

PHR No. S.0087530-22
Injury Surveillance for U.S. Army Basic Combat Training
and One Station Unit Training, Fiscal Year 2019

Approved for public release; distribution unlimited

General Medical: 500A

November 2022



ACKNOWLEDGEMENTS

Contributing Authors:

Keith G. Hauret, MSPH, MPT¹

Ryan Steelman, MPH¹

Michelle Canham-Chervak, PhD, MPH¹

¹ Injury Prevention Branch, Clinical Public Health and Epidemiology Directorate, U.S. Army Public Health Center, Aberdeen Proving Ground, Maryland.

Acknowledgement and thanks to Ms. Mimi Eng for providing editing support with the preparation of this manuscript.

The mention of any non-federal entity and/or its products is not to be construed or interpreted, in any manner, as federal endorsement of that non-federal entity or its products.

REPORT DOCUMENTATION PAGE					<i>Form Approved</i> OMB No. 0704-0188	
The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.						
1. REPORT DATE (DD-MM-YYYY) 10/20/2022		2. REPORT TYPE Final - Public Health Report			3. DATES COVERED (From - To) October 2018 - September 2019	
4. TITLE AND SUBTITLE Injury Surveillance for U.S. Army Basic Combat Training and One Station Unit Training, Fiscal Year 2019 (PHR No. S.0087530-22)				5a. CONTRACT NUMBER N/A		
				5b. GRANT NUMBER N/A		
				5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) Keith Hauret, Ryan Steelman, Michelle Canham-Chervak				5d. PROJECT NUMBER S.0087530		
				5e. TASK NUMBER N/A		
				5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Public Health Center, Aberdeen Proving Ground, MD 21010-5403					8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Public Health Center, Aberdeen Proving Ground, MD 21010-5403					10. SPONSOR/MONITOR'S ACRONYM(S)	
					11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for Public Release/Distribution Unlimited						
13. SUPPLEMENTARY NOTES						
14. ABSTRACT This report summarizes findings from systematic injury surveillance by the Army Public Health Center Injury Prevention Branch for the cohort of Army trainees who began Basic Combat Training (BCT) or One Station Unit Training (OSUT) in Fiscal Year (FY) 2019. BCT injury rates for women and men in FY 2019 were not statistically different compared to their rates in FYs 2017 and 2018. OSUT injury rates in FY 2019 were significantly lower than rates in FYs 2017 and 2018 for men in three of the OSUTs (11B/C IN, 19K AR, and 31B MP) and women in the 31B MP OSUT. Injured trainees were five times more likely to attrit from BCT and four times more likely to attrit from OSUT compared to non-injured trainees.						
15. SUBJECT TERMS Army, injury, basic combat training (BCT), one station unit training (OSUT), attrition						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON	
a. REPORT	b. ABSTRACT	c. THIS PAGE			Keith Hauret	
Unclassified	Unclassified	Unclassified			19b. TELEPHONE NUMBER (Include area code) (410) 436-4312	

EXECUTIVE SUMMARY
PUBLIC HEALTH REPORT NO. S. 0087530-22
INJURY SURVEILLANCE FOR U.S. Army BASIC COMBAT TRAINING AND
ONE STATION UNIT TRAINING, FISCAL YEAR 2019

1 PURPOSE

The U.S. Army Public Health Center (APHC) provides technical and support capabilities to enhance Army readiness by identifying, assessing, and providing recommended solutions for current and emerging public health issues (Department of the Army (DA) 2020). The APHC Injury Prevention Branch (IPB) conducts systematic surveillance of musculoskeletal (MSK) injuries to support the U.S. Army Medical Command (MEDCOM) and the U.S. Army. Findings from this surveillance and subsequent epidemiologic analyses are the foundation for developing, implementing, evaluating, and re-evaluating interventions to reduce MSK injuries.

The primary purpose of this report is to summarize MSK injury surveillance findings for the cohort of enlisted Army trainees that began Basic Combat Training (BCT) and One Station Unit Training (OSUT) during fiscal year (FY) 2019 (i.e., 1 October 2018 through 30 September 2019). Secondarily, this report summarizes the association of graduation status and MSK injuries for BCT and OSUT for this cohort.

2 FINDINGS

2.1 BCT Injury Surveillance Summary

The FY 2019 BCT cohort included 20,397 female trainees and 53,959 male trainees. Among these trainees, 53% of women and 28% of men had at least one MSK injury during BCT. By training center, the injury incidence ranged from 45% to 56% among women and from 20% to 34% among men.

The overall MSK injury rates for BCT (training centers, combined) were 23.1 per 100 person-months among women and 12.5 per 100 person-months among men. Injury rates for women and men in 2019 were not statistically different ($p>0.05$) compared to their respective rates in FYs 2017 and 2018.

The injury rate for women in FY 2019 was 1.9 times higher than the rate for men (FY 2019 rate ratio (RR) (W/M): 1.85 (1.81–1.90)). This higher injury risk for BCT women compared to men was previously reported by APHC IPB in the annual injury surveillance reports for Army gender integration (APHC 2017b, 2019, 2020b, 2020c).

For women and men in BCT, 92% of MSK injuries were overuse injuries. Overall, the lower extremity accounted for 82% of MSK injuries among women and 76% of injuries among men. These findings are consistent with previous reports (APHC 2018a, Barbeau 2021, Molloy 2012, Springer 2011).

Overall, a statistically significantly larger proportion of men graduated BCT (93%) compared to women (86%; $p<0.001$). For both sexes, there was a statistically significant association of

graduation status (i.e., attrition) with injury status. After controlling for age, component, and education, women with a MSK injury were 4.6 times more likely to attrit (i.e., not graduate) compared to non-injured women (OR: 4.55 (4.10–5.04)); men with a MSK injury were 5.0 times more likely to attrit compared to non-injured men (OR: 5.02 (4.67–5.40)). These findings are consistent with previous reports (Hauret 2004, Knapik 2001, Niebuhr 2008, Swedler 2011).

2.2 OSUT Injury Surveillance Summary

OSUT surveillance included the four OSUTs at Fort Benning (11B Infantry (IN), 11C IN, 19D Cavalry (CAV), and 19K Armor (AR)) and three OSUTs at Fort Leonard (L.) Wood (12B Engineers (EN), 12C EN, and 31B Military Police (MP)). Considering the similarities in training between the 11B and 11C IN OSUTs, surveillance findings were reported for the combined 11B/C IN OSUTs.

The FY 2019 OSUT cohort included 2,459 women and 27,658 men. Overall (OSUTs combined), 68% of women and 34% of men had at least one MSK injury during OSUT. Considering OSUTs separately, injury incidence ranged from 61% to 75% among women and from 30% to 38% among men.

With the variable length of training for the OSUTs, the preferred injury metric for comparing among the individual OSUTs is the injury rate. In FY 2019, injury rates for the individual OSUTs ranged from 14.7 to 23.9 per 100 person-months among women and from 7.6 to 11.7 per 100 person-months among men. The 31B OSUT had the lowest injury rates for both sexes. These OSUT injury rates are consistent with rates that were previously reported (APHC 2012, 2017b, 2019).

In each of the individual OSUTs, injury rates for women tended to decrease across FYs 2017 to 2019. But only in the 19D CAV and 31B MP OSUTs were their FY 2019 injury rates statistically significantly lower compared to FY 2017 (RR (2019/2017) <1.0; $p < 0.05$).

Injury rates for men in the individual OSUTs did not follow a consistent tendency across the three FYs. FY 2019 rates for the 11B/C IN, 19K AR, and 31B MP OSUTs were statistically significantly lower compared to rates in FYs 2017 (RR (2019/2017) <1.0; $p < 0.05$) and 2018 (RR (2017/2019) <1.0; $p < 0.05$). Alternatively, FY 2019 injury rates in the 12C EN and 19D OSUTs were statistically significantly higher in FY 2019 compared to FY 2018 (RR (2019/2018) >1.0; $p < 0.05$).

In FY 2019, eight 11B/C IN OSUT classes followed the extended 22-week program of instruction (POI), while the remainder of their classes followed the legacy 14-week POI (only men trained in the 22-week classes). A statistically significantly larger proportion of men in 22-week classes was injured by the end of training (45% vs. 33%; $p < 0.01$). But, with the longer class duration, the overall injury rate for 22-week classes was statistically significantly lower than the rate for 14-week classes (9.1 vs. 10.3 per 100 person-months; $p < 0.01$). These findings are similar to those previously reported comparing injury metrics between the 14-week and 22-week classes of 11B/C IN OSUT (APHC 2018c, 2020a).

For the OSUTs combined, the injury rate for women in FY 2019 was 1.8 times higher than the rate for men (RR (W/M): 1.81 (1.71–1.90)). This difference in rates is similar to the finding for BCT (BCT: RR (W/M): 1.85 (1.81–1.90)), and is consistent with previously reported findings for OSUT (APHC 2017b, 2019, 2020b).

Nearly 95% of MSK injuries among OSUT trainees (both sexes) were overuse injuries. The lower extremity accounted for 82% of MSK injuries among women and 76% of injuries among men. The second leading anatomic region of injury was the spine & back (7%) among women and the upper extremity among men (11%).

Overall, 69% of women (n=1,694) and 85% of men (23,466) graduated from their OSUT course. There was a statistically significant association for graduation status and injury status among both sexes. Compared to non-injured trainees, the odds of not graduating (i.e., attriting) from OSUT were 3.8 times higher for injured women (OR: 3.81 (2.98–4.87)) and 3.6 times higher for injured men (OR: 3.61 (3.36–3.88)). This association of OSUT graduation and injury has not been reported previously, but has been reported for BCT. Given the similarities in training and characteristics of the trainee cohorts (i.e., BCT and OSUT), this finding for OSUT is not unexpected.

3 CONCLUSIONS

This report summarized findings from the APHC IPB's systematic injury surveillance for the cohort of Army trainees who began BCT or OSUT in FY 2019. Injury rates for BCT and OSUT in FY 2019 were compared to their respective rates in FYs 2017 and 2018. This report also summarized findings for the association of graduation status and MSK injury status.

BCT injury rates for women and men in FY 2019 were not statistically different ($p>0.05$) compared to their respective rates in FYs 2017 and 2018. OSUT injury rates in FY 2019 were statistically significantly lower than rates in FYs 2017 and 2018 for men in three of the OSUTs (11B/C IN, 19K AR, and 31B MP) and women in the 31B MP OSUT. Alternatively, FY 2019 injury rates for men in the 12C EN and 19D CAV OSUTs were statistically significantly higher compared to FY 2018.

Injury rates for women in BCT and OSUT were 1.9 and 1.8 times higher, respectively, compared to rates for men in BCT and OSUT. During BCT and OSUT, men and women train together and experience similar injury hazards. Because extrinsic factors that affect injury risk are controlled during these courses, the nearly two times higher rates for women in BCT and OSUT are thought to reflect the intrinsic risks (i.e., physiologic and anatomic) associated with female gender.

Overall, overuse injuries accounted for the largest proportion of MSK injuries in BCT (91%) and OSUT (94%), and primarily involved the lower extremity (BCT: 79%; OSUT: 77%). Mitigating risks for these injuries should be the focus for injury prevention efforts in IET.

Injuries have a significant impact on graduation outcomes in BCT and OSUT. Injured trainees were five times more likely to attrit from BCT and four times more likely to attrit from OSUT compared to non-injured trainees. These findings demonstrate the need for continued focus on injury prevention and monitoring during IET.

