for the Army occupational specialties and positions that were previously closed to women (i.e., 11B Infantryman, 11C Infantryman-Indirect Fire, 12B Combat Engineer, 13B Cannon Crewmember, 13F Fire Support, 19D Cavalry Scout, and 19K Armor Crewman). This study culminated in developing the Occupational Physical Assessment Test (OPAT) and gender-neutral accession standards for the occupational fields being opened to women (USARIEM, 2015).

- Soldier 2020 Injury Rates/Attrition Rates Working Group (IR/AR WG). The IR/AR WG was facilitated by the Rehabilitation and Reintegration Division, Office of the Surgeon General and was comprised of subject matter experts from MEDCOM, APHC, USARIEM, TRADOC, U.S. Army Forces Command (FORSCOM), National Guard Bureau, US. Army Reserve Command (USARC), U.S. Army Recruiting Command (USAREC), and HQDA G-1. The primary objective of the IR/AR WG was to evaluate research and surveillance on Army injuries and attrition; the WG would then recommend actions to lower the injury and attrition rates in the high physical demand occupational fields that would be opened to women. Staff from the IPD, APHC, had a major role in supporting the IR/AR WG and provided subject matter expertise on injury surveillance, injury rates and trends, and injury risk factors (e.g., physical fitness of women and men) in the operational Army and IET. The IR/AR WG briefed its findings and recommendations to the Chief of Staff, Army (CSA) on 24 June 2015:

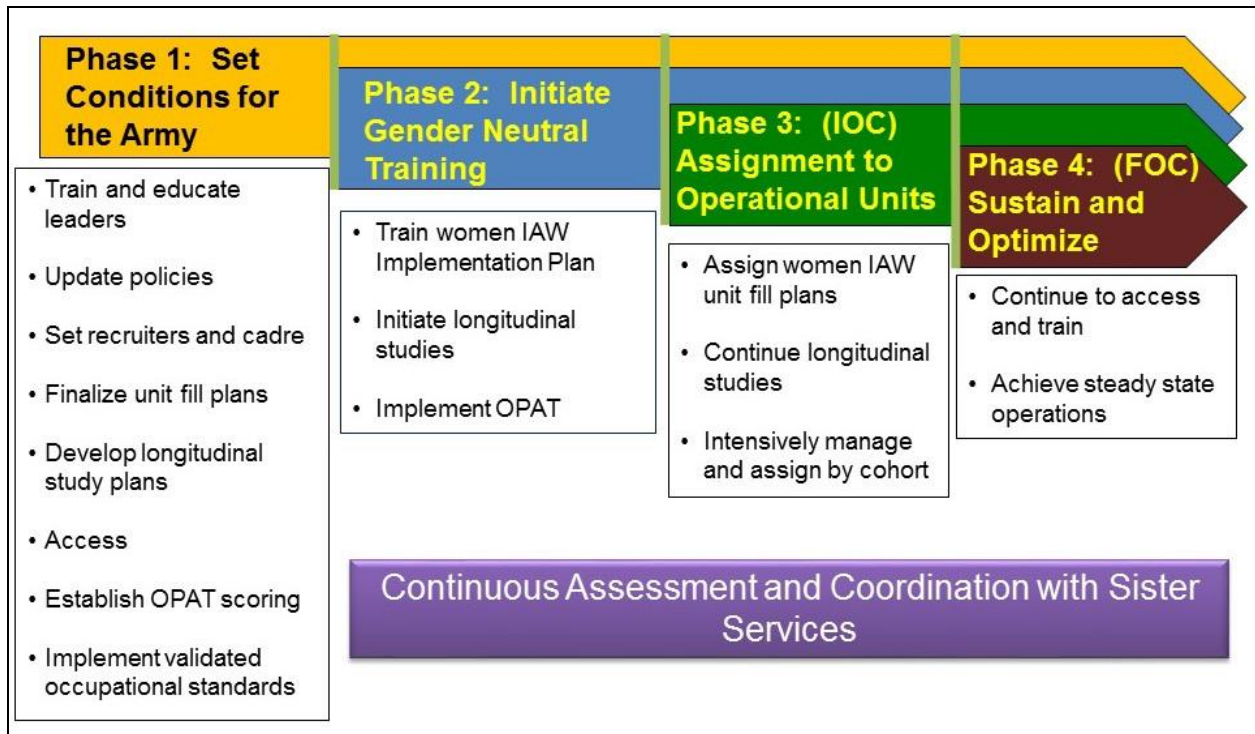
- Appropriate use of physical standards should reduce injuries and medical attrition, and
- There is no medical basis to prohibit opening any occupational field to women or men.

On 10 March 2016, HQDA issued EXORD 097-16 to the Army Implementation Plan 2016-01 (Army Gender Integration) (HQDA, 2016). By 1 April 2016, the Army was to execute its plan to open all occupations to qualified personnel regardless of gender. The EXORD described four phases for the Army's gender integration plan (**Figure 1**) and assigned MEDCOM to do the following (paragraph 3D(5), HQDA, 2016):

- OPAT Implementation Support. Support HQDA G-1 and TRADOC to implement the OPAT as a screening tool for new accessions.

- Longitudinal Studies. Support HQDA G-1 with results of longitudinal studies of musculoskeletal injuries that encompass medical aspects of physically demanding tasks, injury rates from duty performance, and injury prevention.

- Injury Surveillance. Conduct longitudinal surveillance of musculoskeletal injuries and provide annual reports to HQDA G-1 for the three Army components (i.e., Active, National Guard, and Reserve). Annual reports will include: (1) injury rates during the last 5 years for both genders in IET, including newly opened military occupational specialties (MOS), and the operational Army, (2) recommendations to mitigate injury rates, particularly in occupational fields requiring load-bearing activities, and (3) results of on-going studies on injuries and mitigation efforts.



Source: HQDA, 2016

Figure 1. Concept of Operation for the Army’s Plan for Gender Integration

4 ON-GOING LONGITUDINAL STUDIES AND INJURY SURVEILLANCE

The IPD, APHC, and MEDCOM have been actively engaged in the Army's plan for gender integration since EXORD 112-13 was published in 2013. A brief summary of current, ongoing activities to support gender integration in combat follows:

- *Study of Iron Supplementation to Female Recruits.* One of the recommendations from the Soldier 2020 IR/AR WG was to provide a multivitamin with iron to women in IET. Research has shown a significant decline in iron status among female military recruits in BCT. This decline is associated with decrements in physical and cognitive performance. Studies found that a multivitamin with iron could significantly improve performance on the Army Physical Fitness Test (APFT) for women with low iron (McClung, 2016). MEDCOM worked with TRADOC to implement a program that provides a multivitamin with iron to all female recruits at BCT and OSUT installations (HQDA EXORD 172-16, 2016). This program began sequentially at Forts Leonard Wood, Jackson, and Sill beginning in September 2015. The APHC IPD will conduct a program evaluation after 1 full year of implementation at all BCT installations.

- *Occupational Physical Assessment Test (OPAT) and OPAT Longitudinal Validation Study.* The High Physical Demands Study, described above, culminated with development and implementation of the OPAT and gender-neutral accession standards for the occupational fields being opened to women. The OPAT is a battery of four physical fitness tests that will be used as an assessment tool to ensure Soldiers are able to perform the physical demands required of their assigned MOS. The OPAT tests are the medicine ball put, standing long jump, squat lift, and beep test for aerobic capacity (USARIEM, 2015). USARIEM, supported by TRADOC and APHC, is conducting the OPAT Longitudinal Validation Study. The purposes of the study are to validate the OPAT testing procedures in the Initial Military Training setting and to identify appropriate cut-scores for the OPAT in new recruits. Data collection on new recruits in training will be completed in December 2016. The APHC IPD will evaluate the long-term relationship between the OPAT scores, APFT performance, and injuries as Soldiers transition from IET to their first unit of assignment in the operational Army.

- *Injury Surveillance Assessments.* The APHC IPD has primary responsibility for the Army's injury surveillance. It has conducted routine, systematic injury surveillance of the operational Active Army since 2001 and IET since 2010. The IET injury surveillance has continuously monitored injury rates and trends for recruits in the Active Army, National Guard, and Reserves during BCT, OSUT, and selected entry-level AIT courses. This injury surveillance for the operational Army and IET provide valuable historical baselines for injury rates and trends and will be the basis for comparison for injury rates and trends during gender integration. The IPD also administers surveys and conducts field investigations and program evaluations to identify injury risk factors and causes of injury in operational units.

- *Soldier Surveys.* The APHC IPD is collaborating with the Army Research Institute for the Behavioral and Social Sciences (ARI) to include a series of injury-related questions in surveys that will be administered by ARI at the end of Initial Military Training courses and in Army unit assessments. The survey responses will provide invaluable information on injury risk factors and causes of injury in the Army.

5 METHODS AND FINDINGS FROM INJURY SURVEILLANCE, 2011–2015

During all phases of gender integration, assessment of key indicators, outcomes, and metrics is critical. This assessment will inform leaders and serve as a basis for adjusting or modifying aspects of the implementation plan. Among the key metrics that will be monitored are: (1) musculoskeletal injury rates and trends, (2) causes of injury, and (3) long-term effects of injuries on reclassification and attrition. The APHC IPD will monitor these injury-related metrics through systematic injury surveillance of the operational Active Army and IET (BCT, OSUT, and the six AITs newly opened to women in Fiscal Year (FY) 2013).

