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14. ABSTRACT The purpose of this technical information paper was to compare MSK injury rates in Legacy Basic Combat Training (BCT) cycles that began training after 1 October 2018 and graduated by 1 April 2020 with MSK injury rates in Modified BCT cycles that began training after 20 April 2020 and graduated by 1 April 2021. In March and April 2020, the Department of Defense and Army implemented numerous measures to minimize the transmission of the Coronavirus Disease 2019 (COVID-19) and protect Soldiers' health. The program of instruction at BCT centers was subsequently modified. Two approaches were used to calculate and compare MSK injury rates between LBCT cycles (i.e., classes) and MBCT cycles: 1) MSK injury rate by week of training for LBCT and MBCT cycles; and 2) BCT End-of-Cycle Training-related Injury Rates. The weekly MSK injury rates for MBCT cycles were lower than weekly rates in LBCT cycles. When comparing end-of-cycle training rates, TR injury rates for both men and women in MBCT cycles were lower than injury rates in LBCT cycles (24% and 20% lower, respectively).					
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TIP No. 12-121-0322

Comparison of Basic Combat Training Injury Rates Before and After Implementation of Coronavirus Disease Pandemic-related Training Modifications

INTRODUCTION

This document provides a comparison of weekly and end-of-cycle musculoskeletal (MSK) injury rates for Basic Combat Training (BCT) cycles that followed the “legacy” (LBCT) program of instruction (POI) and graduated before 1 April 2020 (baseline cycles) and BCT cycles that started after 20 April 2020 and followed a modified BCT (MBCT) POI.

Training for new Army enlistees begins with the 10-week BCT course. During BCT, trainees learn the traditions, tactics, and methods of becoming a Soldier.¹ They learn discipline, proper dress, marching, and grooming standards and learn to work as a member of a team to accomplish warrior tasks.

Prior to April 2020, the legacy 10-week BCT (LBCT) POI included the following:²

- Week 1: introduction to Army core values, discipline, and drill and ceremony;
- Week 2: combatives training, Victory tower, foundations of physical fitness, and first aid;
- Week 3: pugil sticks and weapons reception;
- Weeks 4–6: development of basic combat skills, with emphasis on weapon qualification and physical readiness training;
- Weeks 7–10: tactical training, increased trainee responsibility and teamwork, final evaluation of physical fitness, and a 4-day culminating event (the FORGE).¹

In March and April 2020, the Department of Defense and Army implemented numerous measures to minimize the transmission of the Coronavirus Disease 2019 (COVID-19) and protect Soldiers’ health.^{3–6} These measures had an immediate impact on travel and training across the Army. They also affected the healthcare delivery system and Soldiers’ utilization of medical services. Impacts to Army BCT included:

- On 3 April 2020, the U.S. Army Training and Doctrine Command (TRADOC) directed modifications to the LBCT POI.⁷ These modifications enabled TRADOC to maintain an appropriate inflow of recruits, while executing “social distance-enabled training” to minimize risk of COVID-19 transmission.
- On 6 April 2020, the Army placed a 2-week hold on new recruits shipping to BCT.⁸
- When training resumed on 20 April 2020, BCT cycles (i.e., classes) followed the MBCT POI (referred to as “2+8” by TRADOC).

The MBCT POI included the following modifications:⁷

- Weeks 1–2: monitoring for COVID-19 symptoms and COVID testing at end of the 2nd week; greater emphasis on classroom training; training conducted within platoons to limit contact; and trainees wore the Army Physical Fitness Uniform (APFU).
- Weeks 3–10: company-level training on warrior tasks, suspension of combatives training and physical fitness testing,⁹ and a shorter culminating event (the FORGE: 3 days).

In addition to protecting the health of trainees during the COVID-19 pandemic, anecdotal reports suggested the MBCT POI may have had a secondary effect of mitigating risks for training-related MSK injury during BCT. The MBCT POI allowed a slower transition to wearing boots, and a more gradual transition to physical training and physically demanding warrior tasks.