TABLE OF CONTENTS

	Page
1 REFERENCES.....	1
2 AUTHORITY	1
3 GENERAL.....	1
3.1 Purpose.....	1
3.2 Scope.....	1
3.3 Background – MSK Injury Surveillance in BCT and OSUT	2
4 METHODS FOR INJURY SURVEILLANCE	5
4.1 Approved Project Plan.....	5
4.2 Population and Follow-up.....	5
4.3 Current Data Sources.....	6
4.4 Injury Surveillance Using Medical Encounter Data	6
4.5 Metrics for Injury Surveillance	7
4.6 Statistical Analyses	7
5 RESULTS FOR BCT INJURY SURVEILLANCE, FY 2019	8
5.1 Physical Characteristics and Demographics.....	8
5.2 BCT MSK Injury Incidence and Rate	9
5.3 Association of BCT Graduation Status and MSK Injuries	14
6 RESULTS FOR OSUT INJURY SURVEILLANCE, FY 2019	15
6.1 Physical Characteristics and Demographics of OSUT Trainees	15
6.2 OSUT MSK Injury Incidence and Rate	16
6.3 Association of Graduation Status and MSK Injuries, OSUT	22
7 SUMMARY.....	25
7.1 BCT Injury Surveillance Summary.....	25
7.2 OSUT Injury Surveillance Summary	26
8 CONCLUSIONS.....	27
9 POINT OF CONTACT	28

APPENDICES

A	REFERENCES.....	A-1
	GLOSSARY	Glossary-1

FIGURES

1.	Diagram of Army Initial Entry Training	2
2.	BCT Injury Rates by Sex, FYs 2017 to 2019	11
3.	Proportion of BCT MSK Injuries by Week of Training, FY 2019.....	13
4.	Injury Rates for Men in 14-Week Classes vs. 22-Week Classes of 11B/C IN OSUT.....	19
5.	OSUT Injury Rates, FYs 2017 to 2019	20
6.	Proportion of MSK Injuries by Week of OSUT Training, FY 2019	22

TABLES

1.	BCT and OSUT Training Centers and Course Duration, FY 2019	3
2.	Physical Characteristics of BCT Trainees, FY 2019	8
3.	Demographics of BCT Trainees, FY 2019	9
4.	BCT MSK Injury Incidence and Rate by Training Center and Sex, FY 2019.....	10
5.	BCT Injury Rate Comparisons by FY, FYs 2017 to 2019	11
6.	BCT Injury Incidence by Army Component and Sex, FY 2019.....	12
7.	BCT MSK Injury Types, FY 2019.....	12
8.	BCT MSK Injuries by Body Region, FY 2019.....	13
9.	BCT Graduation Status by Sex and Injury Status, FY 2019.....	14
10.	Association of BCT Graduation Status (Attriting) and MSK Injury, FY 2019.....	15
11.	Physical Characteristics of OSUT Trainees, FY 2019.....	15
12.	Demographics of OSUT Trainees, FY 2019	16
13.	OSUT MSK Injury Incidence and Rates by Sex and Course, FY 2019	17
14.	OSUT Injury Rate Comparisons by FY, FYs 2017 to 2019	20
15.	OSUT MSK Injury Types, FY 2019.....	21
16.	OSUT MSK Injuries by Body Region, FY 2019.....	21
17.	Graduation Status by OSUT, Injury Status, and Sex, FY 2019	24
18.	Association of Graduation Status (Attriting) from OSUT and MSK Injury, FY 2019.....	25

PUBLIC HEALTH REPORT NO. S.0078580-22
INJURY SURVEILLANCE FOR BASIC COMBAT TRAINING AND
ONE STATION UNIT TRAINING, FISCAL YEAR 2019

1. REFERENCES AND GLOSSARY

Appendix A provides the references cited in this report. The Glossary contains the acronyms and terms used in this report.

2. AUTHORITY

The U.S. Army Public Health Center (APHC) provides technical and support capabilities to enhance Army readiness by identifying, assessing, and providing recommended solutions for current and emerging public health issues. These activities include monitoring health outcomes and health hazards at the population level (Department of the Army (DA) 2020). The APHC Injury Prevention Branch (IPB) conducts these activities with a focus on potentially preventable injuries that negatively affect Army readiness.

3. GENERAL

3.1 Purpose

The primary purpose of this report is to summarize surveillance findings for musculoskeletal (MSK) injuries in the cohort of enlisted Army trainees that began Basic Combat Training (BCT) and One Station Unit Training (OSUT) during fiscal year (FY) 2019 (i.e., 1 October 2018 through 30 September 2019). Secondarily, this report summarizes the association of graduation status and MSK injuries for BCT and OSUT for this cohort.

3.2 Scope

This report provides detailed findings from the APHC IPB's systematic MSK injury surveillance of enlisted trainees that started Army BCT or OSUT during FY 2019. All enlisted recruits (i.e., Active, Reserve, and National Guard) attend either the 10-week BCT course or one of the OSUT courses (14–19 weeks) for their initial entry level training (IET) (Figure 1). BCT and OSUT trainees who started training in FY 2019 were followed until they either graduated or were discharged from training. A variety of Army enterprise data sources were used for this surveillance.

For this surveillance, the APHC IPB defined "MSK injury" as damage or interruption of body tissue function involving the musculoskeletal system (e.g., muscles, tendons, bones, joints) (APHC 2017a). MSK injury can occur suddenly (i.e., traumatic injury, such as fracture, joint dislocation, and tendon ruptures) or gradually (i.e., overuse injury, such as tendonitis, overuse muscle strain, and bone stress fracture) (Hauschild 2019).

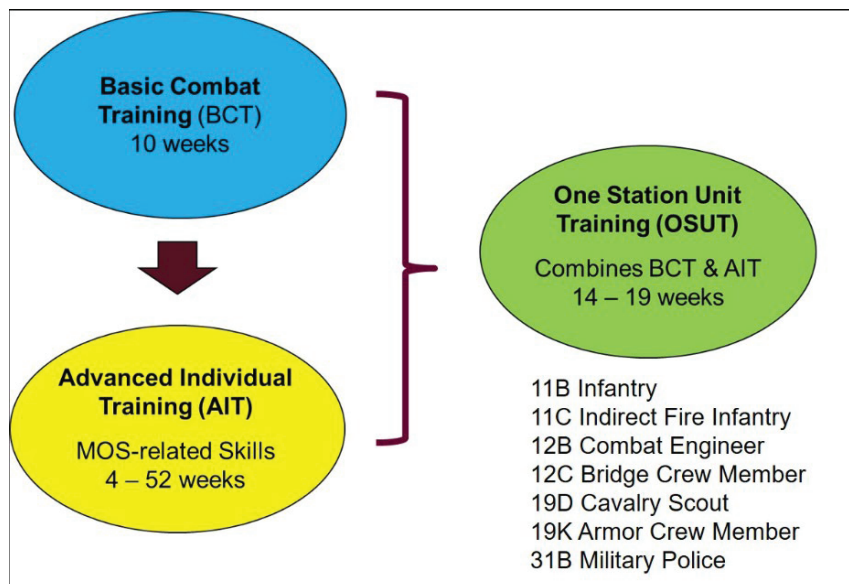


Figure 1. Diagram of Army Initial Entry Training
Legend: MOS = military occupational specialty

3.3 Background – MSK Injury Surveillance in BCT and OSUT

3.3.1 Overview of IET (BCT and OSUT)

Enlisted Soldiers begin their IET by attending the 10-week BCT course, followed by an advanced individual training (AIT) course specific to their military occupational specialty (MOS). For the seven MOSs shown in Figure 1 and Table 1, the BCT and AIT courses are consolidated into one continuous training course conducted by a single training unit (i.e., OSUT courses). In FY 2019, the duration of these OSUT courses ranged from 14 weeks to 19 weeks. Table 1 provides the training center and course duration for the BCT and OSUT courses in FY 2019.

Table 1. BCT and OSUT Training Centers and Course Duration, FY 2019

Course	Training Center	Course Duration (FY 2019)
BCT	Fort Benning, GA ^a Fort Jackson, SC Fort L. Wood, MO Fort Sill, OK	10 weeks
OSUTs		
11B Infantry (IN)	Fort Benning, GA	14 weeks ^b
11C Indirect Fire Infantry (IN)	Fort Benning, GA	14 weeks ^b
12B Combat Engineer (EN)	Fort L. Wood, MO	14 weeks
12C Bridge Crewmember (EN)	Fort L. Wood, MO	14 weeks
19D Cavalry Scout (CAV)	Fort Benning, GA	16 weeks, 5 days
19K M1 Armor Crewmember (AR)	Fort Benning, GA	15 weeks
31B Military Police (MP)	Fort L. Wood, MO	19 weeks

Source: ATRRS, August 2020; prepared by APHC IPB

Legend: GA = Georgia; SC = South Carolina; Fort L. Wood = Fort Leonard Wood; MO = Missouri; OK = Oklahoma

Notes:

^aLast BCT class conducted at Fort Benning graduated in February 2020.

^bIn FY 2019, the 11B and 11C IN OSUTs conducted some classes with an extended 22-week program of instruction (POI). Beginning in FY 2020, all 11B and 11C IN OSUT classes followed the 22-week POI.

Training in BCT, and within each OSUT course, is standardized and adheres to prescribed programs of instruction (POI) from the U.S. Army Training and Doctrine Command (TRADOC) (TRADOC 2019). During BCT and the BCT-phase of the OSUT courses, trainees learn military customs and courtesies, develop baseline physical fitness, and develop proficiency on basic warrior tasks and battle drills. Considering these highly structured and standardized training courses, all trainees in BCT classes, or classes within individual OSUTs, are exposed to similar types and amounts of training. As a result, these courses provide an ideal environment in which to conduct injury surveillance, epidemiologic analyses, and research to evaluate injury risk factors.

During BCT and OSUT, trainees have the highest MSK injury rate of any subgroup in the Army (APHC 2012, Barbeau 2021, Molloy 2012, Springer 2011). In historical reports of injury rates during U.S. Army BCT, rates for female trainees ranged from 16.0 to 33.3 per 100 person-months of training; rates for male trainees ranged from 6.1 to 20.8 per 100 person-months (APHC 2012). Most recently (FY 2018), BCT injury rates were 23.3 per 100 person-months for female trainees and 12.4 per 100 person-months for male trainees (APHC 2020b). Overall, for the OSUT courses combined, FY 2018 injury rates were 19.2 and 10.3 per 100 person-months, respectively, for female and male trainees. Considering the OSUT courses individually, injury rates ranged from 17.4 to 23.4 per 100 person-months for female trainees and from 7.9 to 13.8 per 100 person-months for male trainees (APHC 2020b).

Injuries sustained during BCT and OSUT can significantly impact training outcomes. If unable to train or perform required training events, trainees may need to repeat portions of their training,

or may even need to restart their training (Hauret 2004, TRADOC 2019). Injuries can also negatively impact trainees' motivation and desire to continue training, resulting in a higher risk for discharge and medical attrition (Knapik 2001, Niebuhr 2008, Swedler 2011). The medical cost for injuries during BCT, not including the training costs, was estimated to be \$21.9 million per year (Bulzacchelli 2017).

3.3.2 Historical Overview of Injury Surveillance Conducted by APHC IPB

In 2010, the APHC IPB began conducting injury surveillance of the BCT and OSUTs to support the IET Soldier-Athlete Initiative (IET SAI), a joint initiative between the U.S. Army Medical Command (MEDCOM) and TRADOC (MEDCOM 2010). At its core, the IET SAI was a programmatic evaluation of two courses of action (COA) for providing forward-based medical providers (Musculoskeletal Action Teams vs. only athletic trainers) to the trainee population at Fort L. Wood. To determine which COA resulted in the greatest reduction in injury rates, the APHC IPB conducted local surveillance by assigning two full-time research assistants at Fort L. Wood for the duration of the evaluation (18 months). These individuals gathered class rosters, trainee demographics, and graduation-discharge status from the training units. These data were entered into a digital database by hand, then digitally linked with medical encounter data from the Defense Medical Surveillance System (DMSS) to compile the final data set for analysis (APHC 2012).

During the same timeframe (2010–2013), though not specifically part of the formal IET SAI evaluation, MEDCOM and TRADOC assigned similar forward medical providers to BCT and OSUT units at Forts Benning, Jackson, and Sill, and to AIT units at Fort Lee. The APHC IPB developed a centralized, systematic injury surveillance for all IET classes at these locations. Rather than using locally-obtained unit-level class rosters and graduation status reports (as was done at Fort L. Wood), the IPB relied on Army enterprise data systems with digital class rosters and graduation status for this surveillance (Sources: Army Training Information System, Office of TRADOC Capability Manager; and Army Training Requirements and Resources System (ATRRS), Headquarters, DA, Office of the Deputy Chief of Staff, G-1 (Personnel)). These digital trainee population data were then linked with medical encounter data from the DMSS to report sex-specific injury rates by class, training unit, training type, and installation.

