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Hauret, Keith G; Steelman, Ryan A; McCabe, Ashleigh K; Canham-Chervak, Michelle

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14. ABSTRACT
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Graduation and Injury Outcomes during 22-Week Infantry One Station Unit Training Cycles: Fiscal Years 2018-2019

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Contributing Authors

Keith G. Hauret, MSPH, MPT[1]

Ryan A. Steelman, MPH[2]

Ashleigh K. McCabe, MPH[2]

Michelle C. Chervak, PhD, MPH[1]

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

[2] Army Satellite, Armed Forces Health Surveillance Branch, Defense Health Agency

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EXECUTIVE SUMMARY
TECHNICAL REPORT NO. S.0047239-20
GRADUATION AND INJURY OUTCOMES DURING 22-WEEK INFANTRY ONE STATION UNIT TRAINING CYCLES: FISCAL YEARS 2018 TO 2019, MARCH 2021

1. PURPOSE

This report summarizes findings from an assessment by the U.S. Army Public Health Center (APHC) Injury Prevention Program (IPP) of the extended 22-week training cycle for Infantry (IN) One Station Unit Training (OSUT) at the Maneuver Center of Excellence (MCoE), Fort Benning, Georgia. Findings are presented for two primary outcomes: (1) final graduation status from IN OSUT and (2) musculoskeletal (MSK) injuries for which trainees sought medical care. Outcomes are compared between three training groups of IN OSUT: (1) two 14-week training cycles that began training August 2018, (2) the first two 22-week training cycles (hereafter referred to as "pilot cycles") that began training July 2018, and (3) six additional 22-week training cycles (hereafter referred to as "follow-on cycles") that began training during Fiscal Year (FY) 2019. Comparisons between pilot and follow-on cycles were of primary interest to MCoE.

2. BACKGROUND

Based on recommendations from the Department of Defense (DoD) "Close Combat Strategic Portfolio Review" in 2017, the MCoE and Infantry School at Fort Benning expanded IN OSUT from 14 weeks to 22 weeks in July 2018 (Directorate of Training and Doctrine (DOTD) 2018). The revised program expanded IN-specific training to bolster readiness, lethality, and proficiency of Soldiers before arriving at their first unit of assignment (Suits 2018, Gatchell 2018).

In 2019, the APHC IPP reported the first assessment of the extended 22-week IN OSUT training cycle (APHC 2019). In that report, training outcomes (physical fitness, graduation, and MSK injuries) were compared between the 14-week cycles and pilot cycles (22 weeks). All trainees in the 14-week and pilot cycles were male. Primary findings from the first assessment were:

- Larger proportion of trainees graduated in pilot cycles (92%) compared to 14-week cycles (85%);
- MSK injury rates after 14 weeks of training were similar in pilot cycles and 14-week cycles; and
- After 22 weeks, trainees in pilot cycles sustained 34% more MSK injuries and 21% more trainees had an injury compared to their first 14 weeks of training.

After the first assessment of the 22-week pilot cycles, MCoE made modifications to the 22-week plan of instruction. In February 2020, MCoE requested that APHC IPP conduct a second assessment in order to compare training outcomes (i.e., graduation and injuries) for six additional 22-week training cycles of male trainees conducted in FY 2019 (i.e., follow-on cycles) to the previously evaluated 14-week cycles and pilot cycles.

3. FINDINGS

- Graduation in pilot cycles (95%) was significantly higher than graduation in 14-week cycles (85.4%; $p<0.05$) and follow-on cycles (78%; $p<0.05$).

- After the first 14 weeks of training, follow-on cycles had 1.5 times higher rates for overuse and all MSK injuries and compared to the 14-week and pilot cycles. Forty-two percent of trainees in follow-on cycles had a MSK injury, compared to 30% in 14-week cycles and 31% in pilot cycles ($p<0.05$, all comparisons).

- After 22 weeks, follow-on cycles had 1.4 times higher rates for overuse and all MSK injuries. Forty-five percent of trainees in follow-on cycles had a MSK injury compared to 38% in pilot cycles ($p<0.05$, all comparisons) after 22 weeks.

- After 22 weeks, a larger proportion of trainees in follow-on cycles had at least one bone stress injury (BSI; 9%) compared to pilot cycles (5%; $p<0.05$). There were no differences in the proportion of trainees that sustained a traumatic fracture among the three training groups.

- Even though the extended 22-week cycles allowed more time for trainees to recover from BSIs, the proportion of trainees with BSIs that graduated in pilot and follow-on cycles was similar to the proportion in 14-week cycles.

- Results represent an observational assessment of differences in training outcomes using existing attrition and injury data. The analysis had the following limitations:

    - There were differences in demographics among trainees in pilot cycles compared to 14-week cycles and follow-on cycles. Compared to 14-week cycles and follow-on cycles, pilot cycles had significantly higher proportions of trainees with Military Occupational Specialty (MOS) 18X Special Forces (18%), higher rank (E-4; 13%), and four years of college (12%). Thirty-two percent of trainees in the14-week cycles were in the National Guard compared to only 9% and 8% in the pilot and follow-on cycles, respectively.

    - Trainees in pilot cycles also had significantly higher mean performance on all four events of the Occupational Physical Assessment Test (OPAT) ($p<0.05$ for each event) compared to trainees in 14-week cycles and follow-on cycles. This indicates that pilot cycle trainees, at baseline, had higher levels of (1) upper and lower body muscular power (Seated Power Throw (SPT) and Standing Long Jump (SLJ), respectively), (2) lower body muscular strength (Strength Deadlift (SDL), and (3) aerobic capacity (Interval Aerobic Run (IAR)).

4. CONCLUSIONS

- The APHC IPP compared graduation and injury outcomes among three training groups of IN OSUT: (1) two 14-week cycles from FY 2018 (legacy 14-week cycles), (2) two pilot cycles from FY 2018 (22-week cycles), and (3) six follow-on cycles from FY 2019 that trained for 22 weeks. Follow-on cycles had significantly lower graduation (78%) compared to 14-week cycles (88%) and pilot cycles (95%). After 14 weeks of training, follow-on cycles had significantly higher (1.5 times higher) MSK injury rates compared to 14-week cycles and pilot cycles. After 22 weeks of training, the MSK injury rate for follow-on cycles was still significantly higher (1.4 times higher) than the MSK injury rate for pilot cycles.

- It was beyond the scope of this assessment to examine all potential factors that may have been associated with lower graduation and higher injury rates in follow-on cycles. We noted, however, differences in demographics and entry level fitness in pilot cycles compared to 14-week cycles and follow-on cycles. Further investigation is required to determine if these differences are meaningful in the context of graduation and injuries during OSUT or longitudinal health and physical fitness of IN Soldiers in operational units.

- There are many other training- and performance-related outcomes of IN OSUT that have been, or will be, evaluated by others to determine the overall impact of the extended 22-week training cycle. These outcomes will be evaluated not only during OSUT but also in longitudinal studies that follow graduates into their first units of assignment. These future evaluations, along with this current report, will provide objective evidence to inform leaders of the operational impact of the extended IN OSUT training cycle.

Technical Report No. S.0047239-20, Graduation and Injury Outcomes during 22-Week Infantry One Station Unit Training Cycles: Fiscal Years 2018-2019, March 2021

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GRADUATION AND INJURY OUTCOMES DURING 22-WEEK INFANTRY ONE STATION UNIT TRAINING CYCLES: FISCAL YEARS 2018 TO 2019, MARCH 2021

1. PURPOSE

This report summarizes findings from an assessment by the U.S. Army Public Health Center (APHC) Injury Prevention Program (IPP) of the extended 22-week training cycle for Infantry (IN) One Station Unit Training (OSUT) at the Maneuver Center of Excellence (MCoE), Fort Benning, Georgia. Findings are presented for two primary outcomes: (1) final graduation status from IN OSUT and (2) musculoskeletal (MSK) injuries for which trainees sought medical care. Outcomes are compared between three training groups of IN OSUT: (1) two 14-week training cycles that began training August 2018, (2) the first two 22-week training cycles (hereafter referred to as "pilot cycles") that began training July 2018, and (3) six additional 22-week training cycles (hereafter referred to as "follow-on cycles") that began training during Fiscal Year (FY) 2019. Comparisons between pilot and follow-on cycles were of primary interest to MCoE.

2. REFERENCES

Appendix A provides the references cited within this document.

3. AUTHORITY

The APHC IPP provides technical and support capabilities to enhance Army readiness by identifying, assessing, and providing recommendations for solutions to legacy, current, and emerging public health issues to include monitoring health outcomes and health hazards at the population level (Department of the Army 2020).