Coinciding with the COVID-19 pandemic and the MBCT POI, the Army began implementing some components of the Holistic Health and Fitness (H2F) System.^{10,11} This transition involved a cultural shift in the Army's vision and approach to Soldier performance optimization. To meet H2F physical readiness goals, units throughout the Army, including BCT, were modifying physical training programs in 2020 to align with the physical requirements of the six-event Army Combat Fitness Test (ACFT).¹²⁻¹⁴ The ACFT, designed to simulate warrior task and battle drills, tests five domains of combat physical readiness: muscle strength, muscle endurance, aerobic endurance, anaerobic endurance, and power.¹⁵ The ACFT currently includes a three repetition maximum deadlift, standing power throw, hand release push-ups, sprint-drag-carry, plank, and a 2-mile run.¹⁶ As of March 2022, scoring has been modified to include normed scoring tables by gender and age groups.¹⁷

PURPOSE

The purpose of this investigation was to compare MSK injury rates in LBCT cycles that began training after 1 October 2018 and graduated by 1 April 2020 with MSK injury rates in MBCT cycles that began training after 20 April 2020 and graduated by 1 April 2021.

METHODS

During the overall period of interest (1 October 2018 through 1 April 2021), TRADOC conducted BCT cycles in four training brigades (BDEs; labelled A – D) at three Army Training Centers (labelled 1 – 3). These units were analyzed for this study.

MSK injuries were defined as any acute or cumulative MSK tissue damage resulting from an external energy source, according to established military injury definitions.^{18,19} Using this definition, acute (i.e., traumatic) and overuse (i.e., cumulative effects of microtrauma) MSK injuries were identified by the primary diagnosis code assigned by medical providers during inpatient and outpatient medical encounters. Unique MSK injuries were defined as an occurrence of an MSK injury diagnosis code without another occurrence of the same primary diagnosis code within 30 days. If the same MSK injury diagnosis code occurred after 30 days, it was considered as another unique MSK injury.

Two approaches were used to calculate and compare MSK injury rates between LBCT cycles (i.e., classes) and MBCT cycles:

- MSK injury rate by week of training for LBCT and MBCT cycles.
 - BCT cycle rosters with cycle start and end dates were downloaded from the Army Training Requirements and Resources System (ATRRS). Rosters were linked to digital injury-related medical encounter data from the Defense Medical Surveillance System (DMSS). Medical encounter data included clinic visit dates and standardized diagnoses codes.

- All MSK injuries were included in this portion of the analysis. The date of the trainee's first medical encounter for a unique MSK injury was used to determine the week of training (weeks 1 through 10) when the injury occurred.
- For each BDE individually, and for BDEs combined, sex-specific MSK injury rates were calculated for each training week (weeks 1 through 10) for cycles that started in the following two timeframes:
 - LBCT (Baseline) cycles: started after 1 October 2018 and graduated before 1 April 2020.
 - MBCT (2+8) cycles: started after 20 April 2020 and graduated before 1 April 2021.
- Injury rates by week were calculated as the number of unique MSK injuries during the week per 100 person-weeks of training.
- Injury rate ratios (RRs) and 95% confidence intervals (CI) were calculated to compare sex-specific injury rates between LBCT and MBCT cycles during each week of training (MBCT rate / LBCT rate). A p-value less than 0.05 indicated a statistically significant difference between rates. A RR less than 1.0 indicated that the MBCT rate was lower than the LBCT rate.
- BCT End-of-Cycle Training-related (TR) Injury Rates.
 - This portion of the analysis included only MSK injuries to the lower back, pelvis, and lower extremities. This subset of MSK injuries is referred to as "training-related injuries" (i.e., TR injuries) because they are associated with the volume of weight-bearing training activities.²⁰
 - Using the BCT cycle rosters and training dates from ATRRS, the Armed Forces Health Surveillance Division of the Defense Health Agency used the DMSS medical encounter data to determine the end-of-cycle TR injury rates by sex for each BCT cycle that started after 1 October 2018 and graduated by 1 April 2021.
 - Sex-specific end-of-cycle TR injury rates were then aggregated by BDE, and for the BDEs combined. Three timeframes were selected for comparison in this analysis include:
 - LBCT (Baseline) cycles: started after 1 October 2018 and graduated before 1 April 2020.
 - Hybrid cycles: started before 1 April 2020 and graduated after 20 April 2020. These hybrid cycles included individuals, which started in LBCT cycles and had some training during the MBCT cycles.
 - MBCT (2+8) cycles: started after 20 April 2020 and graduated before 1 April 2021
 - End-of-cycle TR injury rates were calculated as the number of unique TR-related injuries per 100 person-months of training.
 - Injury RRs and 95% CIs were calculated to compare sex-specific end-of-cycle TR injury rates between LBCT, hybrid, and MBCT cycles. A rate ratio greater than 1.0 indicates a higher risk for the group in the numerator, and a rate ratio less than 1.0 indicates a lower risk for the group in the numerator. A 95% CI that does not include the value 1.0 in the range of values indicates that the RR is statistically significant ($p < 0.05$).