With lessons learned from the IET SAI and the centralized, systematic surveillance, the IPB continued to conduct the same level of injury surveillance for the BCT and OSUT courses from 2013 to present. This ongoing injury surveillance includes all of the BCTs and OSUTs (Table 1). The IPB has worked closely with TRADOC's Center for Initial Military Training (CIMT) to provide timely and actionable findings from this injury surveillance for TRADOC leaders. These data have also supported program evaluations and research that included these IET populations (APHC 2018b, 2018c, 2020a).

In March 2016, the Army published its plan for gender integration of the combat occupational specialties (HQDA 2016). This plan assigned responsibility to MEDCOM and APHC to conduct longitudinal surveillance to monitor injury rates, trends, and causes among men and women during IET and in the Army Active component. For the IET portion of this surveillance, the IPB was able to leverage its ongoing IET surveillance to report injury rates and trends for women and men in OSUTs that were opened to women (gender integrated) in 2015 (12B EN OSUT)

and 2017 (11B IN, 11C IN, 19D CAV, and 19K AR OSUTs). Because BCT and OSUT are fully integrated (i.e., women and men train together in the same unit), findings from this IET surveillance provide important insights about how injury rates differ by sex when injury risks are the same for both sexes. Since 2016, IPB has prepared annual reports describing baseline and follow-on injury rates and trends for women and men in gender-integrated BCT and OSUT, with a focus on the newly opened OSUTs (APHC 2017b, 2019, 2020b, 2020c). This report for gender integration is currently an annual requirement without expiration (HQDA 2016).

4. METHODS FOR INJURY SURVEILLANCE

4.1 Approved Project Plan

The APHC's Public Health Review Board approved the IPB's umbrella project plan for injury surveillance (Project #15-427, Routine Function II). This project plan includes this ongoing, systematic IET injury surveillance for FY 2019.

4.2 Population and Follow-up

This report includes all Army BCT and OSUT trainees (Active, National Guard, and Reserve) who began training during FY 2019 (class start dates: 1 October 2018 to 30 September 2019) (Table 2). It does not include the follow-on AIT courses for trainees graduated from BCT.

In FY 2019, four training centers conducted the 10-week BCT course (Forts Benning, Jackson, L. Wood, and Sill). Unlike the other training centers that trained women and men in gender-integrated classes, BCT classes at Fort Benning only trained men. In FY 2019, Fort Benning's mission to conduct BCT was discontinued; the last BCT class graduated 21 February 2020.

All of the OSUT courses at Forts Benning and L. Wood (Table 1) were gender integrated in FY 2019. The OSUT courses varied in duration from 14 weeks to 19 weeks. Due to the small number of women who enlisted for the IN, CAV, and AR MOSs, some of these FY 2019 OSUT classes did not have any women.

As noted in Table 1, the duration of IN OSUTs (11B and 11C) in FY 2019 was 14 weeks (since 1978). In FYs 2018 and 2019, the Maneuver Center of Excellence at Fort Benning began transitioning to an extended 22-week POI for 11B and 11C IN OSUTs. In FY 2019, seven 11B IN OSUT classes (total 11B IN classes in FY 2019: 83) and one 11C IN OSUT class (total 11C IN classes in FY 2019: 11) followed the 22-week POI. Two previous public health reports compared injury rates, types, and causes between 14-week and 22-week classes (APHC 2018c, 2020a).

The IPB's injury surveillance followed trainees from the start date of their first BCT or OSUT class until they eventually graduated or attrited from the course. Attrition included (a) being discharged from the Army or (b) for trainees in the National Guard or Reserve, being sent back to their home unit for processing or additional training (i.e., REFRAD: return from active duty). Data collection for the surveillance was extended through 31 May 2020 to follow FY 2019 trainees who were recycled into FY 2020 classes for additional training or recovery from serious

illness or injury. The final disposition for trainees still assigned to training units after 31 May 2021 was “attrited,” since they had already been recycled several times.

4.3 Current Data Sources

4.3.1 Defense Medical Surveillance System (DMSS)

The Armed Forces Health Surveillance Division (AFHSD) of the Defense Health Agency (DHA) maintains the DMSS. AFHSD provided demographic data (e.g., sex, date of birth, component) and medical encounter data from the electronic health record for the cohort of trainees that started training in FY 2019. These medical encounters included all medical care provided at installation medical treatment facilities and “purchased” medical care from civilian medical facilities near the training centers.

4.3.2 Army Recruiting Information Support System Reception Module (RECMOD)

The U.S. Army Human Resources Command (HRC) is the proponent for the RECMOD. This system provided monthly rosters of trainees that began BCT and OSUT during the month and included demographics (e.g., component and race) and physical characteristics (e.g., height and weight from the Military Entry Processing Station). HRC sent these roster data monthly to the IPB point of contact (POC).

4.3.3 Army Training Requirements and Resources System (ATRRS)

ATRRS is the Army’s system of record for managing student inputs for training. The IPB POC downloaded class rosters and graduation/attrition logs from the ATRRS web portal.

4.3.4 Military Personnel Transition Processing Point Processing System (TRANSPROC)

The HRC is the proponent for TRANSPROC. This system provides data collection and document processing for transitioning Soldiers’ duty status to retirement, discharge, or release from active duty. The APHC IPB POC downloaded data from the TRANSPROC web portal to update and confirm the final graduation or discharge status of BCT and OSUT trainees.

4.3.5 Linked Data Set

Each of the above data included the same unique personal identifier. The APHC IPB used this identifier to link and merge data sets to create the final database for analysis. After linking these data, the IPB de-identified the database for analysis.

4.4 Injury Surveillance Using Medical Encounter Data

The IPB used medical encounter data from DMSS as the primary data source for routine, systematic injury surveillance. These data included dates for medical encounters and standardized diagnosis codes from the International Classification of Diseases – 10th Revision, Clinical Modification (ICD-10-CM).

In 2017, the APHC IPB developed an enhanced injury definition using a comprehensive taxonomy to categorize injuries (APHC 2017a). The taxonomy was accompanied by a list of ICD-10-CM diagnosis codes, which operationalized the taxonomy as a surveillance tool. The IPB defines “injury” as damage or interruption of body tissue function caused by mechanical, thermal, radiant, or other energy exposure that exceeds the tissue’s threshold of tolerance. This energy exposure can occur either suddenly (i.e., traumatic injury from single high intensity force, such as fracture, dislocation, and tendon rupture) or gradually (i.e., overuse injury from cumulative micro-traumatic forces, such as tendonitis, overuse muscle strain, and bone stress fracture).

For this surveillance report, APHC IPB focused solely on the subset of taxonomy injuries that resulted from mechanical energy exposures causing damage to the MSK system (e.g., muscles, tendons, bones, joints). This included traumatic and overuse of the MSK system (i.e., MSK injuries) (Hauschild 2019).

The APHC IPB identified all unique (i.e., new) MSK injuries among the FY 2019 cohort. An injury was considered to be “unique” if the trainee did not have a previous encounter for the same injury (i.e., similar ICD-10-CM code) during the preceding 30-day period.

4.5 Metrics for Injury Surveillance

To understand the surveillance findings in this report, it is important to first operationally define the following MSK injury metrics:

- *Cumulative Injury Incidence*. The proportion of trainees with one or more MSK injuries during the training course.
- *Injury Rate*. The number of trainees with “one or more injuries” per 100 trainees at risk per month (injured per 100 person-months). Injury rates allow comparison of injuries that accrue over varying lengths of follow-up, for example, during different training courses (e.g., BCT, OSUTs) or different years with fluctuating populations of trainees.
- *Injury Rate Ratio (RR) (Group 1 / Group 2)*. The ratio calculated by dividing the injury rate for Group 1 by the injury rate for Group 2. For example, an injury RR (Women/Men) equal to 1.5 indicates that the injury rate for women was 1.5 times higher (50% higher) than the rate for men. A 95% confidence interval (CI) that does not include the value 1.0 in the range of values indicates that the RR is a statistically significant finding ($p < 0.05$).
- *Odds Ratio (OR)*. A measure of association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure, compared to the outcome occurring in the absence of that exposure. A 95% CI that does not include the value 1.0 in the range of values indicates that the OR is a statistically significant finding ($p < 0.05$).

4.6 Statistical Analyses

Descriptive statistics (i.e., central tendency metrics, percentages, and frequencies) were used to describe trainee characteristics. Body mass index (BMI) was calculated from height and weight

(BMI: body mass in kilograms per meter of height squared (kg/m^2)). The Chi-square (χ^2) test of proportions was used to compare equality of proportions (nominal data) and independent sample t-tests were used to evaluate differences between two means for continuous data. Logistic regression was used to assess associations of graduation status and MSK injury.

The APHC IPB used IBM® SPSS® Statistics for Windows®, Version 25 for descriptive analyses and logistic regression. *Open Source Epidemiologic Statistics for Public Health*, (version www.OpenEpi.com, updated 16 May 2013; accessed 8 March 2018) was used to calculate the χ^2 test of proportions and determine rate ratios. For all statistical analyses, $\alpha \leq 0.05$ was set a priori.

5. RESULTS FOR BCT INJURY SURVEILLANCE, FY 2019

5.1 Physical Characteristics and Demographics

The FY 2019 cohort of BCT trainees included 20,397 women (27.4%) and 53,959 men (72.6%). Their mean age was 20.9 (± 4.0) years. Compared to women, men were slightly older, taller, heavier, and had higher BMI (Table 2). Overall, 57% of trainees were in the Active Component, 66% were White, 26% were Black, and 82% had 12th grade education (Table 3). Distributions of these demographics differed by sex.

Table 2. Physical Characteristics of BCT Trainees, FY 2019

Characteristic	Sex			p-value ^a
	Combined (n=74,356)	Women (n=20,397)	Men (n=53,959)	
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	
Age (years)	20.9 $\pm$ 4.0	20.6 $\pm$ 4.0	21.0 $\pm$ 4.1	<0.01
Height (inches)	67.6 $\pm$ 3.6	63.8 $\pm$ 2.6	69.1 $\pm$ 2.8	<0.01
Weight (lbs)	159.5 $\pm$ 31.0	134.7 $\pm$ 18.8	168.9 $\pm$ 29.6	<0.01
BMI	24.4 $\pm$ 3.6	23.2 $\pm$ 2.6	24.8 $\pm$ 3.8	<0.01

Source: DMSS and RECMOD, August 2020; prepared by APHC IPB

Legend: SD = standard deviation

lbs = pounds

BMI = body mass index (weight (kg) / height (m^2))

Note:

^ap-value, independent t-test comparison of means (men vs. women).

Table 3. Demographics of BCT Trainees, FY 2019

Demographic	Category	Sex			p-value ^a
		Combined (n=74,356) (%)	Women (n=20,397) (%)	Men (n=53,959) (%)	
Component	Active	56.5	49.5	59.2	<0.01
	National Guard	28.8	32.9	27.2	
	Reserve	14.7	17.6	13.6	
Race	White	66.0	59.0	68.6	<0.01
	Black	26.2	33.1	23.6	
	Asian	7.1	7.0	7.1	
	Native American	0.7	0.9	0.7	
Education	<12th Grade	4.8	6.2	4.2	<0.01
	12th Grade	82.2	79.6	83.2	
	1 – 4 Years, College	11.9	12.9	11.5	
	>4 Years, College	1.0	1.2	1.0	
	Unknown	0.0	0.1	0.0	

Source: DMSS and RECMOD, August 2020; prepared by APHC IPB

Note:

^a χ^2 p-value (men vs. women).

5.2 BCT MSK Injury Incidence and Rate

Injured female trainees (n=10,705; 52.5%) had 21,306 unique injuries (2.0 injuries per injured trainee) and injured male trainees (n=15,204; 28.2%) had 24,200 unique injuries (1.6 injuries per injured trainee).

Table 4 presents the cumulative MSK injury incidence (i.e., percentage of trainees with ≥ 1 injury) during BCT and injury rate (i.e., number injured per 100 person-months) by sex for each BCT training center. The cumulative injury incidence among women ranged from 45% (Fort Sill) to 56% (Fort Jackson) and among men ranged from 20% (Fort Sill) to 34% (Fort Benning).

Table 4 also presents the annualized injury rates for both sexes. Overall rates for women and men were 23.1 and 12.5 per 100 person-months, respectively. As indicated by the RR (W/M), the overall injury rate for BCT women was 1.9 times higher than the rate for men (RR: 1.86 (1.81–1.90)). Among the individual training centers, Fort Sill had the lowest injury rate for both sexes (p<0.01) but had the highest RR (W/M) (RR: 2.23 (2.09–2.38)).