4. SUMMARY

In 2019, the APHC IPP conducted its first assessment of the extended 22-week IN OSUT training cycle. In that assessment, the IPP compared training outcomes between two pilot cycles (first cycles that conducted the 22-week training cycle) and two 14-week cycles that conducted the 14-week OSUT training cycle. All trainees in the compared training cycles were male. Primary findings from the first assessment were:

- Pilot cycles had significantly higher graduation compared to the 14-week cycles,
- Pilot and 14-week cycles had similar injury rates after 14 weeks of training, but by the end of training (22 weeks), a larger proportion of pilot trainees were injured.

After the first assessment of the 22-week pilot cycles, MCoE made modifications to the 22-week plan of instruction. In February 2020, MCoE requested that APHC IPP conduct a second assessment in order to compare training outcomes (i.e., graduation and MSK injury rates) of six

additional 22-week cycles of male trainees to those observed during the previously evaluated 14-week and pilot cycles **(Table 1)**.

4.1 Trainee Physical Attributes and Demographics

Trainees in follow-on cycles were, on average, six months older than trainees in pilot cycles ($p<0.05$) **(Table 2)**.

Pilot cycles had significantly higher percentages of trainees that enlisted for the 18X Special Forces Military Occupational Specialty (MOS) (18%), started with higher rank (E-4; 13%), and had four years of college (12%) compared to 14-week and follow-on cycles. A higher percentage of trainees in 14-week cycles (32%) were in the National Guard **(Table 3)**.

4.2 Performance on the Occupational Physical Assessment Test

Trainees in pilot cycles had significantly higher mean performance on each of the Occupational Physical Assessment Test (OPAT) events ($p<0.05$ for each event) compared to 14-week and follow-on cycles **(Table 4)**. This indicates that pilot cycle trainees had higher levels of (1) upper and lower body muscular power (Seated Power Throw (SPT) and Standing Long Jump (SLJ), respectively), (2) lower body muscular strength (Standing Dead Lift (SDL)), and (3) aerobic capacity (Interval Aerobic Run (IAR)) when they started training. Whether or not these differences are meaningful in the context of IN OSUT or IN Soldiers remains to be determined. Prior studies reported that trainees with lower levels of aerobic capacity at the beginning of initial entry training have a higher injury risk during training compared to trainees with higher aerobic capacity (APHC 2018b, Knapik 2001). The higher aerobic capacity of trainees in the pilot cycles may be one of the factors that resulted in lower injury rates in the pilot cycles.

4.3 Graduation Status

Graduation in pilot cycles (95%) was significantly higher than 14-week cycles (85.4%; $p<0.05$) and follow-on cycles (78%; $p<0.05$) **(Table 5)**.

4.4 Injury Rates after 14 Weeks of Training

After 14 weeks of training, trainees in follow-on cycles had 1.5 times higher musculoskeletal (MSK) injury rates for overuse and all MSK injuries compared to those in 14-week and pilot cycles **(Table 6)**. Forty-two percent of trainees in follow-on cycles had a MSK injury, compared to 31% in pilot cycles and 30% in 14-week cycles ($p<0.05$, all comparisons).

Trainees in follow-on cycles also had a 1.8 times higher injury rate for all non-MSK injuries compared to those in the pilot cycles ($p<0.05$).

4.5 Injury Rate after 22 Weeks of Training

After 22 weeks, trainees in follow-on cycles exhibited 1.4 times higher injury rates for overuse and all MSK injuries **(Table 7)**. Forty-five percent of follow-on trainees had a MSK injury, compared to 38% of trainees in pilot cycles ($p<0.05$, all comparisons).

Trainees in follow-on cycles also had a 1.8 times higher injury rate for all non-MSK injuries compared to those in the pilot cycles ($p<0.05$).

4.6 Injury Types and Anatomic Location

Overuse MSK injuries accounted for 94% to 95% of MSK injuries by the end of training in 14-week, pilot, and follow-on cycles **(Table 8)**.

Approximately three-fourths of overuse MSK injuries involved the lower extremity (14-week cycles: 78%; pilot cycles: 79%; follow-on cycles: 78%) **(Table 9)**.

4.7 Bone Stress Injuries and Traumatic Fractures

After 22 weeks, a larger proportion of trainees in follow-on cycles had at least one bone stress injury (BSI) (9%) compared to pilot cycles (5%; $p<0.05$) **(Table 10)**. There were no differences in the proportion of trainees that sustained a traumatic fracture among the three training groups.

The hip accounted for the largest proportions (32 to 35%) of BSIs among the three training groups **(Table 11)**. Due to the morbidity that can result from BSIs of the hip, medical providers follow clinical practice guidelines to evaluate and treat trainees that complain of hip-related pain or disability. Only one of the 113 hip BSIs required surgical intervention. This is a positive outcome indicator showing that hip BSIs are being identified and treated early.

4.8 Graduation Status of Trainees with Bone Stress Injury

When comparing between the training groups, the proportions of trainees with a BSI that successfully graduated OSUT were not significantly different ($p>0.05$) **(Table 12)**. Even though the extended IN OSUT cycles allowed more time for injured trainees to recover from these injuries, the proportion of trainees with BSIs that graduated did not increase in these cycles. Further investigation is required to identify training- and treatment-related factors that may enable more trainees with BSIs to graduate from IN OSUT.

4.9 Injury Encounters by Medical Provider Type

Overall, the two leading medical provider types (i.e., specialties) for injury-related encounters (i.e., outpatient and inpatient) were Physical Therapists (PTs) and Athletic Trainers (ATs). Combined, they accounted for 86% of musculoskeletal (MSK) injury encounters (PTs: 47%; ATs: 39%) and 22% of non-MSK injury encounters (PTs: 0%; ATs: 22%).

5. BACKGROUND

In 2017, the Department of Defense (DoD) conducted the "Close Combat Strategic Portfolio Review" to identify the most promising investment opportunities to improve the military's close-combat effectiveness and survivability (Roper 2018). The DoD-level review sought to identify close-combat capabilities that would be critical in future conflicts. A finding from that review was the need to "enhance the lethality and resiliency of Soldiers graduating from initial training" (Directorate of Training and Doctrine (DOTD) 2018).

In response to this finding, the MCoE and Infantry School at Fort Benning began a combined effort with the 198th Infantry Brigade and U.S. Army Training and Doctrine Command (TRADOC) to develop a longer, more rigorous and comprehensive training program for IN Soldiers (Suits 2018). The revised training program is 8 weeks longer (i.e., 22-week training cycle) and expands IN-specific training to bolster readiness, lethality, and proficiency before Soldiers arrive at their first unit of assignment (Suits 2018, Gatchell 2018). In July 2018, the pilot cycles were the first training cycles to implement the extended training cycle.

In 2018, the Chief, Training and Education Development Directorate and the Chief, Program Evaluation Office, DOTD at the MCoE, requested support from the APHC IPP to conduct an assessment of the extended 22-week training cycle for IN OSUT. The IPP compared training outcomes (e.g., physical fitness, graduation, and injuries) between (1) two 14-week training cycles that began training 31 August 2018 (14-week cycles) and (2) two 22-week training cycles that began training 13 July 2018 (pilot cycles). All trainees in these cycles were male. Primary findings from this first evaluation were as follows (APHC 2019):

- Trainees in pilot cycles had significantly higher mean performance on all three events of the final Army Physical Fitness Test and higher average total APFT score (age-adjusted) compared to trainees in 14-week cycles. But in spite of pilot trainees having approximately 6 additional weeks of training before taking the final APFT, the mean differences in event performance between 14-week and pilot trainees were smaller on the final APFT compared to their first (initial) APFT. In other words, 14-week trainees improved more than pilot trainees between the first and final APFTs, most likely due to the lower starting fitness level of trainees in 14-week cycles.

- Overall, graduation success was higher in pilot cycles (92%) compared to 14-week cycles (85%; $p<0.01$).

- After 14 weeks of training, MSK injury rates were similar for 14-week and pilot cycles (13 injuries per 100 trainees per month; $p=0.91$).

- After 22 weeks, trainees in pilot cycles sustained 34% more MSK injuries, and 21% more trainees had an injury compared to their first 14 weeks of training.

After the first assessment of the 22-week pilot cycles, MCoE made modifications to the 22-week plan of instruction. In February 2020, the MCoE requested support from the APHC IPP to conduct a second assessment of the 22-week IN OSUT training cycle. MCoE asked the IPP to compare training outcomes (i.e., graduation and MSK injury) for six 22-week training cycles conducted in FY 2019 (follow-on cycles) to the previously evaluated 14-week and pilot cycles

from the first assessment **(Table 1)**. None of these training cycles had female trainees (all trainees were male).

Table 1. Infantry One Station Unit Training Groups

Training Group	Number of Training Cycles	Number of Trainees	Training Duration	Training Start Date
14-week Cycles	2	470	14 weeks	31 August 2018
Pilot Cycles	2	400	22 weeks	13 July 2018
Follow-on Cycles	6	1,313	22 weeks	FY 2019[a]

Notes:
[a]Follow-on cycle start dates: 4 January 2019, 15 March 2019, 29 March 2019, 12 July 2019, 26 July 2019, and 9 August 2019

6. METHODS

6.1 Data Sources

- For 14-week and pilot cycles, the IPP used training rosters, demographics, and physical performance data (OPAT) from the first assessment that was conducted in 2018 and reported in 2019 (APHC 2019). Because a few trainees in pilot and 14-week cycles were still training (i.e., re-starts and hold-overs) when the first assessment was reported in 2019, the IPP updated data for final graduation status and injuries for this current evaluation and report. This resulted in small differences for these outcomes in this report compared to the 2019 report.