5.1. Methods for Injury Surveillance by the APHC IPD

The APHC IPD's surveillance relies primarily on the medical encounter data (i.e., outpatient clinic visits and hospitalizations) entered by medical providers in Soldiers' electronic health records. These medical encounter data are retrieved from the Defense Medical Surveillance System (DMSS) maintained by the Armed Forces Health Surveillance Branch of the Defense Health Agency. Injury type, date of the medical encounter, and the Soldier's assigned unit are available in DMSS encounter data, but other important details such as what caused the injury, whether the Soldier was on or off duty when the injury occurred, and number of limited duty days required are not available at the present time in the medical encounter data. The IPD links results from the APFTs administered to Soldiers during BCT, OSUT, and AIT to the injury encounter data to evaluate the relationship between physical fitness and injury risk. APFT results were accessed from the TRADOC's Resident Individual Training Management System (RITMS) for the timeframe of this report.

Injury surveillance findings are summarized in this section. Injury rates and trends are presented first for the operational (post-IET) Active Army and then for IET (i.e., BCT, OSUT, and the six AITs newly opened to women). In both cases, injury rates are presented for 2015, the most recent year for which there is complete medical data, and injury trends are presented for the period 2011 to 2015. IET injury rates include Soldiers from all three Army components, but rates for the operational Army only include the Active Army. Medical and training data used in systematic surveillance are not available for the National Guard and Reserve.

To understand the surveillance findings in this report, it is important to first define "injury" and the injury metrics that will be presented:

- *Injury* in this report refers to physical damage to the body caused by application of external mechanical forces for which the Soldier sought medical care. Injuries are identified from diagnosis codes entered by medical providers, and coders in the electronic health record. Injuries of the musculoskeletal system are the focus of this report. Major categories of musculoskeletal (MSK) injuries are: (1) overuse injuries that occur gradually over time in response to low intensity, repetitive mechanical forces (e.g., Achilles tendonitis, "runner's knee," and stress fractures) and (2) traumatic injuries that occur after a sudden application of mechanical force or energy such as occurs when falling to the ground or being struck by an object or person.

- *Injury rate* is the number of injury occurrences per unit of time. In this report, injury rates for the operational Active Army are expressed with different units of time than rates for IET:

- Operational Active Army. Injury rates in this report are expressed in terms of the “number of injuries per 1,000 person-years of training.” For example, an injury rate of 1,500 per 1,000 person-years means there were 1,500 injuries among 1,000 Soldiers who each trained for one year.

- IET. Injury rates for IET are expressed in terms of the “number of Soldiers who had one or more injuries during their training course per 100 person-months of training.” For example, an injury rate of 10 per 100 person-months means that 10 Soldiers had at least one injury during 100 person-months of training. In BCT (10-weeks in duration), 100 person-months are equivalent to 40 Soldiers who each trained for 10 weeks (2.5 months).

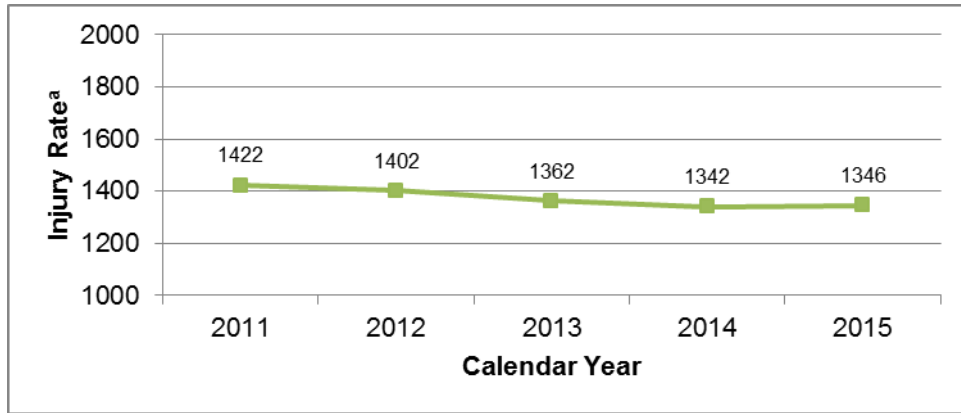
- *Injury Rate Ratio (Women:Men)*. The injury rate ratio is calculated by dividing the injury rate for women (W) by the injury rate for men (M). For example: an injury rate ratio (W:M) equal to 1.5 indicates that the injury rate for women was 1.5 times higher than the rate for men.

5.2. Injury Rates for the Operational Active Army, CYs 2011 to 2015

Population injury rates for women and men in the Active Army overall, in the functional categories, and in the enlisted MOS series and officer areas of concentration (AOC) provide important information about the overall injury risks for Soldiers. In comparing population injury rates for women and men, overall differences in injury risk by gender are evident. However, it must be recognized that these population-based comparisons include all women and men in the categories described below and include all injuries for which Soldiers sought medical care without regard for whether the injuries occurred on duty or off duty.

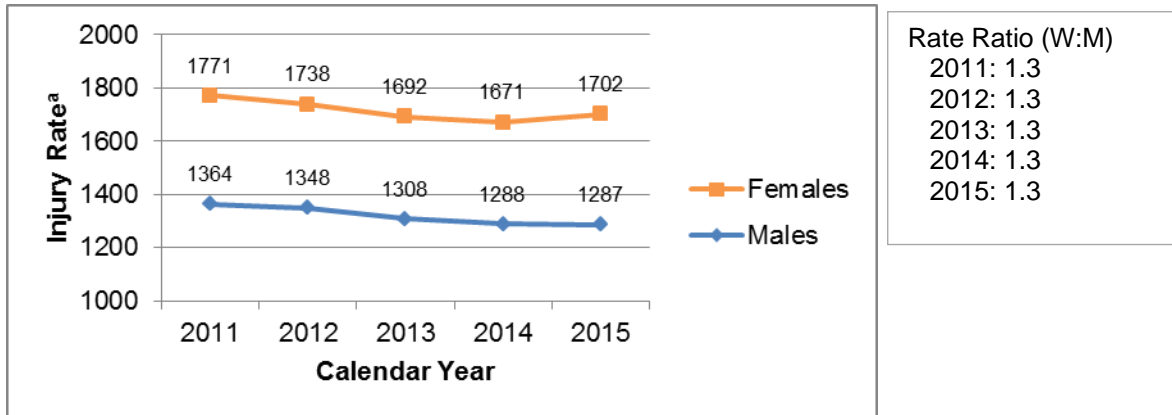
- *Overall Active Army—Injury Rates and Gender Comparisons*. MSK injuries in the operational Active Army affect nearly 275,000 Soldiers annually with many Soldiers having multiple injuries per year. The overall injury rate for the Army in Calendar Year (CY) 2015 was 1,346 injuries per 1,000 person-years (U.S. Army PASBA, 2016). Injuries are one of the greatest challenges to Soldier and unit readiness, responsible for 76 percent of all medically non-deployable Soldiers (APHC, 2015). At any given time, 15 percent of the Active Army have an activity-limiting MSK injury profile. Furthermore, at least 7 percent of Active Army Soldiers (approximately 36,000 Soldiers and equivalent to two active combat divisions or eight brigade combat teams) are non-deployable due to temporary or permanent musculoskeletal injury profiles at any one time (Army Medicine, 2015).

Figure 2 shows the annual injury rates for the Active Army, both genders combined. From CY 2011 to CY 2015, the annual injury rate decreased from 1,422 per 1,000 person-years to 1,346 per 1,000 person-years, a decrease of more than 5 percent. As shown in **Figure 3**, injury rates for both genders followed the same trend as the overall Army rates, decreasing 4 percent for women and 6 percent for men. Each year, the rate ratio (W:M) was 1.3, indicating that the injury rate for women was 1.3 times higher than the rate for men.