Table 4. BCT MSK Injury Incidence and Rate by Training Center and Sex, FY 2019

Training Center	Number Trained (n)		Injury Incidence (%) ^a		Injury Rate ^b (per 100 p-mos)		Injury Rate Ratio Women vs. Men (95% CI) ^c
	Women	Men	Women	Men	Women	Men	
Benning	-	4,234	-	34.2		15.0	-
Jackson	12,374	27,960	55.6	30.4	24.8	13.6	1.83 (1.77–1.89) ^d
L. Wood	4,013	11,689	50.4	27.9	22.1	12.3	1.80 (1.70–1.90) ^d
Sill	4,010	10,076	45.0	19.8	19.2	8.6	2.23 (2.09–2.38) ^d
Overall	20,397	53,959	52.5	28.2	23.1	12.5	1.86 (1.81–1.90) ^d

Source: DMSS, August 2020; prepared by APHC IPB

Legend:

L. Wood = Fort Leonard Wood

p-mos = person-months

CI = confidence interval

Notes:

^aInjury incidence: percent of trainees with at least one injury during BCT.

^bInjury rate: number injured per 100 person-months.

^cInjury Rate Ratio (95% CI): injury rate among women ÷ injury rate among men.

^dIndicates the Rate Ratio is statistically significant ($p \leq 0.05$).

Figure 2 shows the annualized MSK injury rates by sex for BCT cohorts that started training in FYs 2017, 2018, and 2019. The injury rate ratios comparing the sex-specific rates in FY 2019 to rates in FY 2017 and 2018 are presented in Table 5. The FY 2019 rates for women and men were not significantly different compared to their respective rates in 2017 or 2018.

The inset in Figure 2 (top right corner) shows the RR (women (W) / men (M)) and CIs for FYs 2017, 2018, and 2019. Injury rates for BCT women were consistently 1.9 times higher than rates for men across the 3 years.

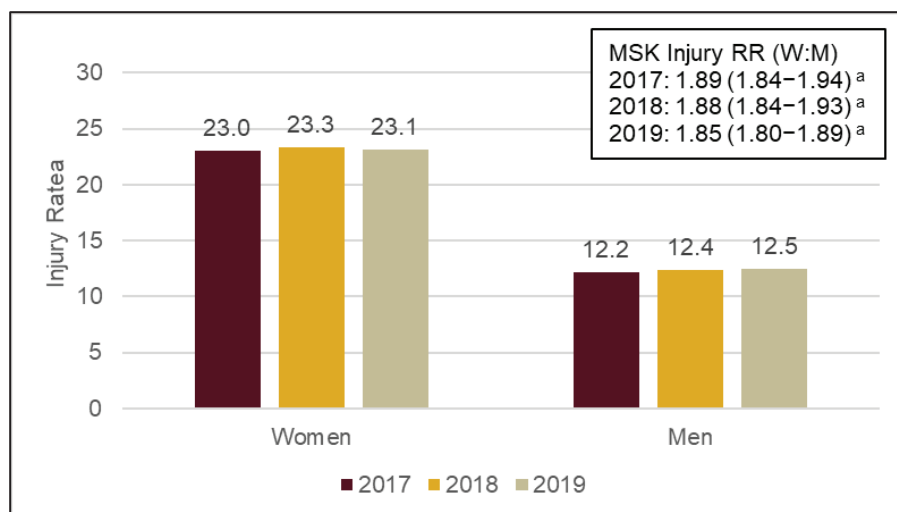


Figure 2. BCT Injury Rates by Sex, FYs 2017 to 2019

Source: DMSS, August 2020; prepared by APHC IPB

Notes:

Injury rate: number injured per 100 person-months (p-mos)

RR (W/M) = injury rate among women ÷ injury rate among men

^aIndicates the injury RR (W/M) is statistically significant ($p \leq 0.05$)

Table 5. BCT Injury Rate Comparisons by FY, FYs 2017 to 2019

Sex	Injury RR (95% CI); p-value			
	RR (2019 / 2017) ^a		RR (2019 / 2018) ^b	
Women	1.01 (0.98–1.03)	0.73	0.99 (0.97–1.02)	0.65
Men	1.02 (1.00–1.05)	0.05	1.01 (0.98–1.03)	0.53

Source: DMSS, August 2020; prepared by APHC IPB

Legend:

Injury RR = injury rate ratio

CI = confidence interval

Notes:

^aInjury RR (FY 2019 / FY 2017) = injury rate in FY 2019 ÷ injury rate in FY 2017

^bInjury RR (FY 2019 / FY 2018) = injury rate in FY 2019 ÷ injury rate in FY 2018

Trainees from all three Army components train together in BCT classes. Table 6 compares the cumulative injury incidence across the three components for the FY 2019 cohort. Injury incidence among women and men in the National Guard was statistically significantly lower compared to their peers in the Active and Reserve components ($p < 0.05$ for each comparison). Men in the Reserve also had statistically significantly lower incidence compared to men in the Active component ($p < 0.05$).

Table 6. BCT Injury Incidence by Army Component and Sex, FY 2019

Army Component	Sex	
	Women (n=20,397)	Men (n=53,959)
	Injury Incidence ^a (%)	Injury Incidence ^a (%)
Active	54.1 ^b	29.4 ^{bc}
National Guard	48.9 ^{bd}	25.7 ^{bd}
Reserve	54.7 ^d	28.0 ^{cd}
Overall	52.5	28.2

Source: DMSS, August 2020; prepared by APHC IPB

Notes:

^aInjury incidence: percent of trainees with at least one injury during BCT^b χ^2 p<0.05 (Active vs. National Guard)^c χ^2 p<0.05 (Active vs. Reserve)^d χ^2 p<0.05 (National Guard vs. Reserve)

Tables 7 and 8 present the distribution of MSK injuries by injury type (i.e., traumatic vs. overuse) and anatomic location, respectively. Distribution of injury type was similar for women and men (p=0.81) with 92% of injuries being overuse injuries (Table 7). Injuries involving the lower extremity accounted for 82% of MSK injuries among women and 76% of injuries among men (Table 8). The second leading anatomic region was the spine and back (7%) among women and the upper extremity (11%) among men.

Table 7. BCT MSK Injury Types, FY 2019

MSK Injury Type	Sex						p-value ^a
	Combined		Women		Men		
	n	%	n	%	n	%	
Traumatic Injuries	3,849	8.5	1,795	8.4	2,054	8.5	0.81
Overuse Injuries	41,657	91.5	19,511	91.6	22,146	91.5	
Total, MSK Injuries	45,506		21,306		24,200		

Source: DMSS, August 2020; prepared by APHC IPB

Note:

^a χ^2 p-value (women vs. men)

Table 8. BCT MSK Injuries by Body Region, FY 2019

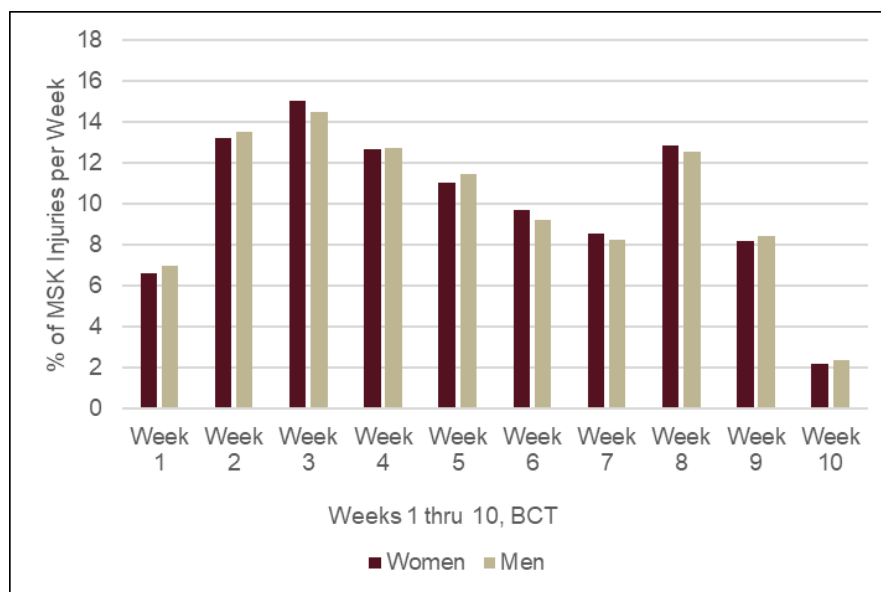
Body Region (MSK Injury)	Sex						p-value ^a
	Combined		Women		Men		
	n	%	n	%	n	%	
Head & Neck	74	0.2	39	0.2	35	0.1	0.31
Spine & Back	3,841	8.4	1,517	7.1	2,324	9.6	<0.01
Torso	979	2.2	605	2.8	374	1.5	<0.01
Upper Extremity	3,724	8.2	1,154	5.4	2,570	10.6	<0.01
Lower Extremity	35,853	78.8	17,468	82.0	18,385	76.0	<0.01
Other & Unspecified	1,035	2.3	523	2.5	512	2.1	0.02
Total MSK Injuries	45,506	100.0	21,306	100.0	24,200	100.0	<0.01

Source: DMSS, August 2020; prepared by APHC IPB

Note:

^a χ^2 p-value (women vs. men)

Figure 3 shows the proportion of all unique MSK injuries that occurred during each week of the 10-week BCT course. Week of injury was determined by subtracting the date of the trainee's first medical encounter for the injury from the date the trainee began BCT. For both sexes, the highest weekly proportion of injuries were weeks 2 and 3. Weekly proportions then decreased in a stepwise manner in weeks 4 through 7, and then increased in week 8. The larger proportion in week 8 coincided with the final 3-day culminating training event at the end of BCT (i.e., "Forge" field training exercise).

**Figure 3. Proportion of BCT MSK Injuries by Week of Training, FY 2019**

Source: DMSS and ATRRS, August 2020; prepared by APHC IPB

5.3 Association of BCT Graduation Status and MSK Injuries

Table 9 summarizes the final graduation status among BCT women and men in FY 2019. The “Graduated” category includes trainees who graduated at the end of the 10-week BCT course (women: n=16,856; men: n=49,230) plus those that eventually graduated after receiving additional training or recovering from serious injury/illness (women: n=598; men: n=944). Overall, 86% of women (n=17,454) graduated from BCT, compared to 93% of men (50,174) (p<0.001). The remainder of trainees were discharged from the Army (women: 12%; men: 6%), returned to their National Guard or Reserve unit for processing (REFRAD: women: <1%; men: <1%), or were lost to follow-up (women: 2%; men: <1%).

Table 9 also demonstrates the association of injury status (non-injured vs. injured) and BCT graduation status. For both sexes, the proportions of injured vs. non-injured trainees that graduated were compared. In this chi-square analysis (p-values shown in Table 9), the categories for discharged, REFRAD, and lost to follow-up were combined into a single “attrited” category. For both sexes, graduation status was statistically significantly different (p<0.01) for injured trainees compared to non-injured trainees. Only 78% of injured women graduated (compared to 94% of non-injured women) and 84% of injured men graduated (compared to 96% of non-injured men).

Table 9. BCT Graduation Status by Sex and Injury Status, FY 2019

Graduation Status (%)	Sex							
	Women (n=20,397)				Men (n=53,959)			
	Overall (20,397)	Non-Injured (9,692)	Injured (n=10,705)	p-value ^a	Overall (53,959)	Non-Injured (38,755)	Injured (15,204)	p-value ^a
Graduated	85.6	94.3	77.7	<0.01	93.0	96.3	84.4	<0.01
Discharged	11.7	4.9	17.7		6.1	3.2	13.6	
REFRAD	0.8	0.2	1.4		0.2	0.1	0.5	
Unknown	2.0	0.6	3.2		0.7	0.4	1.5	

Source: DMSS and ATRRS, August 2020; prepared by APHC IPB

Legend:

REFRAD = Return from Active Duty (National Guard and Reserve)

Note:

^a χ^2 p-value compares Graduation Status (graduated vs. attrited) among “non-injured” vs. “injured” trainees; attrited includes the Discharged, REFRAD, and Unknown categories.