- In the analysis, no corrections were made for multiple tests. All comparisons were planned, and all ask the same or similar question. Across the 20 comparisons we risk having one significant result purely by chance (a false positive). However, the results are consistent across sex and training center, and the risk of having one false positive is less important than increasing the risk of many false negatives.

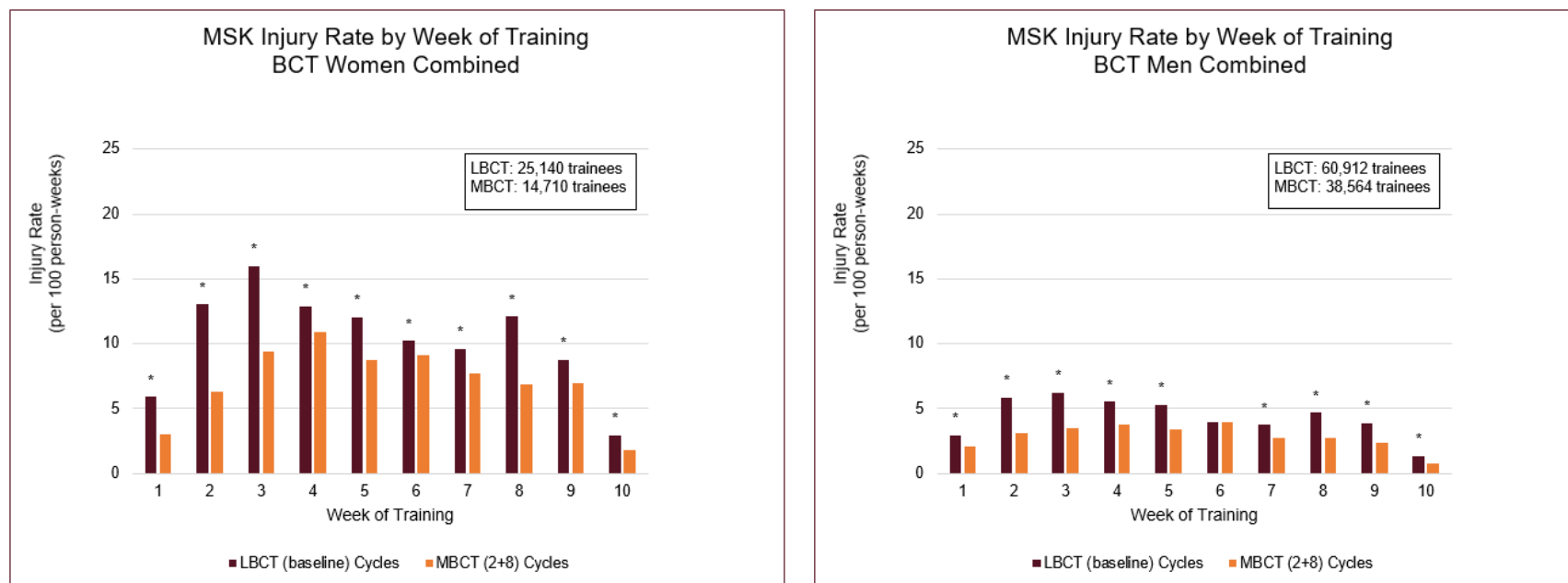
RESULTS

Aggregated MSK Injury Rates by Week of Training for LBCT and MBCT cycles.

Figure 1 shows sex-specific MSK injury rates by week of training for LBCT and MCBT cycles (all BCT BDEs combined). Appendix A includes MSK injury rates by week of training for each individual BDE.

For men and women in LBCT cycles, the highest injury rates occurred in weeks 3 (6.2 per 100 person-weeks for men; 16.0 per 100 person-weeks for women) and 2 (5.9 per 100 person-weeks for men; 13.0 per 100 person-weeks for women). Injury rates in MBCT cycles for men were highest during week 6 (4.0 per 100 person-weeks) and women were highest during week 4 (10.9 per 100 person-weeks).