- Chief, Program Evaluation Office, MCoE provided rosters of trainees in the six follow-on cycles.

- The APHC IPP downloaded rosters with trainees' demographics (age, rank, and MOS) and final graduation status from the Army Training Requirements and Resource System (ATRRS).

- U.S. Army Human Resource Command provided rosters that included height, weight, and OPAT performance data for trainees in follow-on cycles. Trainees took the OPAT during their recruitment phase before shipping to Fort Benning for IN OSUT.

- Armed Forces Health Surveillance Branch (AFHSB), Defense Health Agency (DHA) provided additional demographics and injury-related medical encounters with standardized diagnosis codes from the Defense Medical Surveillance System (DMSS). The encounter data also included a variable that identified the medical or specialty clinic that provided the medical care.

- The EpiData Center, Navy and Marine Corps Public Health Center provided radiographic reports for all suspected bone stress injuries (BSIs) and traumatic fractures of the lower extremities.

6.2 Injury Definitions

In 2017, the APHC IPP developed a comprehensive taxonomy of injuries to uniformly describe and categorize injuries for future injury surveillance, program evaluations, and field investigations (APHC 2017, APHC 2018a). The IPP used this taxonomy, based on standardized injury diagnosis codes (i.e., International Classification of Diseases, 10th Revision, Clinical Module), to identify and categorize injuries. Definitions of injury, injury categories, and injury types used in this evaluation are as follows:

- Injury: Any physical damage to the body that resulted from the transfer of mechanical energy to the body. Injuries from transfers of mechanical energy are categorized by the body system that is damaged (e.g., musculoskeletal system versus (vs.) other body systems) and by injury type (i.e., “acute” or “overuse”).

- MSK Injury: Physical damage to any of the tissues that comprise the body’s musculoskeletal system (e.g., bones, ligaments, muscles, and tendons).

- Non-MSK Injury: Physical damage to tissues that comprise any system of the body (e.g., neurologic, integumentary (skin), and circulatory), excluding the MSK system. Examples of non-MSK injuries are injuries involving the neurological system such as “rucksack” nerve palsy and sciatica, as well as injuries involving the integumentary system such as skin abrasions, lacerations, blisters, and contusions.

- Acute MSK Injury: Physical damage to the body that results from a single large transfer of energy such as occurs in a traumatic event such as a vehicle accident, falling from heights, being struck by an object, or “twisting” an ankle while running. Examples of acute MSK injuries are joint sprains, tendon ruptures, and traumatic fractures.

    - Traumatic Fracture: A sub-type of acute MSK injury in which there is a physical break in bone or cartilage resulting from a physical trauma.

- Overuse MSK Injury: Physical damage to the body from the cumulative effects of repeated exposures to small amplitude energy transfers that gradually cause physical damage (i.e., cumulative effects of microtrauma). This occurs in activities such as running, road marching, and repeated lifting, throwing, pushing or pulling. Examples of overuse injuries are tendonitis, muscular strains, “runner’s knee,” “shin splints,” and BSI (e.g., stress reactions and stress fractures).

    - Bone Stress Injury (BSI): A sub-type of overuse MSK injury in which the bone structural integrity fails after being subjected to repeated tensile or compressive forces (microtraumatic forces), none of which are large enough individually to

cause the bone to fail. These injuries are commonly referred to as stress reactions and stress fractures.

- Injury Rate**:** Number of injuries per 100 trainees per month (e.g., 100 trainee-months).

- Injury Rate Ratio (RR): Ratio of the injury rates for any two of the training groups **(Table 1)** (e.g., RR=injury rate in group 1 ÷ injury rate in group 2). In this example, RR values greater than "1" indicate that the injury rate for group 1 was higher than the rate for group 2. Values less than "1" indicate that the injury rate for group 1 was lower than the rate for group 2.

6.3 Data Analysis

The APHC IPP identified injuries based on the standardized diagnosis codes in the electronic health record (EHR). It then categorized injuries by injury category (i.e., MSK and non-MSK), type (i.e., acute and overuse), diagnosis, and anatomic location according to the injury taxonomy (APHC 2017, APHC 2018a).

An IPP staff member (KH) reviewed radiographic results from radiographs (x-rays), bone scans, and magnetic resonance imaging (MRI) for all suspected BSIs. All BSIs with radiographic confirmation (Grade 1–4) (Rohena-Quinquilla, 2018) that were consistent with physical exam were included in this analysis.

All data were linked and merged, and statistical analyses were conducted using IBM SPSS® Statistics for Windows®, Version 25, SAS® Version 9.2, or Open Source Epidemiologic Statistics for Public Health, version 3.01. Significance level was 5% ($p \leq 0.05$) for all analyses.

Descriptive statistics (i.e., central tendency metrics, percentages, and frequencies) were used to describe trainee characteristics, performance on the OPAT, graduation status, and injury occurrences. Chi-square (χ^2) tests of proportions were used to compare equality of proportions (nominal data) and independent one-way ANOVA with Tukey post-hoc HSD comparisons were used to evaluate differences in means of continuous data. Injury rates between training groups were compared using RRs with 95% confidence intervals (CI) and p-values.

7. FINDINGS

7.1 Trainee Physical Attributes and Demographics

All trainees in the three training groups were men. **Table 2** compares the mean (± standard deviation (SD)) for age, height, weight, and body mass index (BMI ($kg*m^{-2}$)) among trainees in 14-week (n=470), pilot (n=400), and follow-on cycles (n=1,313). The mean age of trainees in follow-on cycles was significantly higher (0.6 years older ($p<0.05$)) than pilot cycles. There were no other statistically significant differences in physical attributes by training group.

Table 2. Trainee Physical Attributes by Training Group

Physical Attributes	Training Group					
	14-week Cycles (14 weeks) (n=470)		Pilot Cycles (22 weeks) (n=400)		Follow-on Cycles (22 weeks) (n = 1,313)	
	Mean	SD	Mean	SD	Mean	SD
Age (yr)	20.9	2.9	20.6	2.8	21.1‡	3.2
Height (in)	69.2	2.7	69.5	2.7	69.4	2.6
Weight (lb)	168.1	29.3	169.8	26.7	169.6	28.3
BMI ($kg*m^{-2}$)	24.6	3.6	24.7	3.4	24.7	3.5

Notes:
‡ Significant difference (ANOVA, p≤0.05) comparing mean value between follow-on and pilot cycles
Legend: SD=standard deviation; yr=years; in=inches; lb=pounds; BMI=body mass index; kg=kilograms; m=meters

Table 3 compares the distributions of trainee demographics between the three training groups. Compared to 14-week and follow-on cycles, pilot cycles had larger proportions of trainees that enlisted for the 18X MOS (Special Forces; 18%), started with higher rank (E-4; 13%), and had four years of college ($p<0.05$ for each comparison). 14-week cycles had a significantly higher percentage of National Guard trainees compared to pilot ($p<0.05$) and follow-on cycles ($p<0.05$).

Table 3. Trainee Demographic Characteristics by Training Group[a]

Demographic Characteristic		Training Group			Training Group Comparisons		
		14-week Cycles (n=470)	Pilot Cycles (n=400)	Follow-on Cycles (n=1,313)	Pilot vs. 14-week	Follow-on vs. 14-week	Follow-on vs. Pilot
		n (%)	n (%)	n (%)	p-value[b]	p-value[b]	p-value[b]
MOS	11B	150 (31.9)	36 (9.0)	73 (5.6)	<0.05	<0.05	<0.05
	11X	320 (68.1)	291 (72.8)	1,135 (86.4)			
	11C	0 (0.0)	0 (0.0)	26 (2.0)			
	18X	0 (0.0)	73 (18.3)	79 (6.0)			
Rank	E-1	305 (64.9)	202 (50.5)	900 (68.5)	<0.05	<0.05	<0.05
	E-2	120 (25.5)	117 (29.3)	278 (21.2)			
	E-3	25 (5.3)	29 (7.3)	77 (5.9)			
	E-4	17 (3.6)	52 (13.0)	58 (4.4)			
	E-5	3 (0.6)	0 (0.0)	0 (0.0)			
Component	Active	322 (67.9)	364 (91.0)	1,214 (92.5)	<0.05	<0.05	0.52
	National Guard	152 (32.1)	36 (9.0)	98 (7.5)			
	Reserve	0 (0.0)	0 (0.0)	1 (0.1)			
Prior Service	Yes	9 (1.9)	12 (3.0)	28 (2.1)	0.58	0.56	0.38
	No	461 (98.1)	388 (97.0)	1,282 (97.6)			
	Unknown	0 (0.0)	0 (0.0)	3 (0.2)			
Education	11th Grade	29 (6.2)	3 (0.8)	12 (0.9)	<0.05	<0.05	<0.05
	12th Grade	408 (86.8)	341 (85.3)	1,218 (92.8)			
	College (1-3 yr)	17 (3.6)	7 (1.8)	30 (2.3)			
	College (≥4 yr)	16 (3.4)	49 (12.3)	53 (4.1)			
Marital Status	Single	431 (91.7)	380 (95.0)	1,212 (92.3)	0.15	0.92	0.17
	Married	36 (7.7)	19 (4.8)	93 (7.1)			
	Divorced	3 (0.6)	1 (0.3)	8 (0.6)			