Univariable and multivariable logistic regression models were used to investigate the association of graduation status (attrited vs. graduated) and MSK injuries among women and men, separately. The sex-specific multivariable models controlled for age, component, and educational level. From these models, Table 10 presents the odds of attriting (i.e., not graduating) if injured during BCT. From the multivariable model, the odds of attriting were 4.6 and 5.0 times higher for injured women and men, respectively, compared to their non-injured peers.

Table 10. Association of BCT Graduation Status (Attriting) and MSK Injury, FY 2019

Univariable Model				
Sex	Injury Status	Odds Ratio	(95% CI)	p-value
Women	Non-injured	1.00		
	Injured (≥ 1 MSK injury)	4.53	(4.09–5.02)	<0.01
Men	Non-injured	1.00		
	Injured (≥ 1 MSK injury)	4.91	(4.57–5.28)	<0.01
Multivariable Model^a				
Sex	Injury Status	Odds Ratio	(95% CI)	p-value
Women	Non-injured	1.00		
	Injured (≥ 1 MSK injury)	4.55	(4.10–5.04)	<0.01
Men	Non-injured	1.00		
	Injured (≥ 1 MSK injury)	5.02	(4.67–5.40)	<0.01

Source: DMSS and ATRRS, August 2020; prepared by APHC IPB

Legend:

CI = confidence interval

Note:

^aMultivariable model controlled for age, component, and education.

6. RESULTS FOR OSUT INJURY SURVEILLANCE, FY 2019

6.1 Physical Characteristics and Demographics of OSUT Trainees

The FY 2019 cohort of OSUT trainees included 2,459 women (8.2%) and 27,658 men (91.8%) (Table 11). The mean age of trainees was 20.4 (± 3.3) years. Compared to women, men were older, taller, heavier, and had higher BMI.

Table 11. Physical Characteristics of OSUT Trainees, FY 2019

Characteristic	Sex			p-value^a
	Combined (n=30,117)	Women (n=2,459)	Men (n=27,658)	
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	
Age (years)	20.4 $\pm$ 3.3	20.0 $\pm$ 3.1	20.5 $\pm$ 3.3	<0.01
Height (inches)	68.7 $\pm$ 3.1	63.9 $\pm$ 2.5	69.2 $\pm$ 2.7	<0.01
Weight (lbs)	166.9 $\pm$ 30.0	135.5 $\pm$ 18.1	169.7 $\pm$ 29.3	<0.01
BMI	24.8 $\pm$ 3.7	23.3 $\pm$ 2.5	24.9 $\pm$ 3.7	<0.01

Source: DMSS and RECMOD, August 2020; prepared by APHC IPB

Legend:

SD = standard deviation

lbs = pounds

BMI = body mass index (weight (kg) / height (m²))

Note:

^ap-value, independent t-test comparison of means (women vs. men).

Table 12 summarizes the demographics of OSUT trainees. The distribution for each demographic was significantly different for women compared to men. Sixty percent of men were in the 11B and 11C IN OSUTs (compared to 9% of women) and 49% of women were in the 31B MP OSUT (compared to 11% of men). Twelve percent of OSUT women and 3% of men were in the Reserve. A larger proportion of women was Black (21% vs. 14%; $p<0.01$) and had one or more years of college (10% vs. 7%; $p<0.01$).

Table 12. Demographics of OSUT Trainees, FY 2019

Demographic	Category	Sex						p-value ^a
		Combined (n=30,117)		Women (n=2,459)		Men (n=27,658)		
		n	%	n	%	n	%	
OSUT Course	11B IN	15,272	50.7	221	9.0	15,051	54.4	<0.01
	11C IN	1,595	5.3	0	0.0	1,595	5.8	
	12B EN	3,468	11.5	755	30.7	2,713	9.8	
	12C EN	434	1.4	90	3.7	344	1.2	
	19D CAV	3,655	12.1	110	4.5	3,545	12.8	
	19K AR	1,391	4.6	88	3.6	1,303	4.7	
	31B MP	4,302	14.3	1,195	48.6	3,107	11.2	
Component	Active	21,794	72.4	1,440	58.6	20,354	73.6	<0.01
	National Guard	7,115	23.6	729	29.6	6,386	23.1	
	Reserve	1,208	4.0	290	11.8	918	3.3	
Race	White	24,136	80.1	1,822	74.1	22,314	80.7	<0.01
	Black	4,302	14.3	503	20.5	3,799	13.7	
	Asian	1,420	4.7	107	4.4	1,313	4.7	
	Native American	255	0.8	27	1.1	228	0.8	
	Other, Unknown	4	0.0	0	0.0	4	0.0	
Education	<12th Grade	385	1.3	0	0.0	385	1.4	<0.01
	12th Grade	27,565	91.5	2,225	90.5	25,340	91.6	
	1-4 Years, College	2,101	7.0	227	9.2	1,874	6.8	
	>4 Years, College	63	0.2	7	0.3	56	0.2	
	Unknown	3	0.0	0	0.0	3	0.0	

Source: DMSS and RECMOD, August 2020; prepared by APHC IPB

Legend:

IN = infantry; EN = engineer; CAV = cavalry; AR = armor; MP = military police

Note:

^a χ^2 p-value (women vs. men).

6.2 OSUT MSK Injury Incidence and Rate

The injury taxonomy was used to identify all unique MSK injuries among the FY 2019 OSUT trainee cohort. Injured female trainees (n=1,682) had 4,827 unique injuries (2.9 injuries per

injured trainee) and injured male trainees (9,626) had 17,883 injuries (1.9 injuries per injured trainee).

Table 13 presents the sex-specific cumulative MSK injury incidence (i.e., percentage of trainees with ≥ 1 injury) and injury rate (i.e., number injured per 100 person-months) for the OSUTs individually and combined (i.e., overall). While both injury metrics are informative, the injury rate is better suited when making comparisons among the OSUTs, considering their variable lengths of training.

Considering similarities in training, the 11B and 11C IN OSUTs were combined for this analysis (i.e., 11B/C IN OSUT). As explained previously (Section 4.2), seven 11B IN OSUT classes and one 11C IN OSUT class followed the extended 22-week POI in FY 2019, while the remainder of classes followed the legacy 14-week POI. Only men trained in 22-week classes. Injury metrics for the 22-week 11B/C OSUT classes are reported separately at the bottom of Table 13.

Table 13. OSUT MSK Injury Incidence and Rates by Sex and Course, FY 2019

OSUT Course	Number Trained (n)		Injury Incidence ^a (%)		Injury Rate ^b (per 100 p-mos)		Injury Rate Ratio Women vs. Men (95% CI) ^c
	Women	Men	Women	Men	Women	Men	
11B/C Infantry (14 weeks)	221	14,863	73.8	33.4	23.9	10.3	2.33 (1.99–2.72) ^d
12B Combat Engineer	755	2,713	75.1	37.9	22.3	11.5	1.94 (1.75–2.27) ^d
12C Bridge Crewmember	90	344	63.3	38.4	19.4	11.7	1.67 (1.22–2.27) ^d
19D Cavalry Scout	110	3,545	69.1	35.9	17.8	9.9	1.81 (1.44–2.28) ^d
19K M1 Armor Crewmember	88	1,303	61.4	30.2	16.0	8.3	1.94 (1.46–2.57) ^d
31B Military Police	1,195	3,107	64.1	33.6	14.7	7.6	1.95 (1.78–2.14) ^d
Overall	2,459	25,875	68.4	34.1	17.8	9.8	1.81 (1.71–1.90) ^d
11B/C Infantry (22 weeks)	-	1,783	-	45.0 ^e	-	9.1 ^e	—

Source: DMSS August 2020; prepared by APHC IPB

Legend:

p-mos = person-months

CI = confidence interval

Notes:

Total number of IN OSUT (11B/C) trainees in FY 2019 (14-Week and 22-Week POIs): M=16,646; W=221.

^aInjury incidence: percent of trainees with at least one injury during OSUT.

^bInjury rate: number injured per 100 person-months (p-mos).

^cInjury Rate Ratio (95% CI): injury rate among women ÷ injury rate among men.

^dIndicates the Rate Ratio (W:M) is statistically significant ($p \leq 0.05$).

^eIndicates the injury incidence and rate among men in 22-Week 11B/C classes were significantly higher ($p < 0.05$) compared to the 14-week 11B/C classes.

Considering the OSUTs, overall, but excluding the 22-week 11B/C OSUT classes, 68% of women and 34% of men had at least one injury during their OSUT course. Across the individual

OSUTs, cumulative injury incidence ranged from 61% to 75% among women and from 30% to 38% among men. These values reflect differences in training and duration among the OSUTs.

Injury rates ranged from 15 to 24 per 100 person-months among OSUT women and from 8 to 12 per 100 person-months among men. Rates tended to be lower for both sexes in OSUTs with longer length of training compared to the 14-week 11B/C, 12B, and 12C OSUTs. Women in the 11B/C OSUT (14 weeks) and men in the 12C OSUT (14 weeks) had the highest sex-specific injury rates. As expressed by the RR (W/M), the FY 2019 injury rate for women ranged from 1.7 (1.22–2.27) to 2.3 (1.99–2.72) times higher than the rate for men in the same OSUT (Table 13).

Injury metrics were also compared between men in the 14-week and 22-week 11B/C OSUT classes (Table 13). As expected, with the longer duration (i.e., increased risk exposure), a statistically significantly larger proportion of men in 22-week classes was injured by the end of training (45% vs. 33%; $p < 0.01$); but, with the longer duration, the injury rate for 22-week classes was statistically significantly lower (9.1 vs. 10.3 per 100 person-months; $p < 0.01$).

To further investigate the injury rate for men in 22-week classes of 11B/C IN OSUT, interval injury rates were compared between (a) the first 14 weeks of training (weeks 1 through 14) and (b) weeks 15 through 22. These interval injury rates for 22-week classes are shown on the right in Figure 4. The rate for the first 14 weeks (13.2 per 100 person-months) was statistically significantly higher than the rate for weeks 15 through 22 (1.8 per 100 person-months; $p < 0.01$). This reflects the finding that only 59 additional trainees (3%) had their first injury during weeks 15 through 22.

When the injury rate for men in weeks 1 through 14 of 22-week classes of 11B/C IN OSUT was compared to the rate for men in 14-week classes of 11B/C IN OSUT (Figure 4). The injury rate during weeks 1 through 14 of 22-week classes was statistically significantly different (28% higher) than the rate at the end of 14-week classes (RR [weeks 1–14 in 22-week classes / 14-week classes]: 1.28 (1.19–1.39); $p < 0.01$).

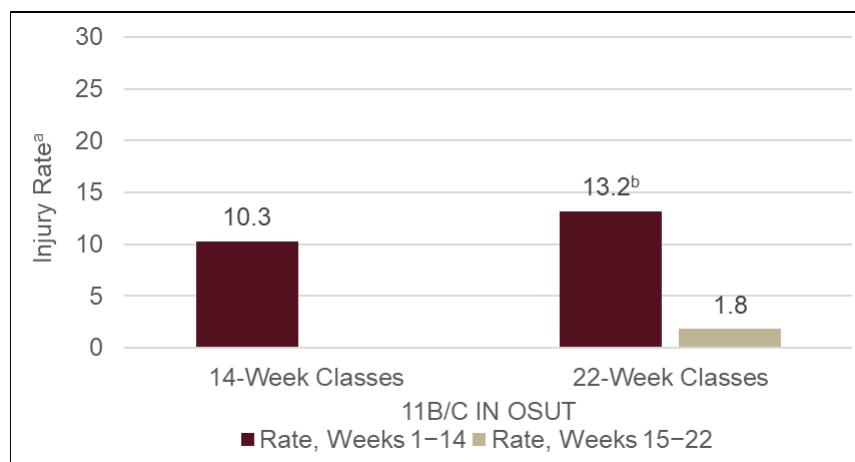


Figure 4. Injury Rates for Men in 14-Week Classes vs. 22-Week Classes of 11B/C IN OSUT

Source: DMSS August 2020; prepared by APHC IPB

Legend: IN = infantry

Notes:

^aInjury rate: number injured per 100 person-months (p-mos)

^bThe injury rate in weeks 1 through 14 of 22-week classes was statistically significantly different (lower) compared to the rate in 14-week classes ($p < 0.05$)

Figure 5 shows the sex-specific injury rates by OSUT course and overall in FYs 2017, 2018, and 2019. The FY 2019 rates for the 11B/C IN OSUT include only the classes that followed the 14-week POI. Length of the other OSUT courses ranged from 14 weeks to 19 weeks (Table 1). Rates were compared between FYs 2019 and 2017 and between FYs 2019 and 2018 (footnotes in Figure 5 identify statistically significant findings). The rate ratios for these FY comparisons are presented in Table 14; cells with statistically significant findings are shaded gray.