During week 6 of training in men, the MBCT injury rate was slightly higher than LBCT cycles, but rates were not significantly different. The largest difference in injury RR between MBCT and LBCT cycles occurred in week 2 for both men and women (0.48 (0.45–0.52) and 0.57 (0.45–0.61), respectively), indicating a protective effect of MBCT cycles.



Notes:

* Statistically significant difference between MBCT cycles vs. LBCT cycles; $p < 0.05$

Number of trainees in each training cycle is shown in the inset box.

Figure 1. MSK Injury Rate by Week of Training for LBCT and MBCT Cycles, All BCT Brigades Combined

Table 1 shows the weekly injury RRs (MBCT/LBCT), 95% CIs and p-values for all BCT trainees stratified by sex. For both men and women, all MBCT cycle rates were significantly lower than LBCT cycles except for men in week 6.

Table 1. Comparison of Weekly Injury Rates, MBCT vs. LBCT

Week of BCT	Women		Men	
	RR (95% CI) (MBCT / LBCT)	p-value	RR (95% CI) (MBCT / LBCT)	p-value
Week 1	0.51 (0.46–0.56)	<0.01	0.70 (0.64–0.76)	<0.01
Week 2	0.48 (0.45–0.52)	<0.01	0.57 (0.53–0.61)	<0.01
Week 3	0.59 (0.56–0.63)	<0.01	0.57 (0.54–0.61)	<0.01
Week 4	0.85 (0.80–0.90)	<0.01	0.69 (0.65–0.73)	<0.01
Week 5	0.72 (0.68–0.77)	<0.01	0.66 (0.62–0.70)	<0.01
Week 6	0.90 (0.84–0.96)	<0.01	1.04 (0.98–1.11)	0.23
Week 7	0.81 (0.75–0.87)	<0.01	0.74 (0.69–0.80)	<0.01
Week 8	0.57 (0.53–0.61)	<0.01	0.58 (0.54–0.62)	<0.01
Week 9	0.80 (0.74–0.86)	<0.01	0.61 (0.56–0.66)	<0.01
Week 10	0.60 (0.52–0.70)	<0.01	0.59 (0.51–0.67)	<0.01

BCT End-of-Cycle TR Injury Rates by BDE and Overall

For each of the four BCT BDEs, **Table 2** shows the number of trainees and the TR injury rate for men and women that trained in LBCT cycles, hybrid cycles, and MBCT cycles. The BDE-level data were also aggregated to show overall BCT metrics (i.e., BDEs combined) for the LBCT, hybrid, and MBCT cycles.

Figure 2 presents the TR injury rates by BDE and BCT, overall, in histogram format to illustrate differences in rates for the LBCT, hybrid, and MBCT cycles for men and women. Symbols above the histogram columns identify the significant differences in these comparisons.

In **Table 2a** and **Figure 2**, the most important comparisons are the LBCT vs. MBCT cycles. The primary reason for including the hybrid cycles was to emphasize that all LBCT cycles started and ended before modifications were implemented in April 2020. Likewise, all MBCT classes started after the modifications were implemented and followed the modified POI for the entire 10-week BCT cycle. **Table 2b** summarizes and interprets the comparison of rate ratios for each training cycle type stratified by gender and BDE.

For both sexes in each BDE individually and BDEs combined, the TR injury rate for MBCT cycles was statistically significantly lower than the rate in LBCT cycles. The rate for men in MBCT cycles ranged from 14% to 42% lower than the LBCT rates (RRs and 95% CI: 0.86 (0.81-0.93) and 0.58 (0.54-0.61), respectively); for women the rate in MBCT cycles ranged from 12% to 37% lower than LBCT rates (RRs and 95% CIs: 0.88 (0.84-0.92) and 0.63 (0.59-0.67), respectively). The injury rate in MBCT cycles was also significantly lower than the rate in the

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hybrid cycles for each BDE and BCT, overall, ranging from 14.4% to 32.5% lower. However, injury rates were higher in hybrid cycles (compared to LBCT cycles) for women in both BDEs at training center 1 and for men in BDE B at training center 1. There were significantly lower injury rates for men at training center 2 between LBCT and hybrid cycles.