Note: ^a Rate: Number of injuries per 1,000 person-years
 Source: DMSS, prepared by the APHC IPD

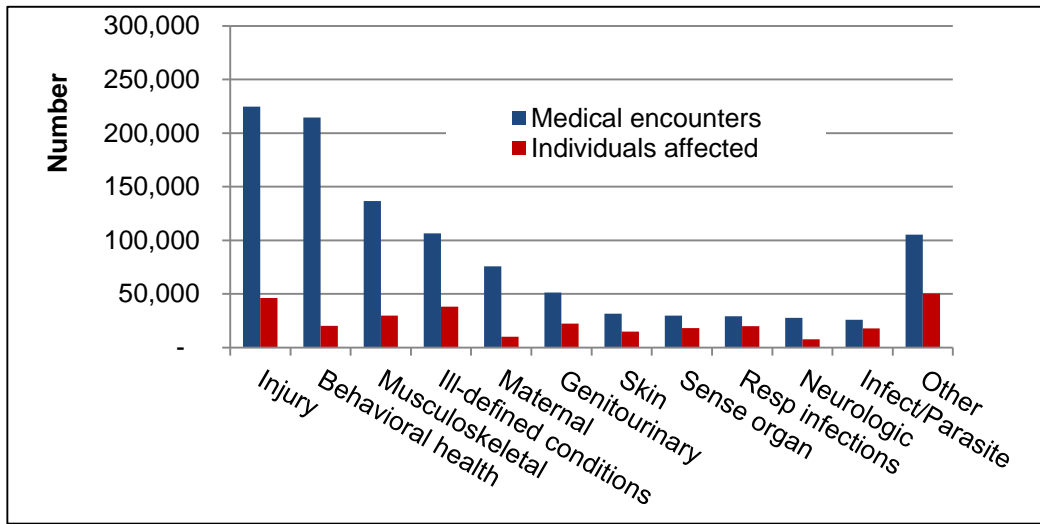
Figure 2. Annual Injury Rates^a for the Active Army, CYs 2011 to 2015



Note: ^a Rate: Number of injuries per 1,000 person-years
 Source: DMSS, prepared by APHC IPD

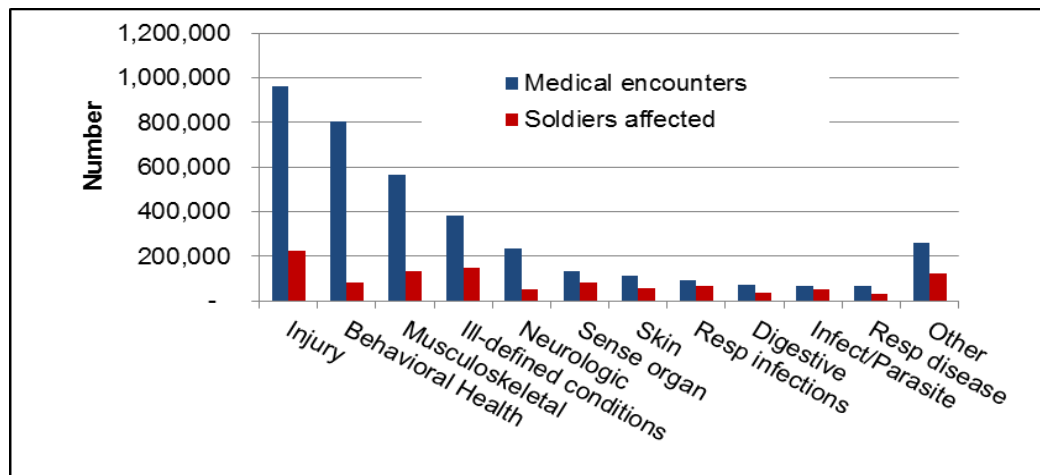
Figure 3. Annual Injury Rates^a for Women and Men in the Active Army, CYs 2011 to 2015

- Overall Active Army—Leading Diagnoses and Gender Comparisons.** In 2015, the top four diagnosis categories for all medical encounters were the same for both genders in the operational Active Army. For women (**Figure 4**) and men (**Figure 5**), injury was the leading diagnosis category, accounting for 21 percent and 26 percent of all encounters, respectively, followed by behavioral health and musculoskeletal conditions. In 2015, 68 percent and 54 percent of all women and men, respectively, had at least 1 injury.



Source: DMSS, prepared by APHC IPD

Figure 4. Medical Encounters and Soldiers Affected by Major Diagnosis Groups for Active Army Women, CY 2015



Source: DMSS, prepared by APHC IPD

Figure 5. Medical Encounters and Soldiers Affected by Major Diagnosis Groups for Active Army Men, CY 2015

5.3 Injury Rates by Functional Category and MOS/AOC, CY 2015

The U.S. Army Human Resources Command (HRC) groups the enlisted MOSs into three functional categories (i.e., Operations, Operations Support, and Force Sustainment) and the officer AOCs into five functional categories (i.e., Army Special Operations Forces, Operations, Operations Support, Force Sustainment, and Health Services) (Department of the Army, 2009; USAHRC Web sites, 2016, see Table 2).

It is useful to compare injury rates for the functional categories and by gender within each category to understand how injury risks vary for these large functional categories. However, it is also important to remember that each category includes a broad spectrum of MOSs or AOCs, and Soldiers within any single MOS or AOC can have very different types of duties, assignments, and injury risks.

- *Enlisted Functional Category Injury Rate Comparisons.* **Table 2** presents 2015 injury rates for enlisted women and men in the functional categories. The overall injury rate ratio (W:M) of 1.4 indicates that the injury rate for women was 1.4 times higher than the rate for men. Injury rates for both genders were lowest in the Operations category, but the injury rate ratio (W:M) was highest in this category.

Table 2. Injury Rates for Enlisted Soldiers by Functional Category, CY 2015

Enlisted Functional Categories ^b	Women	Men	Rate Ratio W:M
	Injury Rate ^a	Injury Rate ^a	
Operations ^c	1,797	1,216	1.5
Operations Support ^d	1,870	1,383	1.4
Force Sustainment ^e	1,860	1,494	1.2
Overall	1,859	1,357	1.4

Notes:

^a Rate: Number of injuries per 1,000 person-years

^b Functional categories defined using the USAHRC Web sites

<https://www.hrc.army.mil/content/Enlisted%20Personnel%20Management%20Directorate>

^c Operations: 11, 13, 14, 15, 18, 19, 37, and 38

^d Operations Support: 09, 12, 17, 25, 29, 31, 35, 46, and 74

^e Force Sustainment: 27, 36, 42, 51, 56, 68, 79, 88, 89, 91, 92, and 94

Source: DMSS, prepared by APHC IPD

- *Officer Functional Category Injury Rate Comparisons.* **Table 3** presents CY 2015 injury rates for the officer functional categories. Injury rates for both genders were highest in the Force Sustainment category, but officers in Health Services had a slightly higher rate ratio (W:M, 1.3).

Table 3. Injury Rates for Officers by Functional Category, CY 2015

Officer Functional Categories ^b	Women	Men	Rate Ratio W:M
	Rate ^a	Rate ^a	
Army Special Operations Forces (ARSOF) ^c	1,420	1,179	1.2
Operations ^d	1,187	965	1.2
Operations Support ^e	1,472	1,233	1.2
Force Sustainment ^f	1,517	1,320	1.2
Health Services ^g	1,172	927	1.3
Overall	1,322	1,086	1.2

Notes:

^aRate: Number of injuries per 1,000 person-years

^b Functional categories defined using the U.S. Army Human Resources Command website <https://www.hrc.army.mil/content/Officer%20Personnel%20Management%20Directorate>.

^c Army special operation forces: 18, 37, and 38

^d Operations: 02, 11, 12, 13, 14, 15, 19, 31, and 74

^e Operations Support: 17, 24, 25, 29, 30, 34, 35, 40, 46, 47, 48, 49, 50, 52, 53, 57, 59, and 94

^f Force Sustainment: 01, 27, 36, 42, 51, 56, 88, 89, 90, 91, and 92

^g Health Services: 05, 60, 61, 62, 63, 64, 65, 66, 67, 70, 71, 72, and 73

Source: DMSS prepared by APHC IPD

- *Officer vs. Enlisted Gender-based Injury Rate Comparisons.* In all functional categories, injury rates are notably lower for officers than compared with enlisted. The overall injury rate for enlisted women was 41 percent higher than the rate for officer women and the rate for enlisted men was 25 percent higher than for officer men. The overall rate ratio (women: men) for enlisted Soldiers was also higher than the rate ratio for officers.

- *Specific MOS and AOC Gender-Based Injury Rate Comparisons.* **Table 4** presents the injury rates for Active Army women and men in the enlisted MOS and officer AOC series that are included in the Army’s gender integration plan. The enlisted MOSs are in the enlisted “operations” functional category (**Table 2**); the officer AOCs are in the “operations” and “special operations” functional categories (**Table 3**). It is useful to evaluate injury rates for MOS and AOC series to understand how injury risks vary even at this level of evaluation. However, it is also important to recognize that each MOS and AOC series is comprised of many occupational specialties, each having unique injury risks.

Table 4. Injury Rates for Army Occupational Specialties Most Affected by Gender Integration, 2015

AOC/MOS	Enlisted			Officer		
	Women	Men	Rate Ratio W:M	Women	Men	Rate Ratio W:M
	Injury Rate ^a	Injury Rate ^a		Injury Rate ^a	Injury Rate ^a	
11 (Infantry)		1,165	--		865	--
12 (Engineer)	2,048	1,399	1.5	1,121	973	1.2
13 (Field Artillery)	2,001	1,281	1.6	1,057	955	1.1
18 (Special Forces)		1,160	--		1,236	--
19 (Armor)		1,258	--		840	--

Note: ^aRate: Number of injuries per 1,000 person-years

Source: DMSS, prepared by APHC IPD

5.4 Injury Rates and Causes for Two Army Brigades

As discussed previously, causes of injury cannot be determined from coded data in the current electronic health record. To identify causes of injury in operational units, the APHC IPD has conducted injury evaluations and surveys of selected operational units.

- *Gender-based Injury Rates Comparison.* **Table 5** presents the injury rates for women and men from evaluations of two operational brigades (i.e., a light infantry brigade and a chemical brigade). Because the source data for these evaluations is based on Soldiers' responses to survey (as opposed to medical records), injury rates in Table 5 are expressed as the number of Soldiers with one or more injuries per 1,000 person-years. Key findings from these evaluations include:
 - The overall injury rate for both genders was higher in the chemical brigade than in the light infantry brigade.
 - The overall injury rate ratios (W:M) were 1.3 and 1.2 for the light infantry and chemical brigades, respectively, and are similar to the rate ratios (W:M) presented above for the operational Active Army and the functional categories.
 - In the chemical brigade, overuse injury rates were higher than traumatic injury rates for both genders. This is a common finding in operational units. The overuse injury rate for women was 1.2 times higher than the rate for men.