Note:

[a] All trainees in the three training groups were men

[b] p-value χ^2 test of proportions

7.2 Performance on the Occupational Physical Assessment Test

Table 4 compares the mean OPAT event performance by training group. Trainees took the 4-event OPAT during the recruitment process before shipping to Fort Benning for IN OSUT. As required for IN OSUT, all trainees met or exceeded the Black (Heavy) performance standard on each event. On each event, the mean performance by pilot cycle trainees was significantly higher than the mean for trainees in 14-week or follow-on cycles ($p<0.05$ for each comparison). In other words, compared to trainees in 14-week and follow-on cycles, pilot cycle trainees had significantly higher levels of (1) upper and lower body muscular power (seated power throw SPT and SLJ, respectively), (2) lower body muscular strength (SDL), and (3) aerobic fitness (IAR) prior to starting IN OSUT.

Table 4. Occupational Physical Assessment Test Event Performance by Training Group

	Training Group					
	14-week Cycles (n=470)		Pilot Cycles (n=400)		Follow-on Cycles (n=1,313)	
OPAT Event	Mean	SD	Mean	SD	Mean	SD
Seated Power Throw (SPT) (cm)	583.0	88.2	606.6 †	90.3	591.8 ‡	88.4
Standing Long Jump (SLJ) (cm)	201.2	28.5	214.2 †	29.7	204.6 †, ‡	27.5
Standing Dead Lift (SDL) (lb)	184.2	26.2	193.9 †	26.4	189.2 †, ‡	26.1
Interval Aerobic Run (IAR) (shuttles)	49.6	10.2	54.6 †	15.9	49.9 ‡	11.3

Notes:
† Significant difference (ANOVA, $p\leq0.05$) comparing mean performance vs. 14-week cycles
‡ Significant difference (ANOVA, $p\leq0.05$) comparing mean performance vs. pilot cycles
Legend:
OPAT=Occupational Physical Assessment Test; cm=centimeters; lb=pounds; SD=standard deviation.

7.3 Graduation Status

Table 5 summarizes and compares final graduation status among trainees in 14-week, pilot, and follow-on cycles. Trainees that did not graduate with their training unit were followed until they eventually graduated or were discharged (e.g., discharged, absent without leave [AWOL], return from active duty [REFRAD]). As of 13 March 2020, 19 trainees that started in one of the follow-on cycles were still in a training status in a different training unit (e.g., re-start, hold-over) according to ATRRS.

The proportion of trainees that graduated IN OSUT ranged from 78% (follow-on cycles) to 95% (pilot cycles). A significantly smaller proportion of trainees in follow-on cycles graduated compared to 14-week ($p<0.05$) or pilot cycles ($p<0.05$).

Table 5. Graduation Status by Training Group

Graduation Status	Training Group			Training Group Comparisons		
	14-week Cycles (n=470)	Pilot Cycles (n=400)	Follow-on Cycles (1,313)	Pilot vs. 14-week	Follow-on vs. 14-week	Follow-on vs. Pilot
	n (%)	n (%)	n (%)	p-value[a]	p-value[a]	p-value[a]
Graduates	410 (87.2)	378 (94.5)	1,027 (78.2)			
Non-Graduates	60 (12.8)	22 (5.5)	267 (20.3)	<0.05	<0.05	<0.05
Still in Training[b]	0 (0.0)	0 (0.0)	19 (1.4)			

Notes:
[a] p-value χ^2 test of proportions
[b] Still in training: Trainees with no final disposition in ATRRS as of March 13, 2020.

7.4 Injury Rates after 14 Weeks of Training

We first compared injury metrics (i.e., injury rate and proportion of trainees that were injured) between the three training groups after 14 weeks of training (end of training for 14-week cycles) so all groups were normalized to the same amount of training time (time at risk for injury) **(Table 6)**. Metrics are reported for two injury categories (MSK and non-MSK) and three injury types within each category: (1) acute (i.e., traumatic) injuries, (2) overuse (i.e., cumulative effects of microtrauma) injuries, and (3) all injuries (acute and overuse injuries, combined). **Tables C1, C2, and C3** (Appendix C) present the same injury data as Table 6, but in greater detail, and report injury RRs comparing injury rates between training groups with p-values for RRs and χ^2 test of proportions.

After 14 weeks of training, MSK injuries accounted for more than three-fourths of all injuries in 14-week (77%), pilot (90%), and follow-on (86%) cycles. Approximately 95% of MSK injuries were overuse injuries in all three training groups.

Regarding MSK injuries, 14-week and pilot cycles had similar injury rates and proportions of injured trainees (i.e., no significant difference; p>0.05) **(Tables 6 and C1)**. However, follow-on cycles had a larger proportion of trainees with MSK injuries (42%) compared to 14-week (30%; p<0.05) and pilot (31%; p<0.05) cycles. Follow-on cycle rates were approximately 1.5 times higher injury rates for overuse (p<0.05) and all MSK (p<0.05) injuries compared to 14-week and pilot cycles **(Tables 6, C2, and C3)**.

Regarding overuse and all non-MSK injuries separately, pilot and follow-on cycles had significantly lower injury rates and smaller proportions of injured trainees (p<0.05 for all comparisons) compared to 14-week cycles **(Tables 6, C1, and C2)**. Pilot cycles had the lowest non-MSK injury rates. Comparing pilot and follow-on cycles, the all non-MSK injury rate for trainees in follow-on cycles was 2 times higher than the rate for those in the pilot cycles (p<0.05).

Table 6. Injury Rates after 14 Weeks by Training Group

Injury Category	Injury Type	Training Group								
		14-week Cycles (14 Weeks) (n=470)			Pilot Cycles (1st 14 Weeks) (n=400)			Follow-on Cycles (1st 14 Weeks) (n=1,313)		
		Injured Trainees (n)[a] (%)	Injuries n (%)	Injury Rate[b]	Injured Trainees (n)[a] (%)	Injuries n (%)	Injury Rate[b]	Injured Trainees (n)[a] (%)	Injuries n (%)	Injury Rate[b]
MSK	Acute	12 (2.6)	13 (5.3)	0.9	11 (2.8)	12 (6.0)	0.9	41 (3.1)	43 (4.4)	1.1
	Overuse	136 (29.4)	231 (94.7)	15.6	122 (30.5)	189 (94.0)	14.7	534 (40.7)†, ‡	924 (95.6)	22.7†, ‡
	All	141 (30.0)	244 (100)	16.4	125 (31.3)	201 (100)	15.6	546 (41.6)†, ‡	967 (100)	23.8†, ‡
Non-MSK	Acute	18 (3.8)	19 (27.1)	1.3	16 (4.0)	18 (81.8)	1.4	72 (5.5)	79 (56.8)	1.9†
	Overuse	50 (10.6)	51 (72.9)	3.4	4 (1.0)†	4 (18.2)	0.3†	60 (4.6)†, ‡	60 (43.2)	1.5†, ‡
	All	66 (14.0)	70 (100)	4.7	20 (5.0)†	22 (100)	1.7†	126 (9.6)†, ‡	139 (100)	3.4†, ‡

Notes:

† Significant difference ($p \leq 0.05$) compared to 14-week cycles (injury RRs or χ^2 test of proportions)

‡ Significant difference ($p \leq 0.05$) compared to pilot cycles (injury RRs or χ^2 test of proportions)

[a] Some trainees had an acute MSK injury and an overuse MSK injury, and/or multiple injuries of the same type. The total number of trainees with one or more MSK injuries (All) does not equal the sum of trainees with acute and overuse injuries. The same applies to non-MSK injuries.

[b] Injury Rate: Injuries per 100 trainees per month

Additional detail of data in this table are presented in **Tables C1, C2, and C3 (Appendix C)**.

Legend:

MSK = musculoskeletal; Non-MSK = non-musculoskeletal

7.5 Injury Rates after 22 Weeks of Training

Table 7 compares the end-of-cycle (22 weeks) injury rates and proportions of injured trainees in pilot and follow-on cycles. This represents 8 additional weeks of training and exposure to injury risks compared to the first 14 weeks of training (**Tables 6, C1, C2, and C3)**. **Table C4** (Appendix C) presents the injury data from **Table 7** in greater detail, including injury rate ratios comparing injury rates between training groups (RR: injury rate for follow-on cycles ÷ injury rate for pilot cycles) with p-values for rate ratios and χ^2 test of proportions.