In each of the individual OSUTs, injury rates for women tended to decrease across the three FYs of surveillance (left pane of Figure 5 and Table 14). But only in the 19D CAV and 31B MP OSUTs were their FY 2019 injury rates statistically significantly lower compared to FY 2017 (RR (2019/2017) < 1.0 ; $p < 0.05$).

Injury rates for men in the individual OSUTs did not follow a consistent tendency across the three FYs (right pane of Figure 5 and Table 14). FY 2019 rates for men in the 11B/C IN, 19K AR, and 31B MP OSUTs were statistically significantly lower compared to rates in FYs 2017 (RR (2019/2017) < 1.0 ; $p < 0.05$) and 2018 (RR (2019/2018) < 1.0 ; $p < 0.05$). Alternatively, FY 2019 injury rates in the 12C EN and 19D OSUTs were statistically significantly higher in FY 2019 compared to FY 2018 (RR (2018/2019) > 1.0 ; $p < 0.05$).

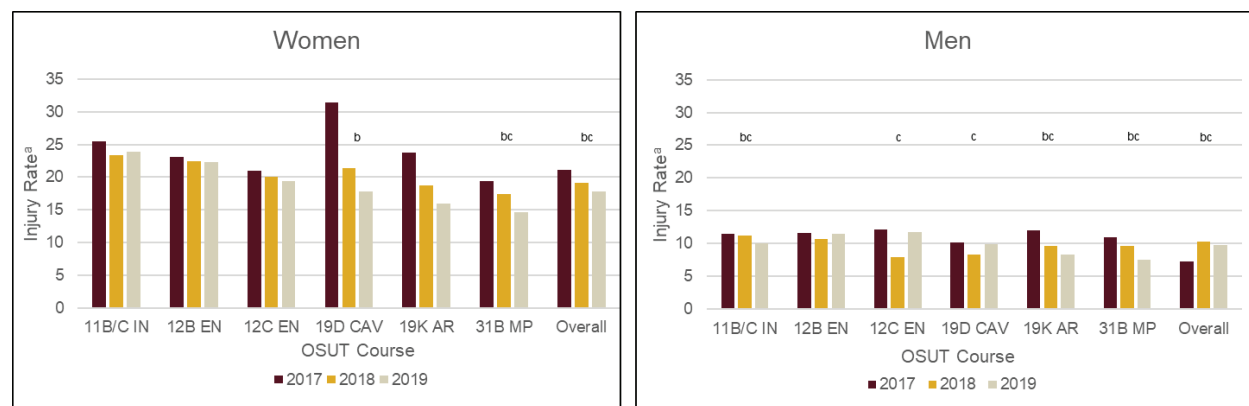


Figure 5. OSUT Injury Rates, FYs 2017 to 2019

Data Source: DMSS and ATRRS 2020; prepared by APHC IPB

Legend: IN = infantry; EN = engineer; CAV = cavalry; AR = armor; MP = military police

Notes:

^aMSK injury rate: Number injured per 100 trainees per month

^bIndicates that the FY 2019 injury rate was statistically significantly different vs. FY 2017 ($p < 0.05$)

^cIndicates that the FY 2019 injury rate is statistically significantly different vs. FY 2018 ($p < 0.05$)

Table 14. OSUT Injury Rate Comparisons by FY, FYs 2017 to 2019

OSUT Course	Sex	Injury RR (95% CI); p-value			
		RR (2019 / 2017) ^a		RR (2019 / 2018) ^b	
11B/C IN	Men	0.89 (0.86-0.93)	<0.01	0.92 (0.89-0.96)	<0.01
	Women	0.94 (0.75-1.17)	0.58	1.02 (0.81-1.29)	0.86
12B EN	Men	0.99 (0.91-1.08)	0.88	1.08 (0.99-1.17)	0.95
	Women	0.96 (0.85-1.10)	0.57	1.00 (0.87-1.14)	0.97
12C EN	Men	0.95 (0.75-1.20)	0.68	1.48 (1.11-1.99)	<0.01
	Women	0.92 (0.65-1.32)	0.66	0.97 (0.64-1.45)	0.87
19D CAV	Men	0.97 (0.89-1.05)	0.43	1.18 (1.09-1.28)	<0.01
	Women	0.57 (0.43-0.81)	<0.01	0.83 (0.59-1.18)	0.30
19K AR	Men	0.69 (0.60-0.78)	<0.01	0.85 (0.75-0.98)	0.02
	Women	0.67 (0.45-1.02)	0.06	0.85 (0.58-1.26)	0.43
31B MP	Men	0.70 (0.64-0.75)	<0.01	0.79 (0.73-0.86)	<0.01
	Women	0.76 (0.69-0.84)	<0.01	0.85 (0.77-0.94)	<0.01
Overall	Men	0.86 (0.84-0.89)	<0.01	0.95 (0.92-0.97)	<0.01
	Women	0.84 (0.79-0.90)	<0.01	0.93 (0.86-0.99)	0.04

Source: DMSS, August 2020; prepared by APHC IPB

Legend:

Injury RR = injury rate ratio; IN = infantry; EN = engineer; CAV = cavalry; AR = armor; MP = military police
Shaded cells represent a statistically significant rate ratio

Notes:

^aInjury RR (FY 2017 / FY 2019) = injury rate in FY 2017 ÷ injury rate in FY 2019.

^bInjury RR (FY 2018 / FY 2019) = injury rate in FY 2018 ÷ injury rate in FY 2019.

Tables 15 and 16 present the MSK injury distributions by injury type and body region, respectively. Distributions of injury type were similar among women and men ($p=0.17$). Nearly 95% of injuries among both sexes were overuse injuries (e.g., muscle strains, tendinitis, and stress fractures) and only 5% were traumatic injuries (e.g., joint sprains, tendon rupture, and fractures).

There were sex differences in the distribution of injuries by body region (Table 16), but the leading body regions were similar. Injuries involving the lower extremity were, by far, the leading body region, accounting for 82% of injuries among women and 76% of injuries among men ($p<0.01$). The second leading anatomic regions were the spine and back among women (65%) and upper extremity among men (11%).

Table 15. OSUT MSK Injury Types, FY 2019

MSK Injury Type	Sex						p-value ^a
	Combined		Women		Men		
	n	%	n	%	n	%	
Traumatic Injuries	1,253	5.5	247	5.1	1,006	5.6	0.17
Overuse Injuries	21,457	94.5	4,580	94.9	16,877	94.4	
Total, MSK Injuries	22,710		4,827		17,883		

Source: DMSS August 2020; prepared by APHC IPB

Note:

^a χ^2 p-value (women vs. men)

Table 16. OSUT MSK Injuries by Body Region, FY 2019

Body Region (MSK Injuries)	Sex						p-value ^a
	Combined		Women		Men		
	n	%	n	%	n	%	
Head and Neck	72	0.3	13	0.3	59	0.3	0.51
Spine and Back	2,053	9.0	309	6.4	1,744	9.8	<0.01
Torso	499	2.3	182	3.8	317	1.8	<0.01
Upper Extremity	2,262	10.0	270	5.6	1,992	11.1	<0.01
Lower Extremity	17,508	77.1	3,963	82.1	13,545	75.7	<0.01
Other and Unspecified	316	1.4	90	1.9	226	1.3	<0.01

Source: DMSS August 2020; prepared by APHC IPB

Notes:

^a χ^2 p-value (women vs. men)

For each of the OSUT courses, the training during the first 10 weeks is similar and aligns with the the first 10 weeks of BCT (Figure 1). After the first 10 weeks, training in each OSUT differs as training becomes more focused on the specific MOS being trained.

During the first 10 weeks, OSUT women had 3,754 unique injuries and men had 14,386 injuries. For the OSUTs, combined, Figure 6 shows the proportion of these injuries that occurred during each week for the first 10 weeks of training. For both sexes, the highest weekly proportions of injuries occurred in weeks 2 and 3. Weekly proportions then decreased in a stepwise manner in weeks 4 through 6, increased slightly in week 7, then continued to decrease in weeks 8 through 10.

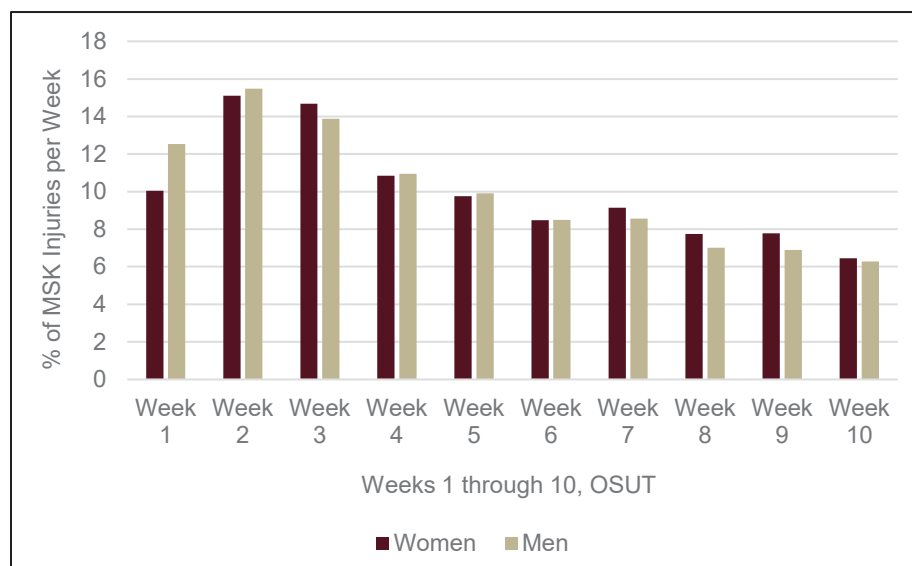


Figure 6. Proportion of MSK Injuries by Week of OSUT Training, FY 2019

Source: DMSS August 2020; prepared by APHC IPB

6.3 Association of Graduation Status and MSK Injuries, OSUT

Table 17 summarizes the final graduation status for the FY 2019 OSUT cohort. The “graduated” category included trainees who graduated at the end of their first OSUT class (women: n=1,528 (62%); men: n=22,600 (81%)) plus those that eventually graduated after receiving additional training or recovering from serious injury/illness (women: n=166; men: n=866). Overall, 69% of women (n=1,694) and 85% of men (23,466) graduated from OSUT. The remainder were discharged from the Army (women: 26%%; men 14%), returned to their National Guard or Reserve unit for processing (REFRAD: return from active duty; women: <1%; men: <1%), or were lost to follow-up (unknown: women: 5%; men: 1.4%).

The percentage of OSUT trainees that graduated varied by OSUT course and sex. Among women, graduation ranged from 46% (19D CAV) to 90% (19K AR). Among men, graduation ranged from 82% (19D CAV) to 91% (12C EN).

Table 17 also demonstrates the association of injury status (non-injured vs. injured) on OSUT graduation. For each OSUT course and both sexes, the distribution of graduation status was compared between trainees that were injured and trainees that were non-injured. For the chi-

square analyses (p-values shown in Table 16), the three non-graduation categories were collapsed into a single “attrited” category. Considering the OSUTs combined, 86% of non-injured women graduated compared to 61% of injured women ($p < 0.01$); 91% of non-injured men graduated compared to 73% of injured men ($p < 0.01$). Considering the OSUTs individually, a larger percentage of non-injured men (vs. injured men) graduated from each of the OSUTs ($p < 0.01$ for each comparison); a larger percentage of non-injured women (vs. injured women) graduated from the 11B/C IN, 12B EN, 19D CAV, and 31B MP OSUTs ($p < 0.05$ for each comparison).