Table 5. Injury Rates^a for Women and Men in Two Operational Units

Brigade	Injury Type	Women	Men	Rate Ratio	
		Injury Rate ^a	Injury Rate ^a	W:M	p-value
Light Infantry Brigade (2011) (survey, self-response) ^b W: n=176; M: n=1,806	Any injury	569	446	1.3	.04
Chemical Brigade (2015) (medical records) ^c W: n=391; M: n=1,099	Any injury	767	662	1.2	.03
	Overuse injury	642	536	1.2	.02
	Traumatic injury	386	354	1.1	.36

Notes:

^a Rate: Number of injured Soldiers per 1,000 person-years

^b Anderson, 2016

^c Anderson, 2015

- *Gender-based Comparison of Injury Causes.* Surveys of the operational brigades included questions regarding what activity Soldiers were doing when their injury occurred and what specifically caused the injury. These important factors associated with injuries must be understood before any intervention to mitigate injuries can be implemented. **Table 6** summarizes results from the survey administered to the light infantry brigade. For both genders, the leading injury-related activities were running, lifting/moving heavy objects, and walking/hiking/road marching. These activities have previously been identified as leading injury-related activities in surveys administered to operational Army units. In **Table 7**, causes of injury were asked in a slightly different way—but again, the responses showed similar cause trends for both genders. Overuse from repetitive activities was by far the leading cause identified by Soldiers. These causes of injury are attributed to activities such as running and distance road marches.

Table 6. Three Leading Activities Resulting in Injuries in a Light Infantry Brigade^a

Top Three Activities	Women (%) ^b	Men (%) ^c
Running	34	30
Lifting or moving heavy objects	18	12
Walking, hiking, or road marching	10	20

Notes:

^a Anderson, 2016

^b Percentage of all injuries for women

^c Percentage of all injuries for men

Table 7. Leading Causes of Injury in a Chemical Brigade^a

Leading Causes of Injury	Women (%) ^b	Men (%) ^c
Overuse/Repetitive activity	49%	42
Single twisting/over-extension	13	13
Single overexertion effort	5	12
Falling - Level surface	8	7
Contact (hit by/against)	5	7

Notes:

^a Anderson, 2015

^b Percentage of all injuries for women

^c Percentage of all injuries for men

5.5 Injury Surveillance for IET

In 2010, the APHC IPD implemented the first systematic unit-level injury surveillance of injuries during IET. Injury rates, trends, and risk factors were monitored for IET Soldiers since the beginning of FY 2010 and will continue through implementation of gender integration

Recruits who begin training during each FY are followed as a cohort through their BCT, OSUT, or AIT. Surveillance findings are reported for each FY cohort. Findings from this systematic surveillance provide a valuable historical record for injury rates prior to gender integration and a basis of comparing injury rates during and after gender integration.

Integrated BCTs and OSUTs, and to a lesser degree the AITs, are unique training environments in the Army where large numbers of female and male Soldiers do exactly the same training throughout the day and are exposed to the same hazards and injury risks throughout the course of training. For these reasons, integrated BCT and OSUT provide the best comparison of injury rates for women and men. Surveillance of the OSUTs as they begin training women and continued surveillance of newly opened AITs will provide the best early opportunity to meaningfully compare injury rates among women and men with nearly the same injury risks and exposures in the newly opened occupational fields. The IET injury surveillance summarized in this report includes the following:

- BCT at Forts Jackson, Leonard Wood, Sill, and Benning for FY 2011 through FY 2015. In FY 2015, 18,499 female recruits and 53,299 male recruits attended BCT. Fort Benning is the only BCT that was not gender integrated during the surveillance period.
- All OSUTs for FY 2011 through FY 2015 (**Table 8**). The 12B Combat Engineer OSUT opened to women in FY 2015. The 12C Bridge Crewmember and 31B Military Police OSUTs trained women during the entire surveillance period FY 2011 to FY 2015.

Table 8. OSUTs Included in APHC Injury Surveillance and Number Trained in FY 2015

MOS	Title	Gender Integrated (as of FY 2015)	Women Trained n) (FY 2015)	Men Trained (n) (FY 2015)
11B	Infantryman	No	-	15,420
11C	Indirect Fire Infantryman	No	-	1,495
12B	Combat Engineer ^a	Yes	28	3,316
12C	Bridge Crewmember	Yes	34	324
19D	Cavalry Scout	No	-	2,354
19K	M1 Armor Crewmember	No	-	1,436
31B	Military Police	Yes	1,205	3,514
	Total OSUT FY 2015		1,319	27,859

Note: ^a12B OSUT began training women for the first time in FY 2015

Source: DMSS, prepared by APHC IPD

– Six entry-level AIT courses for enlisted MOSs that began training women in FY 2013. The number of Soldiers that attended these AITs from FY 2013 through FY 2015 is shown in **Table 9**. These AITs train small numbers of Soldiers each year. Because of this, injury rates presented below for these AITs include all Soldiers that trained from FY 2013 through FY 2015.

Table 9. AITs Opened to Women in FY 2013 and Number Trained FYs 2013 to 2015

MOS	Title	Women Trained (n) FYs 2013-2015	Men Trained (n) FYs 2013-2015
13M	MLRS ^a Crewmember	167	762
13P	MLRS Operations/Fire Detection Specialist	141	542
13R	Field Artillery Firefinder Radar Operator	108	585
91A	M1 Abrams Tank System Maintainer	130	572
91M	Bradley Fighting Vehicle System Maintainer	157	754
91P	Artillery Mechanic	33	190
	Overall	736	3,405

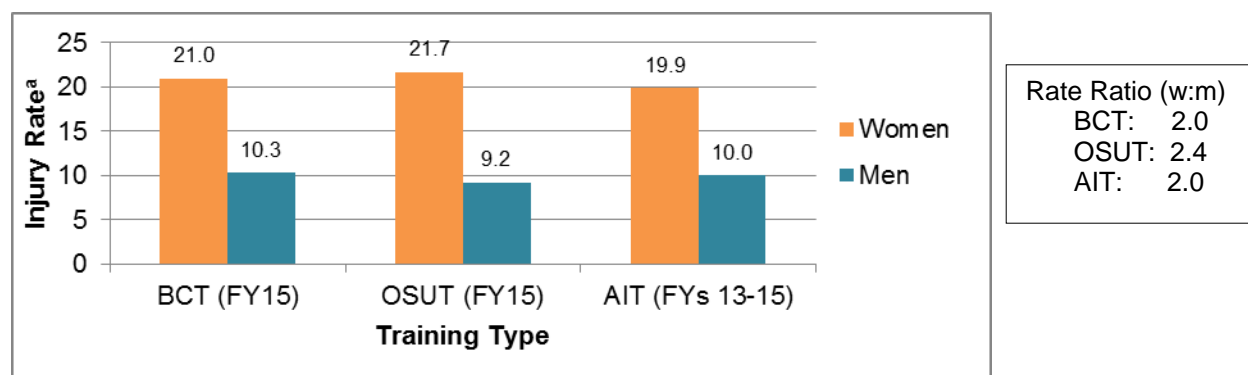
Note: ^a Multiple Launch Rocket System

Source: DMSS, prepared by APHC IPD

5.6 Injury Rates for BCT, OSUT, and Six Newly Opened AITs

- *BCT, OSUT, and AIT Injury Rates, FY 2015.* Figure 6 depicts overall injury rates (injured per 100 person-months of training) for both genders for BCT, OSUT, and the six AITs that began training women in FY 2013. BCT and OSUT rates are for the FY 2015 cohort. Rates for the AITs are for FY 2013 to FY 2015 cohorts because of the small number of Soldiers trained in these AITs each year.

Injury rates for IET women ranged from 19.9 to 21.7 per 100 person-months. Rates for men ranged from 9.2 to 10.3 per 100 person-months. The rate ratio (W:M) for BCT and AIT was 2.0; the rate ratio (W:M) for OSUT was 2.4. These IET rate ratios (W:M) are higher than the rate ratios (W:M) reported above for the operational (i.e., post IET) Army and functional categories. Women and men perform the same training and have nearly the same injury risk exposures during IET. However, in operational units, injury risks for women and men are more variable depending on MOS, assignment, rank, and type of unit. For this reason, the IET rate ratios (W:M) may be the best metric to consider when estimating the differential injury risk for women and men who perform the same duties in the same environment.