For pilot and follow-on cycles, injury rates (MSK and non-MSK injuries) after 22 weeks **(Table 7)** were lower than their respective rates after 14 weeks **(Table 6)**, even though the total number of injuries and proportion of injured trainees increased for both injury categories. In other words, during the last 8 weeks of training (week 15 to week 22), there were fewer injuries per 100 trainees per month compared to the first 14 weeks of training.

After 22 weeks, follow-on cycles had 1.4 times higher rates for overuse MSK and all MSK injuries compared to pilot cycles ($p<0.05$ for both comparisons) **(Table 7 and C4)**. Follow-on cycles also had larger proportions of trainees with overuse MSKs (44%) and all MSK (45%) injuries compared to pilot cycles (37% and 38%, respectively) ($p<0.05$ for both comparisons). Follow-on cycles also had a 1.8 times higher injury rate for all non-MSK injuries compared to the pilot cycles ($p<0.05$).

Table 7. Injury Rates of Pilot and Follow-on Cycles after 22 Weeks

		Training Group					
		Pilot Cycles (22 Weeks) (n=400)			Follow-on Cycles (22 Weeks) (n=1,313)		
Injury Category	Injury Type	Injured Trainees (n)[a] (%)	Injuries n (%)	Injury Rate[b]	Injured Trainees (n)[a] (%)	Injuries n (%)	Injury Rate[b]
MSK	Acute	15 (3.8)	17 (6.4)	0.9	48 (3.7)	55 (4.7)	0.9
	Overuse	147 (36.8)	249 (93.6)	13.0	580 (44.2)‡	1,103 (95.3)	18.3‡
	All	150 (37.5)	266 (100)	13.9	589 (44.9)‡	1,158 (100)	19.2‡
Non-MSK	Acute	22 (5.5)	24 (75.0)	1.3	89 (6.8)	102 (57.3)	1.7
	Overuse	8 (2.0)	8 (25.0)	0.4	75 (5.7)‡	76 (42.7)	1.3‡
	All	29 (7.3)	32 (100)	1.7	156 (11.9)‡	178 (100)	2.9‡

Notes:
‡ Significant difference ($p\leq0.05$) compared to pilot cycles (injury RRs or χ^2 test of proportions)
[a] Some trainees had an acute MSK injury and an overuse MSK injury, and/or multiple injuries of the same type. The total number of trainees with one or more MSK injuries (All) does not equal the sum of trainees with acute and overuse injuries. The same applies to non-MSK injuries.
[b] Injury Rate: Injuries per 100 trainees per month
Additional details regarding data in this table are presented in **Table C4 (Appendix C)**.
Legend:
MSK = musculoskeletal; Non-MSK = non-musculoskeletal

7.6 Injury Types and Anatomic Locations by Training Group

MSK injuries (versus non-MSK injuries) are of greatest concern during IN OSUT, being the most common injuries and having the greatest impact on training outcomes. By the end of training, MSK injuries accounted for 78% of all injuries (MSK and non-MSK injuries, combined) in 14-week cycles (14 weeks), and accounted for 89% and 87% of all injuries in pilot and follow-on cycles, respectively (22 weeks).

Table 8 shows the distribution of injuries (based on diagnosis codes in the EHR) by injury category and type for the three training groups. By the end of training, acute MSK injuries comprised only 5% to 6% of MSK injuries in the training groups **(Tables 6 and 7)**. Traumatic fractures and joint sprains were the two leading types of acute MSK injuries in each of the training groups **(Table 8)**.

Overuse MSK injuries accounted for 94% to 95% of all MSK injuries in the training groups, and typically include injuries such as muscle strains and tendonitis which result from cumulative effects of microtrauma. Unfortunately, medical providers tended to use broad, non-specific injury diagnosis codes in the EHR for most overuse MSK injuries. Two common examples of these non-specific diagnosis codes are “pain in leg” and “pain in knee”. Because providers use these codes, we are unable to further classify the majority of these injuries by diagnosis. In **Table 8**, the only specific type of overuse MSK injury is BSI. The remainder of overuse MSK injuries are categorized as “soft tissue damage”. More specific information about the BSIs is presented in **Section 7.7**.

Table 9 summarizes the anatomic distribution of injuries by injury category and type. The lower extremity accounted for the largest proportion of injuries within each injury category and type. Approximately three-quarters of overuse MSK injuries (the largest injury category and type) involved the lower extremity (14-week cycles: 78%; pilot cycles: 79%; follow-on cycles: 78%). The upper extremity and back accounted for smaller, but similar proportions of overuse MSK injuries in the three training groups.

Table 8. Injury Diagnosis by Injury Category and Type by Training Group

Injury Category and Type	Injury Diagnosis[a]	Training Group					
		14-week Cycles (n=470)		Pilot Cycles (n=400)		Follow-on Cycles) (n=1,313)	
		Injuries (n)	Percent (%)	Injuries (n)	Percent (%)	Injuries (n)	Percent (%)
MSK: Acute	Fracture	5	38.5	6	35.3	27	49.1
	Sprain	5	38.5	4	23.5	14	25.5
	Strain	3	23.1	3	17.6	8	14.5
	Dislocation	0	0.0	2	11.8	4	7.3
	Other tissue damage	0	0.0	1	5.9	2	3.6
	Crush	0	0.0	1	5.9	0	0.0
	Total	13	100.0	17	100.0	55	100.0
MSK: Overuse	Soft tissue damage	210	90.9	237	93.1	963	87.7
	Bone Stress Injury (BSI)	21	9.1	12	4.8	135	12.3
	Total	231	100.0	249	100.0	1,098	100.0
Non-MSK: Acute	Contusion	9	47.4	11	45.8	59	59.6
	Open wound	7	36.8	10	41.7	25	25.2
	Other tissue damage	2	10.5	1	4.2	8	8.1
	Internal organ	1	5.3	2	8.3	7	7.1
	Total	19	100.0	24	100.0	99	100.0
Non-MSK: Overuse	Contusions	48	94.1	7	87.5	67	88.2
	Nerve	2	3.9	1	12.5	5	6.6
	Other tissue damage	1	2.0	0	0.0	4	5.3
	Total	51	100.0	8	100.0	76	100.0

Notes:
[a] Source: diagnosis codes in the electronic health record (EHR)
Legend:
MSK = musculoskeletal; Non-MSK = non-musculoskeletal

Table 9. Anatomic Distribution of Injuries by Training Group[a]

Injury Category and Type	Anatomic Location	Training Group					
		14-week Cycles (n=474)		Pilot Cycles (n=400)		Follow-on Cycles (n = 1,313)	
		Injuries (n)	Percent (%)	Injuries (n)	Percent (%)	Injuries (n)	Percent (%)
MSK: Acute	Head/Neck	1	7.7	0	0.0	5	9.1
	Back	2	15.4	0	0.0	2	3.6
	Torso	1	7.7	4	23.5	4	7.3
	Upper Extremity	3	23.1	7	41.2	22	40.0
	Lower Extremity	6	46.2	6	35.3	22	40.0
	Other	0	0.0	0	0.0	0	0.0
	Total	13	100.0	17	100.0	55	100.0
MSK: Overuse	Back	26	11.3	23	9.2	118	10.7
	Torso	1	0.4	1	0.4	19	1.7
	Upper Extremity	22	9.5	29	11.6	104	9.4
	Lower Extremity	181	78.4	196	78.7	857	77.7
	Other	1	0.4	0	0.0	5	0.5
	Total	231	100.0	249	100.0	1,103	100.0
Non-MSK: Acute	Head/Neck	6	31.6	10	41.7	35	34.3
	Torso	0	0.0	2	8.3	10	9.8
	Upper Extremity	8	42.1	8	33.3	37	36.3
	Lower Extremity	5	26.3	4	16.7	20	19.6
	Total	19	100.0	24	100.0	102	100.0
Non-MSK: Overuse	Head/Neck	1	2.0	0	0.0	4	5.3
	Back	1	2.0	0	0.0	4	5.3
	Torso	1	2.0	0	0.0	2	2.6
	Upper Extremity	0	0.0	1	12.5	2	2.6
	Lower Extremity	48	94.1	7	87.5	64	84.2
	Total	51	100.0	8	100.0	76	100.0

Notes:
[a] Source: diagnosis codes in the electronic health record (EHR)
Legend: MSK=musculoskeletal; Non-MSK=non-musculoskeletal

7.7 Bone Stress Injuries and Traumatic Fractures

IPP clinical staff (KH) reviewed the radiographic reports for all suspected bone stress injuries (BSIs) and traumatic fractures. In trainee populations, BSIs (i.e., stress reactions and "stress fractures) in the lower extremity are associated with weight-bearing training activities such as drill and ceremony, running, and road marching. BSIs are important injuries because they often require prolonged rest and recovery, may require surgery, and can result in long-term disability. By comparison, traumatic fractures are acute musculoskeletal injuries that result from a sudden exchange of mechanical energy (i.e., trauma) that causes a bone to fracture.