Table 17. Graduation Status by OSUT, Injury Status, and Sex, FY 2019

OSUT Course	Graduation Status	Women (n=2,459)				p-value ^a	Men (n=27,658)				p-value ^a
		Overall	Non-Injured	Injured			Overall	Non-Injured	Injured		
11B/C IN	Trainees (n)	(221)	(58)	(163)			(16,646)	(10,886)	(5,760)		
	Graduated (%)	51.6	65.5	46.6		0.01	84.4	89.6	74.4		<0.01
	Discharged (%)	44.3	32.8	48.5			14.5	9.8	23.6		
	REFRAD (%)	0.9	0.0	1.2			0.1	0.1	0.2		
	Unknown (%)	3.2	1.7	3.7			1.0	0.6	1.8		
12B EN	Trainees (n)	(755)	(188)	(567)			(2,713)	(1,685)	(1,028)		
	Graduated (%)	65.7	89.4	57.8		<0.01	87.5	95.3	74.8		<0.01
	Discharged (%)	28.3	10.1	34.4			10.9	4.3	21.7		
	REFRAD (%)	1.3	0.5	1.6			0.1	0.1	0.3		
	Unknown (%)	4.6	0.0	6.2			1.4	0.4	3.2		
12C EN	Trainees (n)	(90)	(33)	(57)			(344)	(212)	(132)		
	Graduated (%)	74.4	84.8	68.4		0.09	91.0	95.8	83.3		<0.01
	Discharged (%)	21.1	15.2	24.6			8.1	3.3	15.9		
	Unknown (%)	4.4	0.0	7.0			0.9	0.9	0.8		
	Trained (n)	(110)	(34)	(76)			(3,545)	(2,272)	(1,273)		
19D CAV	Graduated (%)	45.5	61.8	38.2		0.02	81.8	90.4	66.6		<0.01
	Discharged (%)	52.7	38.2	59.2			15.3	7.8	28.7		
	Unknown (%)	1.8	0.0	2.6			2.8	1.8	4.7		
	Trainees (n)	(88)	(34)	(54)			(1,303)	(910)	(393)		
	Graduated (%)	89.8	94.1	87.0		0.32	87.4	93.1	74.3		<0.01
19K AR	Discharged (%)	10.2	5.9	13.0			10.7	6.6	20.4		
	Unknown (%)	0.0	0.0	0.0			1.8	0.3	5.3		
	Trainees (n)	(1,195)	(429)	(766)			(3,107)	(2,064)	(1,043)		
	Graduated (%)	74.3	89.3	65.9		<0.01	86.7	93.8	72.6		<0.01
	Discharged (%)	19.8	7.9	26.5			11.3	5.1	23.6		
31B MP	REFRAD (%)	0.4	0.2	0.5			0.2	0.0	0.4		
	Unknown (%)	5.4	2.6	7.0			1.8	1.0	3.5		
	Trainees (n)	(2,459)	(776)	(1,683)			(27,658)	(18,029)	(9,629)		
	Graduated (%)	68.9	86.3	60.8		<0.01	84.8	91.0	73.4		<0.01
	Discharged (%)	25.8	11.9	32.3			13.7	8.2	23.8		
Overall	REFRAD (%)	0.7	0.3	0.9			0.1	0.0	0.2		
	Unknown (%)	4.6	1.5	6.0			1.4	0.7	2.7		

Source: Source: DMSS and ATRRS, August 2020; prepared by APHC IPB

Legend:

IN = infantry; EN = engineer; CAV = cavalry; AR = armor; MP = military police; REFRAD = Return from Active Duty

Notes:

^a χ^2 p-value compares Graduated Status (i.e., graduated vs. attrited) among “non-injured” vs. “injured” trainees; attrited includes Discharged, REFRAD, and Unknown categories.

Table 18 presents the odds of attriting from OSUT (i.e., discharge, REFRAD, and unknown, combined) for injured vs. non-injured women and men. Univariable and multivariable logistic regression were used to investigate the association of graduation status (i.e., attrited vs. graduated) with MSK injuries for the OSUTs, combined. Sex-specific multivariable models controlled age, component, educational status, and OSUT course. From the multivariable models, the odds of attriting were 3.8 (2.98–4.87) and 3.6 (3.36–3.88) times higher for injured women and men, respectively, compared to their non-injured peers.

Table 18. Association of Graduation Status (Attriting) from OSUT and MSK Injury, FY 2019

Univariable Model				
Sex	Injury Status	Odds Ratio	(95% CI)	p-value
Women	Non-injured	1.00		
	Injured (≥ 1 MSK injury)	3.88	(3.06–4.93)	<0.01
Men	Non-injured	1.00		
	Injured (≥ 1 MSK injury)	3.59	(3.35–3.86)	<0.01
Multivariable Model^a				
Sex	Injury Status	Odds Ratio	(95% CI)	p-value
Women	Non-injured	1.00		
	Injured (≥ 1 MSK injury)	3.81	(2.98–4.87)	<0.01
Men	Non-injured	1.00		
	Injured (≥ 1 MSK injury)	3.61	(3.36–3.88)	<0.01

Source: DMSS and ATRRS, August 2020; prepared by APHC IPB

CI = confidence interval

Notes:

^aMultivariable model controlled for OSUT course, age, component, and education

7. SUMMARY

This report summarized findings from systematic MSK injury surveillance conducted by the APHC IPB for the cohort of BCT and OSUT trainees that began training in FY 2019. Injury rates for the FY 2019 BCT and OSUT cohorts were compared to rates for the FY 2017 and FY 2018 cohorts. This report also summarizes the association of graduation status with MSK injuries for BCT and OSUT. To the best of our knowledge, this is the most complete report of injury surveillance findings for each of the BCT training centers and the individual OSUTs.

7.1 BCT Injury Surveillance Summary

The FY 2019 BCT cohort included 20,397 female trainees and 53,959 male trainees. Among these trainees, 53% of women and 28% of men had at least one MSK injury during BCT. By training center, the injury incidence ranged from 45% to 56% among women and from 20% to 34% among men.

The overall MSK injury rates for BCT (training centers, combined) were 23.1 per 100 person-months among women and 12.5 per 100 person-months among men. Injury rates for women and men in 2019 were not statistically different ($p>0.05$) compared to their respective rates in FYs 2017 and 2018.

The injury rate for women in FY 2019 was 1.9 times higher than the rate for men (FY 2019 RR (W/M): 1.85 (1.81–1.90)). This higher injury risk for BCT women compared to men was previously reported by APHC IPB in the annual injury surveillance reports for Army gender integration (APHC 2017b, 2019, 2020b, 2020c).

For women and men in BCT, 92% of MSK injuries were overuse injuries. Overall, the lower extremity accounted for 82% of MSK injuries among women and 76% of injuries among men. These findings are consistent with previous reports (APHC 2018a, Barbeau 2021, Molloy 2012, Springer 2011).

Overall, a statistically significantly larger proportion of men graduated BCT (93%) compared to women (86%; $p<0.001$). For both sexes, there was a statistically significant association of graduation status (i.e., attrition) and injury status. After controlling for age, component, and education, women with a MSK injury were 4.6 times more likely to attrit (i.e., not graduate) compared to non-injured women (OR: 4.55 (4.10–5.04); men with a MSK injury were 5.0 times more likely to attrit compared to non-injured men (OR: 5.02 (4.67–5.40)). These findings are consistent with previous reports (Hauret 2004, Knapik 2001, Niebuhr 2008, Swedler 2011).

7.2 OSUT Injury Surveillance Summary

The FY 2019 OSUT cohort included 2,459 women and 27,658 men. Considering the similarities in training between the 11B and 11C IN OSUTs, surveillance findings were reported for the combined 11B/C IN OSUTs.

Overall (OSUTs combined), 68% of women and 34% of men had at least one MSK injury during OSUT. Considering OSUTs separately, injury incidence ranged from 61% to 75% among women and from 30% to 38% among men.

With the variable length of training for OSUT courses, the preferred injury metric for comparing among the individual OSUTs is the injury rate. In FY 2019, injury rates for the individual OSUTs ranged from 14.7 to 23.9 per 100 person-months among women and from 7.6 to 11.7 per 100 person-months among men. The 31B OSUT had the lowest injury rates for both sexes. These OSUT injury rates are consistent with rates that were previously reported (APHC 2012, 2017b, 2019).

In each of the individual OSUTs, injury rates for women tended to decrease across FYs 2017 to 2019. But only in the 19D CAV and 31B MP OSUTs were their FY 2019 injury rates statistically significantly lower compared to FY 2017 (RR (2019/2017) < 1.0 ; $p<0.05$).

Injury rates for men in the individual OSUTs did not follow a consistent tendency across the three FYs. FY 2019 rates for men in the 11B/C IN, 19K AR, and 31B MP OSUTs were statistically significantly lower compared to rates in FYs 2017 (RR (2019/2017) < 1.0 ; $p<0.05$).

and 2018 (RR (2019/2018) <1.0; $p < 0.05$). Alternatively, FY 2019 injury rates in the 12C EN and 19D OSUTs were statistically significantly higher in FY 2019 compared to FY 2018 (RR (2019/2018) >1.0; $p < 0.05$).

In FY 2019, eight 11B/C IN OSUT classes followed the extended 22-week POI, while the remainder of their classes followed the legacy 14-week POI (only men trained in the 22-week classes). A statistically significantly larger proportion of men in 22-week classes was injured by the end of training (45% vs. 33%; $p < 0.01$). However, with the longer class duration, the overall injury rate for 22-week classes was statistically significantly lower than the rate for 14-week classes (9.1 vs. 10.3 per 100 person-months; $p < 0.01$). These findings are similar to those previously reported comparing injury metrics between the 14-week and 22-week classes of 11B/C IN OSUT (APHC 2018c, 2020a).

For the OSUTs combined, the injury rate for women in FY 2019 was 1.8 times the rate for men (RR (W/M): 1.81 (1.71–1.90)). This difference in rates is similar to the finding for BCT (BCT: RR (W/M): 1.85 (1.81–1.90)), and is consistent with previously reported findings for OSUT (APHC 2017b, 2019, 2020b).

Nearly 95% of MSK injuries among OSUT trainees (both sexes) were overuse injuries. The lower extremity accounted for 82% of MSK injuries among women and 76% of injuries among men. The second leading anatomic region of injury was the spine and back (7%) among women and the upper extremity (11%) among men. These findings have not been previously reported for the OSUTs, but they are consistent with findings presented in this report for BCT.

Overall, 69% of women ($n=1,694$) and 85% of men (23,466) graduated from their OSUT course. There was a statistically significant association for graduation status and injury status among both sexes. Compared to non-injured trainees, the odds of attriting from OSUT were 3.8 times higher for injured women (OR: 3.81 (2.98–4.87)) and 3.6 times higher for injured men (OR: 3.61 (3.36–3.88)). This association of OSUT graduation and injury has not been reported previously, but has been reported for BCT. Given the similarities in training and characteristics of the trainee cohorts (i.e., BCT and OSUT), this finding for OSUT is not unexpected.

8 CONCLUSIONS

This report summarized findings from the APHC IPB's systematic injury surveillance for the cohort of Army trainees who began BCT or OSUT in FY 2019. Injury rates for BCT and OSUT in FY 2019 were compared to their respective rates in FYs 2017 and 2018. This report also summarized findings for the association of graduation status and MSK injury status.

BCT injury rates for women and men in FY 2019 were not statistically different ($p > 0.05$) compared to their respective rates in FYs 2017 and 2018. OSUT Injury rates in FY 2019 were statistically significantly lower than rates in FYs 2017 and 2018 for men in three of the OSUTs (11B/C IN, 19K AR, and 31B MP) and women in the 31B MP OSUT. Alternatively, FY 2019 injury rates for men in the 12C EN and 19D CAV OSUTs were statistically significantly higher compared to FY 2018.

Injury rates for women in BCT and OSUT were 1.9 and 1.8 times higher, respectively, compared to rates for men in BCT and OSUT. During BCT and OSUT, men and women train together and experience similar injury hazards. Because extrinsic factors that affect injury risk are controlled during these courses, the nearly two times higher rates for women in BCT and OSUT are thought to reflect the intrinsic risks (i.e., physiologic and anatomic) associated with female gender.

Overuse injuries accounted for the largest proportion of MSK injuries in BCT (91%) and OSUT (94%), and primarily involved the lower extremity (BCT: 79%; OSUT: 77%). Mitigating risks for these injuries should be the focus for injury prevention efforts in IET.