Notes:

^a Rate: Number of injured Soldiers per 100 person-months of training

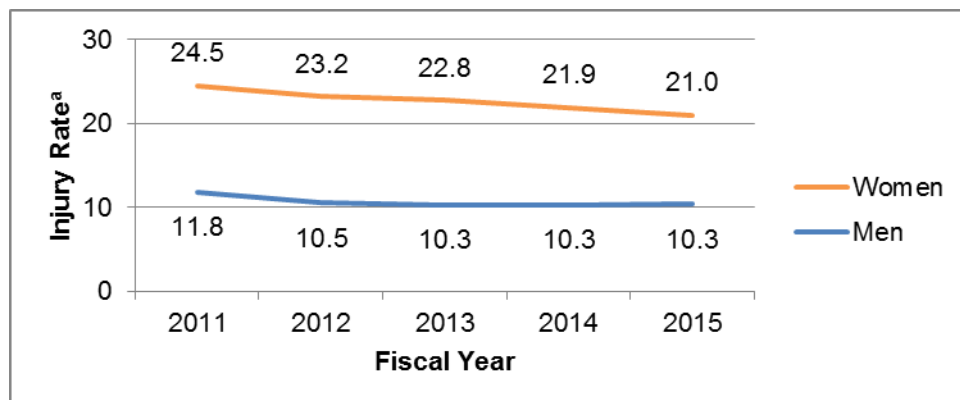
^b BCT includes Forts Jackson, Benning, Leonard Wood, and Sill (FY 2015)

^c OSUT includes 11B/C, 12B/C, 19D, 19K, and 31B (FY 2015)

^d AIT includes 13M, 13P, 13R, 91A, 91M, and 91P. Due to small numbers of women trained per year in these MOSs, injury rates encompass FYs 2013 to 2015.

Figure 6. Injury Rates^a for BCT^b, OSUT^c, and Newly Opened AITs^d

- *BCT Injury Rates by Gender, FY 2011 to FY 2015.* Annual BCT injury rates for both genders are shown in **Figure 7** for FYs 2011 to 2015. During this surveillance period, there was a 14.3 percent decrease in the annual injury rate for women and a 9.8 percent decrease in the annual rate for men.

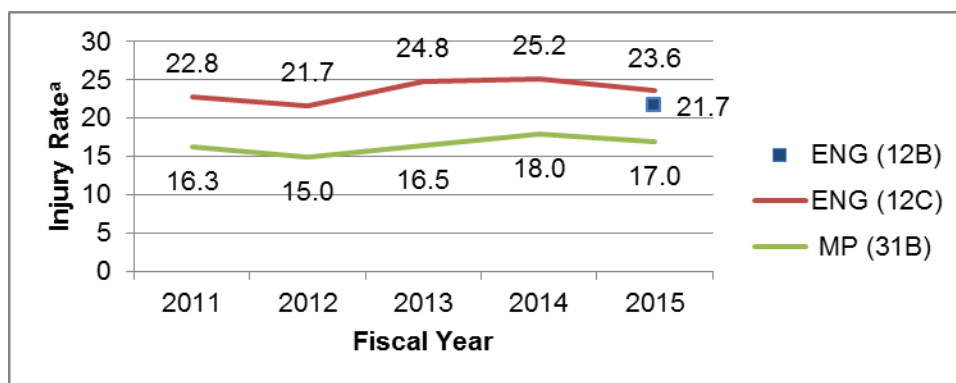


Note: ^a Rate: Number of injured Soldiers per 100 person-months of training

Figure 7. Annual Injury Rates^a for Women and Men in BCT, FYs 2011 to 2015

- OSUT Injury Rates by Gender, FY 2011 to FY 2015.

Women: Annual injury rates for OSUT women are shown in **Figure 8** for FYs 2011 to 2015. Injury rates are presented for the 12C Bridge Crewmember and 31B Military Police OSUTs for all 5 years. Since women began training in the 12B Combat Engineer OSUT during the last quarter of FY 2015, only the FY 2015 injury rate is shown. Unlike the rates for women in BCT, which decreased during the surveillance period, rates for the 12C Bridge Crewmember and 31B Military Police OSUTs did not significantly change during this timeframe.



Notes:

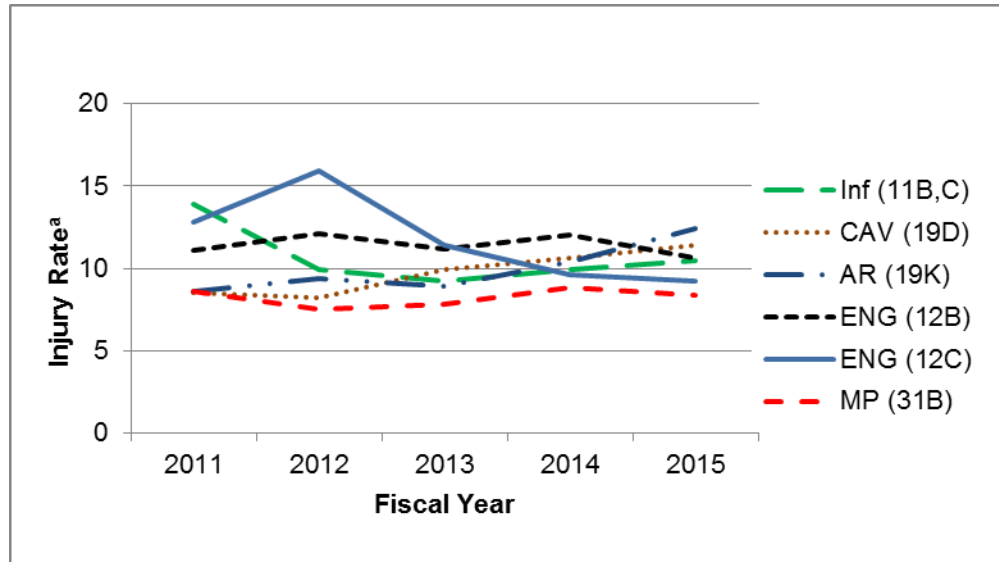
^a Rate: Number of injured Soldiers per 100 person-months of training

^b One Station Unit Training for women: 12B Combat Engineers (opened to women in 2015), 12C Bridge Crewmember, and 31B Military Police

Figure 8. Annual Injury Rates^a for Women in OSUT^b, FYs 2011 to 2015

– Men: Annual injury rates for OSUT men are shown in **Figure 9** for FY 2011 to FY 2015. During this timeframe, the annual injury rate for the 12C Bridge Crewmember OSUT decreased 28 percent and the rate for the Infantry (11B and 11C, combined) OSUT decreased

24 percent. To the contrary, the injury rate for the 19K M1 Armor Crewmember OSUT increased 44 percent.

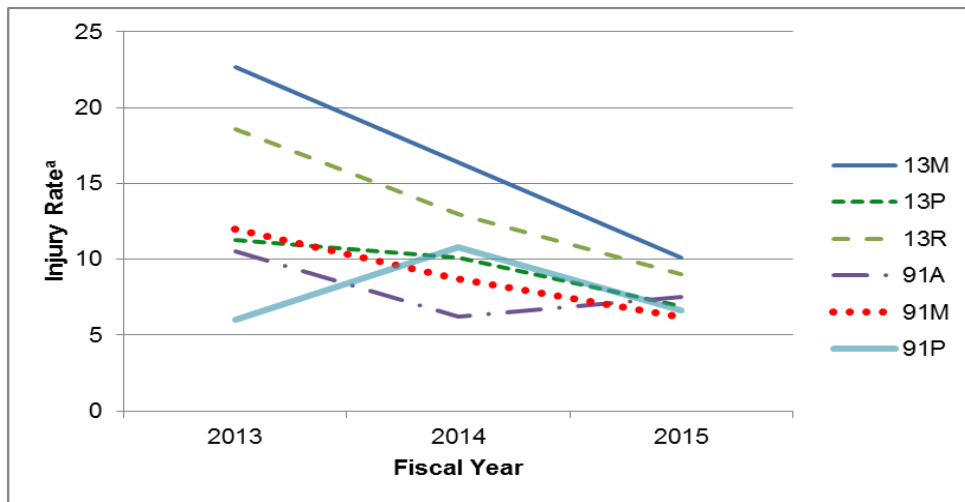


Note: ^a Rate: Number of injured Soldiers per 100 person-months of training

Figure 9. Annual Injury Rates^a for Men in OSUT, FYs 2011 to 2015

- *AIT Injury Rates, FY 2013 to FY 2015.* Injury rates for the six AITs that began training women in FY 2013 (**Table 9**) were monitored from FY 2013 to FY 2015. The annual injury rate for women in each AIT was not calculated due to the small number of women that trained each year. Instead, a combined injury rate for the six AITs was calculated for the period FY 2013 to FY 2015 (**Figure 6**; 19.9 per 100 person-months).

Annual rates for men in each of the AITs are shown in **Figure 10** for FYs 2013 to 2015. The annual injury rates for these AITs vary widely. The annual injury rates for the 13M and 13P MOSs were much higher in 2013 compared to the other MOSs. However, by FY 2015, the rates for both of these AITs decreased and were more similar to the rates for the other MOSs.