Whereas the previous tables **(Tables 8 and 9)** were based solely on diagnoses entered by medical providers in the EHR, findings in this section are based on radiologic reports that confirmed BSIs (mild to severe) and traumatic fractures. Radiographic studies, including radiographs (x-rays), bone scans, and MRI, were ordered by medical providers when they suspected a BSI or traumatic fracture. These tests are able to identify BSIs in the early stages. As explained previously **(Section 5.6)**, medical providers often use non-specific diagnosis codes in the EHR for MSK overuse injuries, including BSIs. As a result, fewer BSIs were identified from the EHR **(Table 7)** compared to results from radiographic reports when reviewed by the IPP clinical staff member **(Tables 10 to 13).**

Table 10 summarizes and compares injury rates for radiographically confirmed BSIs and traumatic fractures between the three training groups. **Table C5** (Appendix C) provides greater detail for the statistical comparisons annotated in **Table 10**. In 14-week cycles, 24 trainees had a total of 42 BSIs; in pilot cycles, 18 trainees had a total of 37 BSIs; and in follow-on cycles, 120 trainees had a total of 266 BSIs. The BSI rates were similar (not significantly different; $p=0.09$) for 14-week (3/100 trainees per month) and pilot (2/100 trainees per month) cycles ($p=0.09$), but the rate was significantly higher in follow-on cycles (4/100 trainees per month) compared to 14-week and pilot cycles ($p<0.05$ for both comparisons). There was no significant difference in the traumatic fracture rate among the three training groups ($p>0.05$ for all comparisons).

Table 10. Bone Stress Injuries and Traumatic Fractures by Training Group

	Training Group								
	14-week Cycles (n=470)			Pilot Cycles (n=400)			Follow-on Cycles (n=1,313)		
Injury Type	Injured Trainees (n)[a] (%)	Injuries n (%)	Injury Rate[b]	Injured Trainees (n)[a] (%)	Injuries n (%)	Injury Rate[b]	Injured Trainees (n)[a] (%)	Injuries n (%)	Injury Rate[b]
BSI	24 (5.1)	42	2.8	18 (4.5)	37	1.9	120 (9.1) †, ‡	266	4.4†, ‡
Traumatic Fx	6 (1.3)	6	0.4	5 (1.3)	5	0.3	27 (2.1)	27	0.4

Notes:
† Significant difference (p≤0.05) compared to 14-week cycles (injury RRs or χ^2 test of proportions)
‡ Significant difference (p≤0.05) compared to pilot cycles (injury RRs or χ^2 test of proportions)
[a] Some trainees had an acute MSK injury and an overuse MSK injury, and/or multiple injuries of the same type. The total number of trainees with one or more MSK injuries (All) does not equal the sum of trainees with acute and overuse injuries. The same applies to non-MSK injuries.
[b] Injury Rate: Injuries per 100 trainees per month
Additional details regarding data in this table are presented in **Table C5 (Appendix C)**.
Legend:
BSI = bone stress injury; Traumatic Fx = traumatic fracture

The distribution of the BSIs by anatomic location and training group is presented in **Table 11**. In this table, BSIs involving the hip include the femoral neck, femoral head, and acetabulum. The hip accounted for the highest proportions of BSIs in all three training groups. Because of the potential morbidity of femoral neck BSIs, medical providers follow clinical practice guidelines when evaluating trainees with hip pain. A primary objective of these guidelines is to identify and treat hip BSIs in the earliest stages possible, before they become severe and require surgical intervention. In these training cycles, only one of the 113 hip BSIs required surgical intervention. This is a positive outcome indicator showing that hip BSIs are being identified and treated early.

Due to small numbers of BSI by anatomic location and training group, the only significantly different proportions ($p<0.05$) by anatomic location among the groups were the (1) metatarsal (lower proportion in follow-on cycles compared to 14-week and pilot cycles) and (2) pelvis (higher proportion in pilot cycles compared to 14-week cycles). Further in-depth investigation is required to understand if/how these differences in anatomic distribution relate to differences in training, physical fitness of trainees, and other factors among the three training groups.

Table 11. Anatomic Distribution of Bone Stress[a] Injuries by Training Group

Anatomic Location	Training Group					
	14-week Cycles (n=42)		Pilot Cycles (n=37)		Follow-On Cycles (n=266)	
	BSI[a] (n)	Percent of BSI (%)	BSI[a] (n)	Percent of BSI (%)	BSI[a] (n)	Percent of BSI (%)
Calcaneus	1	2.4	0	0.0	2	0.8
Femur	10	23.8	4	10.8	63	23.7
Fibula	0	0.0	0	0.0	4	1.5
Foot	0	0.0	0	0.0	1	0.4
Hip[b]	14	33.3	13	35.1	86	32.3
Metatarsal	4	9.5	4	10.8	3	1.1†, ‡
Pelvis	3	7.1	9	24.3†	38	14.3
Sacroiliac Region	2	4.8	1	2.7	19	7.1
Tibia	8	19.0	6	16.2	50	18.8

Notes:
† Significant difference ($p\leq0.05$) compared to 14-week cycles (proportion of BSIs by anatomic of BSIs)
‡ Significant difference ($p\leq0.05$) compared to pilot cycles (proportion of BSIs by anatomic location of BSIs)
[a] Includes all radiographically confirmed BSIs; some trainees had more than one BSI
[b] Hip BSIs include femoral neck, femoral head, and acetabulum
Legend:
BSI = bone stress injury

7.8 Graduation Status of Trainees with Bone Stress Injury

Table 12 compares the OSUT graduation status of trainees with and without radiologically confirmed BSIs within each training group, and between training groups. Within follow-on and 14-week cycles, significantly smaller proportions ($p<0.05$) of trainees with a BSI graduated compared to trainees *without* a BSI. However, in the pilot cycles, proportions of trainees with and without a BSI that graduated were not significantly different ($p=0.08$).

When compared between the training groups, the proportions of trainees with a BSI that graduated were not significantly different ($p>0.05$) for any comparison. However, the proportion of trainees with no BSI that graduated in follow-on cycles (80%) was significantly lower compared to the 14-week (89%) and pilot (95%) cycles ($p<0.05$ for both comparisons).

Table 12. Graduation Status of Trainees with Bone Stress Injuries by Training Group

Graduation Status	Training Group								
	14-week Cycles (n=470)			Pilot Cycles (n=400)			Follow-on Cycles (n=1,313)		
	BSI (n=24)	No BSI (n=446)		BSI (n=18)	No BSI (n=382)		BSI (n=120)	No BSI (n=1,193)	
	n (%)	n (%)	p-value[d]	n (%)	n (%)	p-value[d]	n (%)	n (%)	p-value[d]
Graduates	15 (62.5)	395 (88.6)	<0.05	15 (83.3)	363 (95.0) [b]	0.08	75 (62.5)	952 (79.8) [b, c]	<0.05
Non-Graduates	9 (37.5)	51 (11.4)		3 (16.7)	19 (5.0)		38 (31.7)	229 (19.2)	
Still in Training[a]	0 (0.0)	0 (0.0		0 (0.0)	0 (0.0)		7 (5.8)	12 (1.0)	

Notes:
[a] Still in Training: trainees with no final disposition in ATRRS as of March 13, 2020
[b] Significant difference (p≤0.05) compared to 14-week cycles (trainees with no BSI)
[c] Significant difference (p≤0.05) comparing graduates with no BSI to pilot cycles
[d] p-value χ^2 test of proportions
There were no significant differences comparing graduates with a BSI among the training groups (due to small number of BSIs)
Legend:
BSI = bone stress injury

7.9 Injury Encounters by Medical Provider Type

Medical providers at Fort Benning document injury-related medical care (inpatient and outpatient encounters) in the EHR. These records provide information about the total number of injury-related encounters and the types of medical provider that rendered care. Athletic trainers are assigned to the IN OSUT training battalions as a means of providing forward and timely evaluation and treatment of injured trainees. TRADOC leaders expect that injured trainees seen by the battalion-based athletic trainers receive more timely care for injuries, and return to training earlier in the day, compared to trainees evaluated at the medical treatment facility (MTF).

Overall, there were 1,668 MSK injuries and 280 non-MSK injuries in the combined training groups **(Tables 6 and 7)**. Medical providers recorded 4,626 encounters for MSK injuries (on average, 2.8 encounters per injury) and 329 encounters for non-MSK injuries (on average, 1.2 encounters per injury) **(Table 13)**.