Injuries have a significant impact on graduation outcomes in BCT and OSUT. Injured trainees were five times more likely to attrit from BCT and four times more likely to attrit from OSUT compared to non-injured trainees. These findings demonstrate the need for continued focus on injury prevention and monitoring during IET.

9 POINT OF CONTACT

The point of contact for this report is the APHC IPB. Questions may be directed to the IPB at usarmy.apg.medcom-aphc.mbx.injuryprevention@health.mil, commercial phone 410-436-4312, or DSN 584-4312.

Approved:

Michelle C. Chervak, MPH, PhD
Chief, Injury Prevention Branch

APPENDIX A

REFERENCES

- APHC. 2012. Epidemiological Report No. S.0007856-11, *The Soldier-Athlete Initiative: Program Evaluation of Athletic Trainers Compared to Musculoskeletal Action Teams in Initial Entry Training, Fort Leonard Wood, June 2010 – December 2011*. Prepared by Joseph J. Knapik, Bria Graham, Jacketta Cobbs, Diane Thompson, Ryan Steelman, Tyson Grier, Timothy Pendergrass, Nikki Butler, Janet Pappazis, Rodney Gonzalez, and Bruce H. Jones. Aberdeen Proving Ground, Maryland. <https://apps.dtic.mil/sti/pdfs/ADA586863.pdf>
- APHC. 2017a. Public Health Information Paper No. 12-01-0717, *A Taxonomy of Injuries for Public Health Monitoring and Reporting*. Prepared by Veronique D. Hauschild, Keith G. Hauret, Melissa Richardson, and Bruce H. Jones. Aberdeen Proving Ground, Maryland. <https://apps.dtic.mil/dtic/tr/fulltext/u2/1039481.pdf>
- APHC. 2017b. Public Health Report No. S.0047231-16, *Annual Assessment of Longitudinal Studies and Injury Surveillance for Gender Integration in the Army, 2016*. Prepared by Keith G. Hauret, Cindy Bush, Steve Rossi, Melissa Richardson, and Bruce H. Jones. Aberdeen Proving Ground, Maryland. <http://www.dtic.mil/dtic/tr/fulltext/u2/1037640.pdf>
- APHC. 2018a. Public Health Information Paper No. 12-01-0118, *Application of the Taxonomy of Injuries: Analysis of Army Recruit Injuries, CY 2016*. Prepared by Veronique D. Hauschild, Terrence Lee, Melissa Richardson, Keith Hauret, and Bruce H. Jones. Aberdeen Proving Ground, Maryland. <http://www.dtic.mil/dtic/tr/fulltext/u2/1049222.pdf>
- APHC. 2018b. Public Health Report No. S.0047229-18b, *Association of Performance on the Occupational Physical Assessment Test (OPAT), Injuries, and Attrition during Initial Entry Training – OPAT Phase 1*. Prepared by Keith G. Hauret, Ryan A. Steelman, Joseph R. Pierce, Joseph A. Alemany, Marilyn A. Sharp, Stephen A. Foulis, Jan E. Redmond, Maria C. Canino, Bruce S. Cohen, Michael S. McGurk, Whitfield B. East, and Bruce H. Jones. Aberdeen Proving Ground, Maryland. <https://apps.dtic.mil/dtic/tr/fulltext/u2/1061860.pdf>
- APHC. 2018c. Public Health Report No. S.0047239.3, *Comparison of Physical Fitness, Graduation, and Injuries between 14-week and 22-week Infantry One Station Unit Training Cycles: 13 July 2018 to 7 December 2018*. Prepared by Keith G. Hauret, Ryan A. Steelman, and Bruce H. Jones. Aberdeen Proving Ground, Maryland. <https://apps.dtic.mil/dtic/tr/fulltext/u2/1082916.pdf>
- APHC. 2019. *Injury Surveillance and Longitudinal Studies for Gender Integration in the Army: Third Annual Assessment, 2018*, Public Health Report No. S.0047783-18. Prepared by Keith G. Hauret, Melissa D. Richardson, Ashleigh K. McCabe, Bonnie J. Taylor, Esther O. Dada, Joseph R. Pierce, Steven A. Foulis, and Bruce H. Jones. Aberdeen Proving Ground, Maryland. <http://www.dtic.mil/dtic/tr/fulltext/u2/1082827.pdf>

- APHC. 2020a. Technical Report No. S.0047239-20, *Graduation and Injury Outcomes during 22-Week Infantry One Station Unit Training Cycles: Fiscal Years 2018 – 2019*. Prepared by Keith G. Hauret, Ryan A. Steelman, Ashleigh K. McCabe, and Michelle Canham-Chervak. Aberdeen Proving Ground, Maryland. <https://apps.dtic.mil/dtic/tr/fulltext/u2/1127259.pdf>
- APHC. 2020b. Public Health Report No. S.0047783-19, *Injury Surveillance and Longitudinal Studies for Gender Integration in the Army: Fourth Annual Assessment, 2019*. Prepared by Keith G. Hauret, Anna Schuh-Renner, Michelle Canham-Chervak, and Bruce H. Jones. Aberdeen Proving Ground, Maryland. <http://www.dtic.mil/dtic/tr/fulltext/u2/1097515.pdf>
- APHC. 2020c. Public Health Report No. S.0047783-20, *Injury Surveillance and Longitudinal Studies for Gender Integration in the Army: Fifth Annual Assessment, 2019*. Prepared by Keith G. Hauret, Anna Schuh-Renner, Ryan A. Steelman, Shamola Dye, Bonnie J. Taylor, Bruce H. Jones, and Michelle Canham-Chervak. Aberdeen Proving Ground, Maryland. <http://www.dtic.mil/dtic/tr/fulltext/u2/1121582.pdf>
- Bulzacchelli, Maria T., Sandra I. Sulsky, Lei Zhu, Sylvia Brandt, and Andrew Barenberg. 2017. *The Cost of Basic Combat Training Injuries in the US Army: Injury-Related Medical Care and Risk Factors, Final Technical Report*. Prepared for U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts. <https://apps.dtic.mil/sti/pdfs/AD1050457.pdf>
- Barbeau, Pauline, Alan Michaud, Candyce Hamel, Danielle Rice, Becky Skidmore, Brian Hutton, Chantelle Garritty, Danilo F. da Silva, Kevin Semeniuk, and Kristi B. Adamo. 2021. "Musculoskeletal Injuries among Females in the Military: A Scoping Review." *Military Medicine* 186(9-10): e903-e931. <https://doi.org/10.1093/milmed/usaa555>
- Department of the Army. 2020. Army Regulation 40-5, *Army Public Health Program*. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1006800
- Hauret, Keith G., Joseph K. Knapik, Jeffrey L. Lange, Heidi A. Heckel, Dana L. Coval, and David H. Duplesis. 2004. "Outcomes of Fort Jackson's Physical Training and Rehabilitation Program in Army Basic Combat Training: Return to Training, Graduation, and 2-Yer Retention." *Military Medicine* 169(7): 562-567. <https://doi.org/10.7205/milmed.169.7.562>
- Hauschild, Veronique D., Anna Schuh-Renner, Terrence Lee, Melissa D. Richardson, Keith Hauret, and Bruce H. Jones. 2019. "Using Causal Energy Categories to Report the Distribution of Injuries in an Active Population: An Approach Used by the U.S. Army." *Journal of Science and Medicine in Sport* 22(9): 997-1003. <https://doi.org/10.1016/j.jsams.2019.04.001>
- HQDA. 2016. Execution Order 097-16, *U.S. Army Implementation Plan 2016-01 (Army Gender Integration)*. Headquarters, Department of the Army, Washington, DC, 10 March 2016. https://dod.defense.gov/Portals/1/Documents/pubs/WISR_Implementation_Plan_Army.pdf

- Knapik, Joseph J., Michelle Canham-Chervak, Keith Hauret, Edward Hoedebecke, Mary Jo Laurin, and Judith Cuthie. 2001. "Discharges during US Army Basic Combat Training: Injury Rates and Risk Factors." *Military Medicine* 166(7):641-647. <https://doi.org/10.1093/milmed/166.7.641>
- MEDCOM. 2010. Operation Order 10-46, *(Implementation of the Initial Entry Training Soldier-Athlete Initiative)*. Headquarters, U.S. Army Medical Command, Fort Sam Houston, Texas, 19 July 2010.
- Molloy, Joseph M., David N. Feltwell, Shawn J. Scott, and David W. Niebuhr. 2012. "Physical Training Injuries and Interventions for Military Recruits." *Military Medicine* 177(4):553-558. <https://doi.org/10.7205/MILMED-D-11-00329>
- Niebuhr, David W, Christine T. Scott, Timothy E. Powers, Yuanzhang Li, Weiwei Han, Amy M. Millikan, and Margot R. Krauss. 2008. "Assessment of Recruit Motivation and Strength Study: Preaccession Physical Fitness Assessment Predicts Early Attrition." *Military Medicine* 173(6): 555-562. <https://doi.org/10.7205/MILMED.173.6.555>
- Springer Barbara A., and Amy E. Ross. 2011. *Musculoskeletal Injuries in Military Women*. Borden Institute Monograph Series. Government Printing Office: Washington DC.
- Swedler, David I., Joseph J. Knapik, Kelly W. Williams, Tyson L. Grier, and Bruce H. Jones. 2011. "Risk Factors for Medical Discharge from United States Army Basic Combat Training." *Military Medicine* 176(10): 1104-1110. <https://doi.org/10.7205/MILMED-D-10-00451>
- TRADOC. 2019. TRADOC Regulation 350-6, *Enlisted Initial Entry Training Policies and Administration*. Headquarters, U.S. Army TRADOC, Fort Eustis, Virginia. <https://adminpubs.tradoc.army.mil/regulations/TR350-6.pdf>

GLOSSARY

Section I Abbreviations

AFHSD	Armed Forces Health Surveillance Division, Defense Health Agency
AIT	Advanced Individual Training
APHC	U.S. Army Public Health Center
AR	Armor
ATRRS	Army Training Requirements and Resources System
BCT	Basic Combat Training
BMI	body mass index: kilograms per meter of height squared (kg/m ²)
CAV	Cavalry scout
CI	confidence interval
CIMT	Center for Initial Military Training
COA	course of action
DA	U.S. Department of the Army
DMSS	Defense Medical Surveillance System
EN	Engineer
EXORD	Execution Order
FY	fiscal year
HQDA	Headquarters, U.S. Department of the Army
ICD-10-CM	International Classification of Diseases, 10 th Revision, Clinical Modification
IET	initial entry training
IET SAI	Initial Entry Training Soldier-Athlete Initiative
IN	infantry
IPB	Injury Prevention Branch

M	men
MEDCOM	U.S. Army Medical Command
MOS	military occupational specialty
MSK	musculoskeletal
OR	Odds Ratio
OSUT	One Station Unit Training
p-mos	person-months
POC	point of contact
POI	program of instruction
REFRAD	return from active duty
RR	rate ratio
TCM	TRADOC Capability Manager
TRADOC	U.S. Army Training and Doctrine Command
TRANSPROC	Transition Point Processing System
W	women

Section II Definitions

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

Cumulative Injury Incidence: proportion of trainees with one or more MSK injuries during BCT or OSUT.

Injury Rate (IET): number of trainees with “one or more injuries” per 100 trainees at risk per month (injured per 100 person-months). Injury rates allow comparison of injuries that accrue over varying lengths of follow-up, for example, during different training courses (e.g., BCT, OSUTs) or different years with fluctuating populations of trainees.

Injury Rate Ratio (RR) (Group 1 / Group 2): ratio calculated by dividing the injury rate for Group 1 by the injury rate for Group 2. For example, an injury RR (W / M) equal to 1.5 indicates that the injury rate for women was 1.5 times higher (50% higher) than the rate for men. A 95% CI that does not include the value 1.0 in the range of values indicates that the RR is a statistically significant finding ($p < 0.05$).

Odds Ratio (OR): a measure of association between an exposure and an outcome.

Overuse Injury: 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).

Traumatic Injury: 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 (19D CAV)

19K M1 Armor crewmember (19K AR)

Engineer (12 series)

12B Combat engineer (12B EN)

12C Bridge crewmember (12C EN)

Infantry (11 series)

11B Infantry (11B IN)

11C Indirect Fire Infantry (11C IN)

Military Police (31 series)

31B Military Police (31B MP)