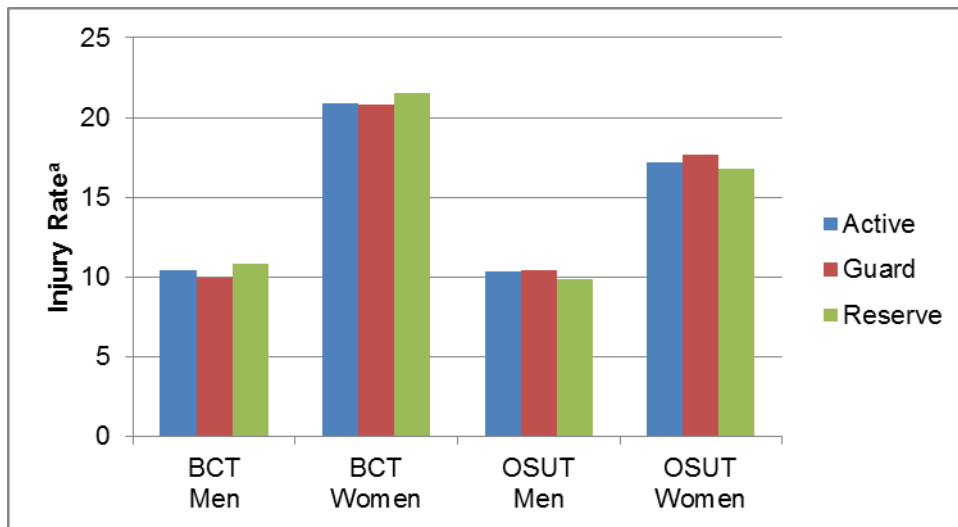
Note: ^aRate: Number of injured Soldiers per 100 person-months of training

Figure 10. Annual Injury Rates^a for Men in Newly Opened AITs, FYs 2013 to 2015

5.7 Injury Rates in IET by Army Component, FY 2015

The IET injury surveillance includes Soldiers from all three Army components (Active Army, National Guard, and Reserves). Due to the operational mission of each component and the mix of MOSs required to support that mission, the number and proportion of all Soldiers in each component vary from BCT to the individual OSUTs and AIT courses.

BCT and OSUT injury rates by component and gender are illustrated in **Figure 11**. Injury rates for the three components are similar for BCT and OSUT, and for both genders.



Notes:

^a Rate: Number of injured Soldiers per 100 person-months of training

Figure 11 Notes (Continued):

- ^b BCT Men: Forts Jackson, Leonard Wood, Sill, and Benning
- ^b BCT Women: Forts Jackson, Leonard Wood, and Sill
- ^c OSUT Men: 11B/C, 12B/C, 19D, 19K, and 31B
- ^c OSUT Women: 12B/C and 31B

Figure 11. Injury Rates^a in BCT^b and OSUT^c by Army Component, FY 2015

Table 10 shows the number of women and men from each component that trained from FY 2013 to FY 2015 in the six AITs that opened to women in FY 2013. No Reservists trained in these AITs. Injury rates for the period FY 2013 to FY 2015 are also presented. For women, there were too few National Guard to calculate injury rates, thus no comparisons are possible.

For men, comparison of Active and National Guard rates should be limited to within each MOS due to the large differences in injury rates by MOS. The column on the far right of **Table 10** shows the percent difference (i.e., increase [+] or decrease [-]) in the injury rate for National Guard men compared to Active Army men in each AIT. Additional evaluations and data will be required in order to understand why the injury rates differ for men by component and AIT.

Table 10. Number of Soldiers Trained and Injury Rates by Gender and Component for the Newly Opened AITs, FYs 2013 to 2015

AIT MOS	Component Number Trained (n)			Component Injury Rate ^a		Percent Difference
	Active	National Guard	Reserve	Active	National Guard	<u>Active-NG</u> x 100 Active
Women						
13M	126	40	0	35.9	*	
13P	104	37	0	27.0	*	
13R	92	15	0	22.8	*	
91A	123	9	0	13.2	*	
91M	131	25	0	19.6	*	
91P	28	5	0	*	*	
Men						
13M	510	269	0	14.3	16.9	+18.2%
13P	361	191	0	10.2	6.7	- 34.3%
13R	507	111	0	24.0	13.4	- 44.2%
91A	456	124	0	8.1	7.5	-13.3%
91M	557	200	0	9.2	9.8	+6.5%
91P	117	73	0	8.7	6.0	-31.0%

Notes:

* Injury rate is not calculated due to small number of Soldiers that trained and were injured

^a Rate: Number of injured Soldiers per 100 person-months of training

Source: APHC IPD

5.8 Physical Fitness in OSUT and AIT, FY 2015

APHC monitored the physical fitness of Soldiers in OSUT and AITs from FY 2010 to 2015. The source for these data was the APFTs entered by the training units in RITMS. **Table 11** shows the average performance on the final APFT for OSUT women and men in FY 2015. When comparing raw scores, women on average did 33 percent to 37 percent fewer push-ups (18 to 21 fewer repetitions), 2 percent less to 4 percent more sit-ups (3 fewer repetitions to 3 more repetitions) and ran 15 percent to 20 percent slower (2.4 to 2.8 minutes slower) compared to men. Total scaled scores (stratified by age and gender) showed differences of 1.3 percent to 6.6 percent.

Studies have consistently found that lower physical fitness is a risk factor for injuries (Jones, 1993; Knapik, 2001). For example, Knapik et al. grouped women and men separately into four equal groups (i.e., quartiles) based on their first 2-mile run time in BCT. The slowest quartile of women had a 1.9 times higher risk of injury compared to the fastest quartile of women. Similarly, the slowest quartile of men had a 1.6 times higher risk of injury compared to the fastest quartile of men. Yet studies in BCT have also found that female and male Soldiers with similar fitness levels have nearly the same injury risk (Bell, 2000).

Table 11. Final APFT Performance for Women and Men in OSUT, FY 2015

OSUT TYPE (MOS)	Event	Women		Men		Percent Difference (W:M) ^a
		N	M ± SD	N	M ± SD	
INFANTRY (11B)	Pushup-up			13,372	55.8 ± 12.6	
	Sit-up			13,372	69.0 ± 11.7	
	2-Mile Run			13,372	13.9 ± 1.2	
	Total Score ^b			13,372	246.7 ± 33.6	
INFANTRY (11C)	Pushup-up			1,281	54.4 ± 12.9	
	Sit-up			1,281	69.3 ± 12.8	
	2-Mile Run			1,281	14.0 ± 1.4	
	Total Score ^b			1,281	244.2 ± 37.6	
ENGINEERS (12B)	Push-up	18	34.3 ± 10.7	2,520	54.2 ± 11.0	-36.7%
	Sit-up	18	63.0 ± 8.0	2,520	66.2 ± 9.2	-4.8%
	2-Mile Run	18	16.5 ± 1.2	2,520	14.1 ± 1.2	-11.0%
	Total Score ^b	18	247.4 ± 28.5	2,520	241.4 ± 29.1	2.5%
ENGINEERS (12C)	Push-up	52	36.6 ± 9.0	231	54.2 ± 11.4	-32.4%
	Sit-up	52	69.8 ± 10.3	231	67.2 ± 10.1	3.9%
	2-Mile Run	52	16.5 ± 1.7	231	14.0 ± 1.3	-11.9%
	Total Score ^b	52	259.4 ± 30.2	231	243.3 ± 31.6	6.6%
CAVALRY (19D)	Push-up			1,752	57.0 ± 10.9	
	Sit-up			1,752	65.7 ± 8.8	
	2-Mile Run			1,752	14.0 ± 1.0	
	Total Score ^b			1,752	245.2 ± 26.1	
ARMOR (19K)	Push-up			1,142	56.7 ± 11.0	
	Sit-up			1,142	67.2 ± 9.4	
	2-Mile Run			1,142	14.1 ± 1.0	
	Total Score ^b			1,142	245.2 ± 27.0	
MP (31B)	Push-up	749	38.6 ± 11.6	2,615	59.7 ± 12.6	-35.3%
	Sit-up	749	72.1 ± 10.9	2,615	73.8 ± 10.4	-2.3%
	2-Mile Run	749	16.8 ± 1.5	2,615	14.0 ± 1.1	-20.0%
	Total Score ^b	749	260.3 ± 29.8	2,615	257.0 ± 28.9	1.3%

Notes:

^a Positive values (+) indicate that performance for women was higher than the performance for men (i.e., more repetitions for push-ups or sit-ups, or ran faster).^b Total scaled scores

Table 12 shows the average performance on the final APFT for women and men in the six AITs that began training women in FY 2013. Compared to men, women on average did 30 percent to 46 percent fewer push-ups (18 to 29 fewer repetitions), 1 percent to 11 percent fewer sit-ups (1 to 7 fewer repetitions), and ran 14 percent to 29 percent slower (1.9 to 3.1 minutes slower).