Overall, the two leading medical provider types (i.e., specialties) for injury-related encounters (i.e., outpatient and inpatient) were PTs and ATs. Combined, they accounted for 86% of MSK injury encounters (PTs: 47%; ATs: 39%) and 22% of non-MSK injury encounters (PTs: 0%; ATs: 22%).

Unfortunately, we were unable to determine if trainees treated by battalion-based ATs missed less training during the day, had fewer days of limited duty, or recovered more quickly compared to trainees treated at the MTF. These data were not available in the EHR or from MCoE.

Table 13. Injury Medical Encounters by Medical Provider Type[a]

Injury Type	Injury Medical Encounters (Visits) (n=4,955)										Total Encounters (n)
	Oral Surgery	Podiatry	Internal Medicine	Orthopedic	Occupational Therapy	Emergency Room	Primary Care	Athletic Trainer	Physical Therapy	Other Clinic[b]	
MSK Injuries											
Acute	7	7	0	44	0	39	26	8	1	16	148
Overuse	0	2	6	25	118	27	329	1,775	2,180	16	4,478
All	7	9	6	69	118	66	355	1,783	2,181	32	4,626
Percent of All (%)	*0.2*	*0.2*	*0.1*	*1.5*	*2.6*	*1.4*	*7.7*	*38.5*	*47.1*	*0.7*	*100.0*
Non-MSK Injuries											
Acute	0	0	4	1	9	65	77	4	0	13	173
Overuse	0	0	0	0	0	11	71	69	0	5	156
All	0	0	4	1	9	76	148	73	0	18	329
Percent of All (%)	*0.0*	*0.0*	*1.2*	*0.3*	*2.7*	*23.1*	*45.0*	*22.2*	*0.0*	*5.5*	*100.0*
All Injuries											
Total Encounters	7	9	10	70	127	142	502	1,856	2,181	51	4,955
Percent of Total (%)	*0.1*	*0.2*	*0.2*	*1.4*	*2.6*	*2.9*	*10.1*	*37.5*	*44.0*	*1.2*	*100.0*

Notes:
[a] Source: medical encounters from the electronic health record (EHR)
[b] Other Clinic includes: Ophthalmology, Physical Medicine, and unknown
Legend:
MSK =musculoskeletal; Non-MSK = non-musculoskeletal

8. CONCLUSIONS

For this assessment of the extended 22-week cycle for IN OSUT, the APHC IPP compared graduation and injury outcomes among three training groups of IN OSUT: (1) two 14-week cycles from FY 2018 (legacy 14-week cycles), (2) two pilot cycles from FY 2018 (22-week cycles), and (3) six follow-on cycles from FY 2019 that trained for 22 weeks. Follow-on cycles had significantly lower graduation (78%) compared to the pilot (95%) and 14-week cycles (88%). After 14 weeks of training, follow-on cycles had significantly higher (1.5 times higher) MSK injury rates compared to pilot and 14-week cycles. After 22 weeks of training, the MSK injury rate for follow-on cycles was still significantly higher (1.4 times higher) than the MSK injury rate for pilot cycles. By the end of training, a smaller proportion of trainees with a BSI graduated from follow-on cycles (63%) compared to the pilot cycles (83%).

It was beyond the scope of this program evaluation to examine all potential factors that may have been associated with lower graduation and higher injury rates in follow-on cycles. We noted, however, that larger proportions of trainees in pilot cycles enlisted for the 18X Special Forces MOS, started at a higher rank (E-4), and had at least 4 years of college compared to trainees in 14-week and follow-on cycles. Based on OPAT event performance during recruitment, pilot cycle trainees also had higher baseline (1) upper and lower body muscular power, (2) lower body muscular strength, and (3) aerobic fitness compared to trainees in 14-week and follow-on cycles. These baseline characteristics may have contributed to the higher graduation and lower injury rates in the pilot cycles. Analyses of additional units and/or further investigation is required to determine if these differences are meaningful in the context of graduation and injuries during IN OSUT or longitudinal health and physical fitness of IN Soldiers in operational units.

There are many other training- and performance-related outcomes of IN OSUT that have been, or will be, evaluated by others to determine the overall impact of the extended 22-week training cycle. These outcomes will be evaluated not only during OSUT but also in longitudinal studies that follow graduates into their first units of assignment. These future evaluations, along with this current report, will provide objective evidence to inform leaders of the operational impact of the extended IN OSUT training cycle.

9. RECOMMENDATIONS

Recommend that MCoE and the Infantry School continue to monitor injury rates in future IN OSUT cycles as part of a systematic effort to mitigate injuries and lower injury rates. Since all IN OSUT cycles beginning in FY 2020 will be extended 22-week cycles, APHC recommends that the MCoE and Infantry School monitor injury rates and injury-related attrition in future cycles. Injury surveillance data from APHC's Quarterly Training-Related Injury Report (APHC 2020) has shown that injury rates during IN OSUT vary by training cycle (i.e., class) and by training unit. Training cycles with relatively low injury rates should be further evaluated to identify and evaluate potential factors that contributed to lower injury rates. Lessons learned from these training cycles with lower rates can then be applied to training units that tend to have higher injury rates.

10. POINT OF CONTACT

The point of contact for this report is the APHC IPP. Questions may be directed to the Injury Prevention Program (IPP) at usarmy.apg.medcom-aphc.mbx.injuryprevention@mail.mil, commercial phone 410-436-4312, or DSN 584-4312.

Approved:

Michelle C. Chervak, MPH, PhD
Program Manager, Injury Prevention Program

APPENDIX A

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APPENDIX B

Glossary

AFHSB
Armed Forces Health Surveillance Branch

APFT
Army Physical Fitness Test

APHC
Army Public Health Center

AR
Army Regulation

AT
Athletic Trainer

ATRRS
Army Training Requirements and Resource System

AWOL
Absent Without Leave

BMI
Body Mass Index (weight (kg) * height $(m)^{-2}$)

BSI
Bone Stress Injury

χ^2
Chi-square test of proportions

CI
Confidence Interval

cm
centimeters

DA
Department of the Army

DHA
Defense Health Agency

DMSS
Defense Medical Surveillance System

DOD
Department of Defense

DOTD
Directorate of Training and Doctrine

EHR
Electronic Health Record

FY
Fiscal Year

IAR
Interval Aerobic Run

in
inches

IN
Infantry

IPP
Injury Prevention Program, Army Public Health Center

kg
kilogram

lb
pounds

m
meter

MEDCOM
U.S. Army Medical Command

MCoE
Maneuver Center of Excellence

MOS
Military Occupational Specialty

MRI
Magnetic Resonance Imaging

MSK
Musculoskeletal

MTF
Medical Treatment Facility

NG
National Guard

OPAT
Occupational Physical Assessment Test

OSUT
One Station Unit Training

PT
Physical Therapist

REFRAD
Return from Active Duty

RR
Rate Ratio

SD
Standard Deviation

SDL
Strength Deadlift

SLJ
Standing Long Jump

SPT
Seated Power Throw

TRADOC
U.S. Army Training and Doctrine Command

vs.
versus

APPENDIX C

Supplementary Tables

Table C1. Comparison of Injury Rates between Pilot and 14-week Cycles after 14 Weeks

Injury Category	Injury Type	Training Groups: 14-week Cycles (14 Weeks) (n=470) Injured Trainees (n)[a] (%)	14-week Cycles (14 Weeks) (n=470) Injuries n (%)	14-week Cycles (14 Weeks) (n=470) Injury Rate[b]	Pilot Cycles (14 Weeks) (n=400) Injured Trainees (n)[a] (%)	Pilot Cycles (14 Weeks) (n=400) Injuries n (%)	Pilot Cycles (14 Weeks) (n=400) Injury Rate[b]	Comparison Pilot vs. 14-week Injured Trainees p-value[c]	Comparison Pilot vs. 14-week Rate Ratio (RR)[d]	Comparison Pilot vs. 14-week Rate Ratio p-value[e]
MSK	Acute	12 (2.6)	13 (5.3)	0.9	11 (2.8)	12 (6.0)	0.9	0.86	1.07	0.87
	Overuse	136 (29.4)	231 (94.7)	15.6	122 (30.5)	189 (94.0)	14.7	0.71	0.95	0.57
	All	141 (30.0)	244 (100)	16.4	125 (31.3)	201 (100)	15.6	0.69	0.95	0.61
Non-MSK	Acute	18 (3.8)	19 (27.1)	1.3	16 (4.0)	18 (81.8)	1.4	0.90	1.10	0.78
	Overuse	50 (10.6)	51 (72.9)	3.4	4 (1.0)	4 (18.2)	0.3	**<0.05**	**0.09**	**<0.05**
	All	66 (14.0)	70 (100)	4.7	20 (5.0)	22 (100)	1.7	**<0.05**	**0.36**	**<0.05**

Notes:

[a] Some trainees had an acute MSK injury and an overuse MSK injury, and/or multiple injuries of the same type. The total number of trainees with one or more MSK injuries (All) does not equal the sum of trainees with acute and overuse injuries. The same applies to non-MSK injuries.