Table 12. Final APFT Performance in AITs Opened (FY 2013) to Women, FY 2015

AIT MOS	EVENT	WOMEN		MEN		Percent Difference (W:M) ^a
		N	M ± SD	N	M ± SD	
13M	Push-ups	40	33.4 ± 10.5	206	54.4 ± 9.8	-38.6
	Sit-ups	40	62.5 ± 9.6	206	63.4 ± 7.9	-1.4
	2-mile Run ^a	40	17.2 ± 1.5	206	14.8 ± 1.0	+16.2
	Final Score ^b	40	236.2 ± 32.7	206	229.6 ± 25.9	2.9
13P	Push-ups	50	36.1 ± 8.5	210	54.2 ± 10.7	-33.4
	Sit-ups	50	61.9 ± 5.9	210	63.0 ± 8.5	-1.7
	2-mile Run ^a	50	17.2 ± 1.2	210	14.8 ± 1.0	+16.2
	Final Score ^b	50	241.7 ± 22.7	210	228.5 ± 25.9	5.8
13R	Push-ups	40	35.1 ± 8.8	183	55.3 ± 11.3	-36.5
	Sit-ups	40	61.9 ± 8.6	183	64.7 ± 9.2	-4.3
	2-mile Run ^a	40	17.3 ± 1.2	183	14.8 ± 1.0	+16.9
	Final Score ^b	40	240.2 ± 27.4	183	232.6 ± 26.4	3.3
91A	Push-ups	40	33.7 ± 10.5	187	62.3 ± 12.6	-45.9
	Sit-ups	40	65.3 ± 10.4	187	71.0 ± 10.0	-8.0
	2-mile Run ^a	40	16.9 ± 1.2	187	14.2 ± 1.0	+19.0
	Final Score ^b	40	244.3 ± 30.9	187	255.5 ± 25.6	-4.4
91M	Push-ups	45	32.6 ± 8.6	114	57.8 ± 10.8	-43.6
	Sit-ups	45	60.1 ± 8.6	114	67.5 ± 9.1	-11.0
	2-mile Run ^a	45	17.4 ± 1.1	114	14.3 ± 1.0	+21.7
	Final Score ^b	45	239.1 ± 26.2	114	241.7 ± 27.1	-1.1
91P	Push-ups	9	40.8 ± 12.5	51	58.4 ± 11.0	-30.1
	Sit-ups	9	62.2 ± 12.5	51	65.9 ± 9.0	-5.6
	2-mile Run ^a	9	16.8 ± 1.5	51	14.7 ± 1.1	+14.3
	Final Score ^b	9	252.1 ± 28.0	51	238.3 ± 29.1	5.8

Note:

^a Positive values (+) indicate that performance for women was higher than the performance for men (i.e., more repetitions for push-ups or sit-ups, or ran faster).

^b Total scaled scores

6 PLAN FOR FUTURE STUDIES AND INJURY SURVEILLANCE

- USARIEM will complete the OPAT Longitudinal Validation Study and report findings in FY 2017. As a co-investigator on this OPAT study, the APHC IPD will evaluate the association between OPAT study scores and injury incidence and APFT performance during IET and in the first 2 years of Soldiers' enlistments.

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- The APHC IPD will evaluate the Multivitamin with Iron Program for women in Initial Entry Training during the 2nd and 3rd quarters of FY 2017 (HQDA EXORD 172-16; 13 April 2016).
- The APHC IPD will expand the current injury surveillance for IET and operational Army to monitor injury rates in—
 - Cohorts of women and men in newly opened MOSs/AOCs from IET into their first unit of assignment.
 - Infantry and Armor Basic Officer Leadership Courses.
 - Units receiving the first cohorts of combat MOS/AOC trained women.
- The IPC and MEDCOM will collaborate with ARI to conduct surveys to determine injury rates, causes, and risk factors. Surveys will be administered as “end-of-training” assessments and “unit” assessments.
- An epidemiologist from the APHC IPD and two researchers from MEDCOM will participate in the NATO Science & Technology workgroup for "Combat Integration: Implications for Physical Employment Standards." This work group provides a forum for sharing and learning from the experiences of the other NATO militaries as they integrate women into their combat occupational fields.

7 GAPS IN DATA FOR LONGITUDINAL INJURY SURVEILLANCE

Several data gaps have been identified that may negatively affect the final results of the studies and surveillance that the APHC IPD and MECOM will conduct during gender integration. These gaps are described below along with possible solutions.

7.1 Duty Status and Cause of Injury (Duty-related and MOS-related Injuries)

At present, injuries identified by the systematic injury surveillance include all injuries for which Soldiers sought medical care. We are unable to identify and report injuries that occurred on duty versus off duty, or that occurred while performing MOS-related duties versus other non-training activities. Coded data in the electronic health record are insufficient to distinguish and categorize injuries by these factors or by the cause and mechanism of injury.

Possible Solutions.

- MEDCOM will work to increase entry of the available duty status and cause of injury codes in the current electronic health record and the new electronic health record being phased in over the next 5 years.
- The revised eProfile system (updated Aug 2016) is another tool that will allow medical providers to code causes and circumstances for injuries.

- Army surveys should include questions asking Soldiers about injuries sustained during training. Questions should ask if the injury occurred while on duty or off duty, and what was the cause/mechanism of the injury. Surveys have been used successfully for brigade-sized units but required full command support in order to have large numbers of Soldiers complete the survey.

7.2 Duty Restrictions for Injuries

The number of days of limited duty and the extent of duty restrictions are important indicators of the severity and impact of injuries for longitudinal injury surveillance; however, these data are not currently accessible systematically for injury tracking and surveillance.

Possible Solutions.

- MEDCOM's eProfile is the enterprise system for entering and tracking injury-related duty restrictions. eProfile was recently upgraded in 2016 and should greatly increase access to these data for injury tracking and surveillance. However, use of eProfile in medical clinics with very high throughputs, such as BCT and OSUT, is still limited. In many cases, duty restrictions for less than 7 days are still being issued using non-electronic temporary profiles forms (DD Form 689, *Individual Sick Slip*) that cannot be tracked systematically.

- Surveys of large groups of Soldiers will be needed to get these data for the National Guard and Reserve. Surveys will also be valuable for the Active Army as a means of augmenting and validating data entered in eProfile.

7.3 Access to APFT Performance Data

The physical fitness level of individual Soldiers is an important risk factor for injury. A lower level of fitness is associated with a higher risk of injury (Jones, 1993; Knapik, 2001). APFT data are absolutely required for the Longitudinal Validation of the OPAT Study and the Multivitamin with Iron Program for IET women. These data are also essential for the longitudinal injury surveillance analyses because of the strong relationship between physical fitness and musculoskeletal injuries.

Prior to 2016, RITMS was the system of record for training data in IET, including results of APFTs. However in 2016, RITMS was taken off-line and replaced with the Digital Training Management System (DTMS). Since that transition, the quality and completeness of APFT data accessible for surveillance have greatly decreased. Because of problems with the transition to DTMS, APFT performance data are not currently available for IET Soldiers.

In the operational Army, APFT data in DTMS are incomplete. Compliance with using DTMS to enter APFT performance data varies greatly by unit and installation. These data are extremely important for longitudinal injury surveillance analyses for gender integration, but the incompleteness of the APFT data in DTMS significantly limits its utility.

This inability to track APFT performance in IET and the operational Army is a significant mission limiting factor for the longitudinal studies (e.g., Longitudinal Validation of the OPAT and

evaluation of the Multivitamin with Iron Program) and injury surveillance. This shortfall requires immediate attention.

Possible Solutions.

- Additional administrative staff in IET training units to assist with data input and additional DTMS training are needed so APFT data are entered consistently and completely in DTMS.

In the Active Army, National Guard, and Reserve, greater command emphasis, additional administrative staff to assist with data input, and additional DTMS training are needed to increase use of DTMS by all three Army components to be able to track Soldiers' physical fitness overtime.

7.4 OPAT Results for All Accessions

Access to the OPAT test results from USARC, U.S. Army Cadet Command, and the U.S. Army Military Academy is required for the Longitudinal Validation of the OPAT Study and for many aspects of the longitudinal injury surveillance and analysis being conducted during gender integration. At present, there is no enterprise system to archive OPAT test results and provide them for longitudinal studies and surveillance. Immediate resolution of this mission-limiting shortfall is required. Otherwise, it is likely these early OPAT scores will never be archived or accessible for required analyses.

Possible Solutions.

- TRADOC is currently working on this issue.

7.5 Injury Rates and Causes for the Army National Guard and Reserve

Two factors significantly compromise MEDCOM's injury surveillance for the National Guard and Reserves: (1) lack of an enterprise system to systematically access electronic health records and (2) lack of reliable and complete data on training and drill dates.

- When National Guard and Reserve Soldiers complete their IET and return to their home unit, routine systematic injury surveillance is limited or non-existent. Medical care for duty-related injuries is often provided outside of the military health system and not documented in the military health record. Due to concerns about completeness and reliability of TRICARE medical encounter data when these Soldiers are treated in the Civilian sector for training-related injuries, these data are not used in systematic surveillance. Soldiers also receive Civilian medical care for injuries that occurred during Civilian employment or leisure time activities, but these injuries can also limit their ability to train with their National Guard or Reserve units. Medical care for these injuries might not be documented in the military health record or in the TRICARE medical encounter data.

- Reliable and complete training data that include actual training and drill dates are required to calculate injury rates. These dates are used to calculate the actual person-time of

training, the denominator for calculating injury rates. At present, there is no enterprise system from which these training data can be accessed.

Possible Solutions.

- This gap is anticipated to be resolved with the 5-year systematic roll-out of the new electronic health record. In the meantime, unless other systematic sources of medical encounters and training data are identified, surveys will be the only means of obtaining injury rates, risk factors, causes of injury, and limited duty information for these components. Surveys are a valuable tool to monitor injury rates, identify duty-related causes of injury and limited duty, and evaluate potential injury risk factors. For survey data to be valid and reliable, command support is invaluable to ensure that adequate numbers of Soldiers respond to the surveys. As the Army implementation for gender integration proceeds, surveys will be the best approach to monitor injury rates, causes, duty limitations, and risk factors in the National Guard and Reserve.

8 SUMMARY

This is the APHC IPD's and MEDCOM's first annual assessment of longitudinal studies and MSK injury surveillance for the Army's implementation of gender integration (HQDA EXORD 097-16, 2016). It describes the scope of current and future research and injury surveillance for the Army's gender integration plan. The baseline injury rates for women and men in the operational Army and IET will be the basis for evaluating and comparing injury rates as gender integration proceeds. Rates and rate comparisons for the OSUTs that currently train women (i.e., military police and combat engineer) and the six AITs that recently opened to women, give an indication of possible injury rates for the OSUTs and AITs that will begin training women in FY 2017 (i.e., infantry, armor, and cavalry).

Historically, injury rates for female Soldiers have been higher than rates for male Soldiers in the operational Active Army and IET. These injury rates provide important information about the overall injury risks for Soldiers and differences in injury rates between the genders. The reported injury rate ratios (W:M) for the operational Army ranged from 1.2 to 1.5 for enlisted Soldiers (Table 2) and from 1.1 to 1.3 for officers (Table 3). These rate ratios (W:M) indicate that injury rates for women were 1.1 to 1.5 times higher than rates for men, but these Army injury rates included all women and men, not just those in the same MOS, assignment, or unit. More reliable comparisons of injury rates by gender will require large numbers of women and men in the same MOS with similar assignments. For the combat MOSs and AOCs being opened to women, it will take several years for adequate numbers of women to be assigned in combat operational units before their injury rates can be reliably compared to those of men.

BCT and OSUT, and to a lesser degree AIT, are the only controlled training environments in the Army with large numbers of women and men exposed to nearly the same injury risks and exposures. All aspects of these training courses are integrated and periods of rest and recovery are mostly controlled. In these training courses, the injury rate ratios (W:M) were significantly higher than for the operational Army. For BCT, OSUT, and the newly opened AITs, the rate ratios (W:M) were 2.0, 2.4, and 2.0, respectively (Figure 6). These 2 times higher injury rates for women have been reported consistently in studies of BCT over the past 30 years. These

higher rate ratios (W:M) may be closer to what we will see in the future when we have large numbers of women and men in the combat MOSs and AOCs.

Studies in IET and the operational Army have consistently shown that female and male Soldiers with lower levels of physical fitness have a higher injury risk compared to more physical fit Soldiers (Jones, 1993; Knapik, 2001). In 2015, OSUT women on average did 18 to 21 fewer push-ups and ran 2.4 to 2.8 minutes slower for 2 miles compared to men in the same OSUT. There were similar differences in fitness levels between women and men in the six AITs newly opened to women. The higher injury rates for women and the relationship between lower physical fitness and increased injury risk for both genders emphasize the importance of matching physical fitness levels of new accessions with the heavy physical demands required for their MOS/AOC. In the future, the OPAT will ensure that new accessions have the baseline level of fitness required for their MOS/AOC.

Surveillance of the 11B, 11C, 19D, and 19K OSUTs and the additional Field Artillery AITs as they begin training women, and continued surveillance of the 12B OSUT and newly opened AITs will provide further opportunities to evaluate the injury rates and risk factors in these physically demanding MOSs/AOCs. Surveys, improvements in the electronic health record, and eProfile will provide important information about the causes of injury, Soldiers' duty status at the time of injury and limited duty required for injuries. This will allow a much more comprehensive evaluation of injury risk factors for both genders and the impact of injuries on readiness. However, one of the most notable limitations for the longitudinal studies and injury surveillance in the next few years will be the small numbers of women in the newly opened MOSs, AOCs, and assignments.

The Army's implementation plan for gender integration (HQDA EXORD, 2016) delineates the injury-related metrics that should be assessed and monitored. This report summarized findings for the metrics for which data were available. However, additional metrics that would inform understanding the injury risks in gender integrated training and units were not presented because the required data were either not available or not complete. These unreported metrics are: (1) causes of injury in the combat MOSs and AOCs, (2) rates for duty-related injuries, and (3) injury rates and causes for the National Guard and Reserve components. The success of future longitudinal surveillance will depend on access to required medical, physical fitness, and training data.

The APHC IPD and MEDCOM will expand the longitudinal studies and injury surveillance in FY 2017 as women begin training in the still closed OSUTs and AITs and are assigned to operational combat units. The APHC IPD and MEDCOM will continue their collaborations with USARIEM, TRADOC, and ARI on these studies and surveillance. They will also continue to work through the HQDA G-1 Integrated Studies Work Group to set priorities, address identified gaps in data required for injury metrics, and coordinate future studies and surveillance efforts. Their active participation in the NATO work group for "Combat Integration: Implications for Physical Employment Standards" and the International Congress of Soldiers' Physical Performance will provide important forums for sharing and learning from the experiences of the militaries that are implementing gender integration in combat.

9 RECOMMENDATIONS

The higher injury rates for women and the relationship between low physical fitness and higher injury risk for by genders emphasize the importance of matching physical fitness of new accessions with the heavy physical demands required for their MOS/AOC. To reduce the injury risk for all Soldiers, it is imperative that they have the requisite level of physical fitness to perform the physically demanding tasks of their MOS/AOC. The OPAT will be an important tool to ensure that new accessions meet this fitness standard. Next, it is imperative that physical training programs provide the appropriate training stimulus that allows Soldiers to achieve safely the highest possible level of physical fitness. This will allow them to perform at the highest level in their MOS/AOC and will also reduce their injury risk.

The future success of the longitudinal studies and injury surveillance in monitoring the injury-related metrics described in the Army's implementation plan will partially depend on access to additional medical, physical fitness, and performance data that are not currently available. It is imperative that the APHC IPD and MEDCOM work through the HQDA G-1 Integrated Longitudinal Studies Work Group and the Soldier 2020 Injury Rates/Attrition Rates Work Group to describe these data short-falls and coordinate efforts to ensure data systems are improved or developed that can provide these data.

APPENDIX A

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Glossary

Abbreviations

AOC	area of concentration
AIT	Advanced Individual Training
APFT	Army Physical Fitness Test
APHC	Army Public Health Center
ARI	Army Research Institute for the Behavioral and Social Sciences
BCT	Basic Combat Training
CSA	Chief of Staff, Army
CY	Calendar year
DTMS	Digital Training Management System
DGCDAR	Direct Ground Combat Definition and Assignment Rule
DMSS	Defense Medical Surveillance System
EXORD	Execution Order
FORSCOM	U.S. Army Forces Command
FY	Fiscal Year
HRC	U.S. Army Human Resources Command
HQDA	Headquarters, Department of the Army
IET	Initial Entry Training
IPD	Injury Prevention Division, Army Public Health Center
IR/AR WG	Injury Rates/Attrition Rates Work Group (Soldier 2020)
MEDCOM	U.S. Army Medical Command
MLRS	Multiple Launch Rocket System

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MOS	military occupational specialty
NATO	North Atlantic Treaty Organization
NG	National Guard
OPAT	Occupation Physical Assessment Test
OSUT	One Station Unit Training
RITMS	Resident Individual Training Management System
SECDEF	Secretary of Defense
TRADOC	U.S. Army Training and Doctrine Command
USARC	U.S. Army Reserve Command
USAREC	U.S. Army Recruiting Command
USARIEM	U.S. Army Research Institute of Environmental Medicine

Definitions

Cohort: a group of people banded together or treated as a group

Injury Rate (operational Army): number of injuries per 1,000 person-years of training. For example, an injury rate of 1,500 per 1,000 person-years means there were 1,500 injuries among 1,000 Soldiers who each trained for one year.

Injury Rate (IET): Number of injured Soldiers per 100 person-months of training. For example, an injury rate of 10 per 100 person-months means that 10 Soldiers had at least one injury during 100 person-months of training. In BCT (10-weeks in duration), 100 person-months are equivalent to 40 Soldiers who each trained for 10 weeks (2.5 months).

Injury Rate Ratio (women:men): calculated by dividing the injury rate for women (w) by the injury rate for men (m). Example: a rate ratio (W:M) equal to 1.5 indicates that the injury rate for women was 1.5 times higher than the rate for men.

Overuse injuries: Musculoskeletal injury that occurs gradually over time in response to low intensity, repetitive mechanical forces (e.g., Achilles tendonitis, “runner’s knee” and stress fractures).

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Traumatic injuries: Musculoskeletal injury that occurs after a sudden application of mechanical force or energy such as occurs when falling to the ground or being struck by an object or person.

Military Occupational Specialties (MOS):

Armor (19 series)

- 19D Cavalry scout
- 19K M1 Armor crewmember

Engineer (12 series)

- 12B Combat engineer
- 12C Bridge crewmember

Field Artillery (13 series)

- 13M Multiple Launch Rocket System Crewmember
- 13P Multiple Launch Rocket System operations/fire detection specialist
- 13R Field Artillery Firefinder Radar Operator

Field Mechanical Maintenance (91 series)

- 91A M1 Abrams tank system maintainer
- 91M Bradley Fighting Vehicle System Maintainer
- 91P Artillery Mechanic

Infantry (11 series)

- 11B Infantryman
- 11C Indirect Fire Infantryman

Military Police (31 series)

Special Forces (18 series)