[b] Injury Rate: Injuries per 100 trainees per month

[c] p-value χ^2 test of proportions

[d] Rate Ratio (RR): Compares injury rates between pilot and 14-week cycles (RR=rate for pilot cycles ÷ rate for 14-week cycles)

[e] p-value for Rate Ratio (RR)

Statistically significant results (p≤0.05) are shown in bold font

Legend:

MSK = musculoskeletal; Non-MSK = non-musculoskeletal

Table C2. Comparison of Injury Rates between Follow-on and 14-week Cycles after 14 Weeks

Injury Category	Injury Type	Training Groups: 14-week Cycles (14 Weeks) (n=470)			Training Groups: Follow-on Cycles (14 Weeks) (n=400)			Comparison Follow-on vs. 14-week		
		Injured Trainees (n)[a] (%)	Injuries n (%)	Injury Rate[b]	Injured Trainees (n)[a] (%)	Injuries n (%)	Injury Rate[b]	Injured Trainees p-value[c]	Rate Ratio (RR)[d]	Rate Ratio p-value[e]
MSK	Acute	12 (2.6)	13 (5.3)	0.9	41 (3.1)	43 (4.4)	1.1	0.53	1.21	0.55
	Overuse	136 (29.4)	231 (94.7)	15.6	534 (40.7)	924 (95.6)	22.7	**<0.05**	**1.46**	**<0.05**
	All	141 (30.0)	244 (100)	16.4	546 (41.6)	967 (100)	23.8	**<0.05**	**1.45**	**<0.05**
Non-MSK	Acute	18 (3.8)	19 (27.1)	1.3	72 (5.5)	79 (56.8)	1.9	0.16	1.52	0.09
	Overuse	50 (10.6)	51 (72.9)	3.4	60 (4.6)	60 (43.2)	1.5	**<0.05**	**0.43**	**<0.05**
	All	66 (14.0)	70 (100)	4.7	126 (9.6)	139 (100)	3.4	**<0.05**	**0.73**	**0.03**

Notes:

[a] Some trainees had an acute MSK injury and an overuse MSK injury, and/or multiple injuries of the same type. The total number of trainees with one or more MSK injuries (All) does not equal the sum of trainees with acute and overuse injuries. The same applies to non-MSK injuries.

[b] Injury Rate: Injuries per 100 trainees per month

[c] p-value χ^2 test of proportions

[d] Rate Ratio (RR): Compares injury rates between follow-on and 14-week cycles (RR=rate for follow-on cycles ÷ rate for 14-week cycles)

[e] p-value for Rate Ratio (RR)

Statistically significant results (p≤0.05) are shown in bold font

Legend:

MSK = musculoskeletal; Non-MSK = non-musculoskeletal

Table C3. Comparison of Injury Rates between Follow-on and Pilot Cycles after 14 Weeks

Injury Category	Injury Type	Training Groups: Pilot Cycles (14 Weeks) (n=400) Injured Trainees (n)[a] (%)	Pilot Cycles (14 Weeks) (n=400) Injuries n (%)	Pilot Cycles (14 Weeks) (n=400) Injury Rate[b]	Follow-on Cycles (14 Weeks) (n=1,313) Injured Trainees (n)[a] (%)	Follow-on Cycles (14 Weeks) (n=1,313) Injuries n (%)	Follow-on Cycles (14 Weeks) (n=1,313) Injury Rate[b]	Comparison Follow-on vs. Pilot: Injured Trainees p-value[c]	Comparison Follow-on vs. Pilot: Rate Ratio (RR)[d]	Comparison Follow-on vs. Pilot: Rate Ratio p-value[e]
MSK	Acute	11 (2.8)	12 (6.0)	0.9	41 (3.1)	43 (4.4)	1.1	0.85	1.13	0.72
	Overuse	122 (30.5)	189 (94.0)	14.7	534 (40.7)	924 (95.6)	22.7	**<0.05**	**1.55**	**<0.05**
	All	125 (31.3)	201 (100)	15.6	546 (41.6)	967 (100)	23.8	**<0.05**	**1.52**	**<0.05**
Non-MSK	Acute	16 (4.0)	18 (81.8)	1.4	72 (5.5)	79 (56.8)	1.9	0.24	1.38	0.21
	Overuse	4 (1.0)	4 (18.2)	0.3	60 (4.6)	60 (43.2)	1.5	**<0.05**	**4.75**	**<0.05**
	All	20 (5.0)	22 (100)	1.7	126 (9.6)	139 (100)	3.4	**<0.05**	**2.00**	**<0.05**

Notes:

[a] Some trainees had an acute MSK injury and an overuse MSK injury, and/or multiple injuries of the same type. The total number of trainees with one or more MSK injuries (All) does not equal the sum of trainees with acute and overuse injuries. The same applies to non-MSK injuries.

[b] Injury Rate: Injuries per 100 trainees per month

[c] p-value χ^2 test of proportions

[d] Rate Ratio (RR): Compares injury rates between follow-on and pilot cycles (RR=rate for follow-on cycles ÷ rate for pilot cycles)

[e] p-value for Rate Ratio (RR)

Statistically significant results (p≤0.05) are shown in bold font

Legend:

MSK = musculoskeletal; Non-MSK = non-musculoskeletal

Table C4. Comparison of Injury Rates between Follow-on and Pilot Cycles after 22 Weeks

Injury Category	Injury Type	Training Groups: Pilot Cycles (22 Weeks) (n=400) Injured Trainees (n)[a] (%)	Pilot Cycles (22 Weeks) (n=400) Injuries n (%)	Pilot Cycles (22 Weeks) (n=400) Injury Rate[b]	Follow-on Cycles (22 Weeks) (n=1,313) Injured Trainees (n)[a] (%)	Follow-on Cycles (22 Weeks) (n=1,313) Injuries n (%)	Follow-on Cycles (22 Weeks) (n=1,313) Injury Rate[b]	Comparison Follow-on vs. Pilot: Injured Trainees p-value[c]	Comparison Follow-on vs. Pilot: Rate Ratio (RR)[d]	Comparison Follow-on vs. Pilot: Rate Ratio p-value[e]
MSK	Acute	15 (3.8)	17 (6.4)	0.9	48 (3.7)	55 (4.7)	0.9	0.93	1.03	0.93
	Overuse	147 (36.8)	249 (93.6)	13.0	580 (44.2)	1,103 (95.3)	18.3	**<0.05**	**1.40**	**<0.05**
	All	150 (37.5)	266 (100)	13.9	589 (44.9)	1,158 (100)	19.2	**<0.05**	**1.38**	**<0.05**
Non-MSK	Acute	22 (5.5)	24 (75.0)	1.3	89 (6.8)	102 (57.3)	1.7	**0.36**	**1.35**	**0.19**
	Overuse	8 (2.0)	8 (25.0)	0.4	75 (5.7)	76 (42.7)	1.3	**<0.05**	**3.01**	**<0.05**
	All	29 (7.3)	32 (100)	1.7	156 (11.9)	178 (100)	2.9	**<0.05**	**1.76**	**<0.05**

Notes:

[a] Some trainees had an acute MSK injury and an overuse MSK injury, and/or multiple injuries of the same type. The total number of trainees with one or more MSK injuries (All) does not equal the sum of trainees with acute and overuse injuries. The same applies to non-MSK injuries.

[b] Injury Rate: Injuries per 100 trainees per month

[c] p-value χ^2 test of proportions

[d] Rate Ratio (RR): Compares injury rates between follow-on and pilot cycles (RR=rate for follow-on cycles ÷ rate for pilot cycles)

[e] p-value for Rate Ratio (RR)

Statistically significant results (p≤0.05) are shown in bold font

Legend:

MSK = musculoskeletal; Non-MSK = non-musculoskeletal

Table C5. Comparison of Bone Stress Injuries and Traumatic Fractures among Training Groups

	Training Group Comparisons								
	Pilot vs. 14-week			Follow-on vs 14-week			Follow-on vs. Pilot		
Injury Type	Injured Trainees p-value[a]	Rate Ratio[b] (RR)	Rate Ratio p-value[c]	Injured Trainees p-value[a]	Rate Ratio[b] (RR)	Rate Ratio p-value[c]	Injured Trainees p-value[a]	Rate Ratio[b] (RR)	Rate Ratio p-value[c]
BSI	0.68	0.68	0.09	<0.01	1.56	<0.01	**<0.01**	**2.28**	**<0.001**
Traumatic Fx	0.97	0.65	0.47	0.28	1.11	0.82	0.30	1.71	0.26

Notes:

[a] p-value χ^2 test of proportions

[b] Rate Ratio (RR): Compares injury rates between training groups

[c] p-value for Rate Ratio (RR)

Statistically significant results (p≤0.05) are shown in bold font

Legend:

BSI = bone stress injury; Traumatic Fx = traumatic fracture