Table 2a. Comparison of BCT End-of-Cycle Training Related Injury Rates^a

Training Center	BDE	LBCT Cycles		Hybrid Cycles		MBCT Cycles		Cycle Comparisons RR (95% CI)		
		Trainees (n)	Injury Rate ^b	Trainees (n)	Injury Rate ^b	Trainees (n)	Injury Rate ^b	LBCT/Hybrid	MBCT/Hybrid	MBCT/LBCT
Men										
1	A	10,287	14.1	2,981	13.2	10,453	11.3	1.07 (0.99–1.15)	0.86 (0.80–0.93)*	0.80 (0.76–0.84)*
1	B	11,865	13.8	3,289	14.9	11,262	10.8	0.93 (0.87–0.99)*	0.73 (0.68–0.78)*	0.78 (0.75–0.83)*
2	C	8,000	15.0	2,534	12.4	8,302	8.7	1.21 (1.11–1.31)*	0.70 (0.64–0.76)*	0.58 (0.54–0.61)*
3	D	8,245	9.2	1,548	11.0	6,753	7.9	0.84 (0.7–0.93)*	0.72 (0.64–0.80)*	0.86 (0.81–0.93)*
Overall		38,397	13.1	10,352	13.2	36,770	9.9	0.99 (0.96–1.03)	0.75 (0.72–0.78)*	0.76 (0.74–0.78)*
Women										
1	A	4,793	33.8	1,078	37.0	4,045	27.1	0.91 (0.85–0.98)*	0.73 (0.68–0.79)*	0.80 (0.76–0.84)*
1	B	5,528	33.7	1,295	38.9	4,517	29.5	0.87 (0.81–0.92)*	0.76 (0.71–0.81)*	0.88 (0.84–0.92)*
2	C	3,011	33.7	733	31.4	2,973	21.2	1.08 (0.98–1.18)	0.68 (0.61–0.75)*	0.63 (0.59–0.67)*
3	D	3,374	28.1	654	29.7	2,445	23.3	0.94 (0.85–1.05)	0.78 (0.70–0.87)*	0.83 (0.77–0.89)*
Overall		16,706	32.6	3,760	35.3	13,980	25.9	0.92 (0.89–0.96)*	0.74 (0.71–0.77)*	0.80 (0.77–0.82)*

Legend:

BCT=basic combat training

LBCT= legacy BCT

MBCT=modified BCT

RR=relative risk

Notes:

^a Injuries defined as training-related (TR) include traumatic and overuse injuries in the low back, pelvis, and lower extremity (source: Quarterly Training-related Injury Report, Apr 2021; DMSS).^b Injury Rate: number of unique MSK injuries per 100 person-months of training.

* Statistically significant difference between cycles; p<0.05.

Table 2b. Summary of Comparison of BCT End-of-Cycle Training Related Injury Rates

	LBCT/Hybrid	MBCT/Hybrid	MBCT/LBCT
Men			
Training Center 1 BDE A	NS	S, MBCT 14% lower	S, MBCT 20% lower
Training Center 1 BDE B	S, LBCT 7% lower	S, MBCT 27% lower	S, MBCT 22% lower
Training Center 2 BDE C	S, LBCT 21% higher	S, MBCT 30% lower	S, MBCT 42% lower
Training Center 3 BDE D	S, LBCT 16% lower	S, MBCT 28% lower	S, MBCT 14% lower
Overall	NS	S, MBCT 25% lower	S, MBCT 24% lower
Women			
Training Center 1 BDE A	S, LBCT 9% lower	S, MBCT 27% lower	S, MBCT 20% lower
Training Center 1 BDE B	S, LBCT 13% lower	S, MBCT 24% lower	S, MBCT 12% lower
Training Center 2 BDE C	NS	S, MBCT 32% lower	S, MBCT 37% lower
Training Center 3 BDE D	NS	S, MBCT 22% lower	S, MBCT 17% lower
Overall	S, LBCT 8% lower	S, MBCT 26% lower	S, MBCT 20% lower

Legend:

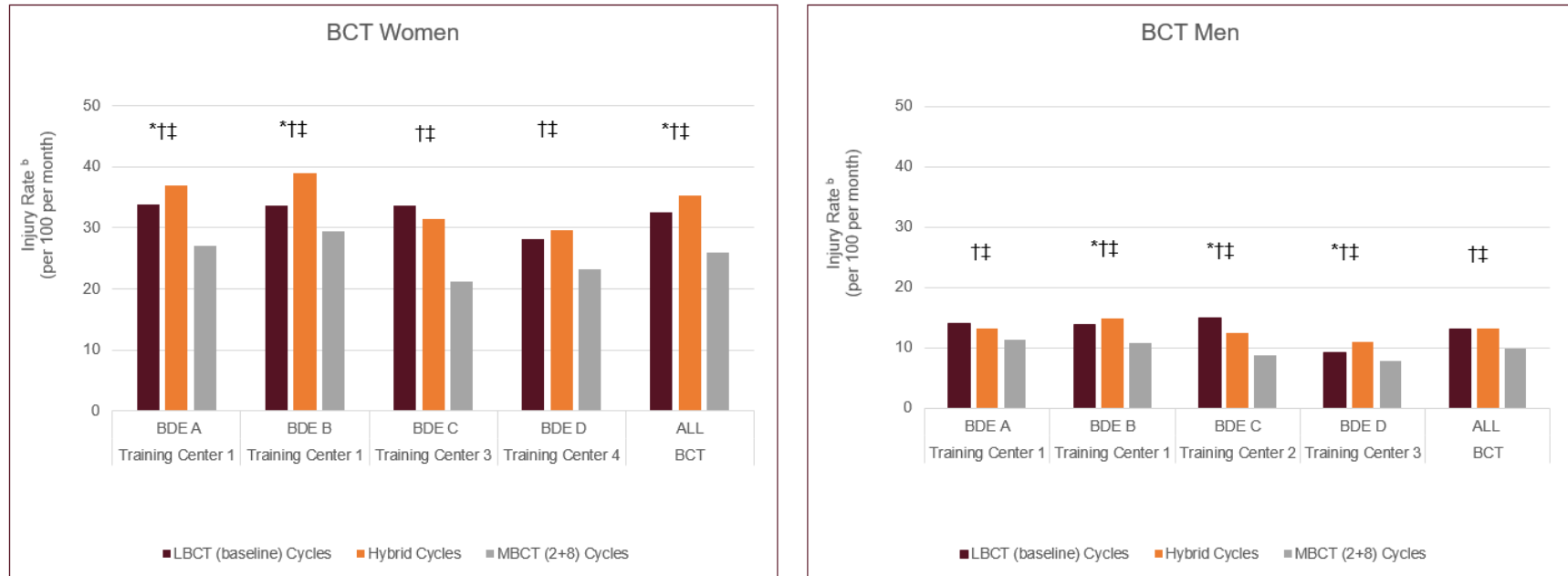
LBCT= legacy

BCT= basic combat training

MBCT=modified BCT

NS=no statistically significant difference

S=statistically significant difference; p<0.05



Notes:

^a Injuries defined as training-related (TR) include traumatic and overuse injuries in the low back, pelvis, and lower extremity (source: Quarterly Training-related Injury Report, Apr 2021; DMSS).

^b Injury Rate: number of unique MSK injuries per 100 person-months of training (to be consistent with other rates presented).

Cycle Injury Rate Comparisons:

* Statistically significant difference between LBCT cycles vs. Hybrid cycles; $p < 0.05$

† Statistically significant difference between Hybrid cycles vs MBCT cycles; $p < 0.05$

‡ Statistically significant difference between LBCT cycles vs. MBCT cycles; $p < 0.05$

Legend:

BCT=basic combat training, LBCT= legacy BCT, MBCT=modified BCT

Figure 2. Comparison of BCT End-of-Cycle TR Injury Rates^a

LIMITATIONS

Limitations of this analysis included that rates did not control for variations in sex or age distributions in the units: variables that can influence injury rates.

CONCLUSIONS

With few exceptions, the weekly MSK injury rates for MBCT cycles were lower than weekly rates in LBCT cycles. When comparing end-of-cycle training rates, TR injury rates for both men and women in MBCT cycles were lower than injury rates in LBCT cycles (24% and 20% lower, respectively). These impacts on injury rates during training were likely due to a combination of factors that included the MBCT POI, changes in physical training related to implementation of the ACFT, fewer exposures to injury hazards and risks during unit and personal physical training, and overall reductions in healthcare utilization during the COVID-19 pandemic. The change in POI should continue to be monitored and assessed for future training cycles.

QUESTIONS

For additional information, please visit the Injury Prevention Branch Website at: <https://phc.amedd.army.mil/topics/discond/ptsaip/Pages/default.aspx>, or contact us by email at: usarmy.apg.medcom-aphc.mbx.injuryprevention@mail.mil.

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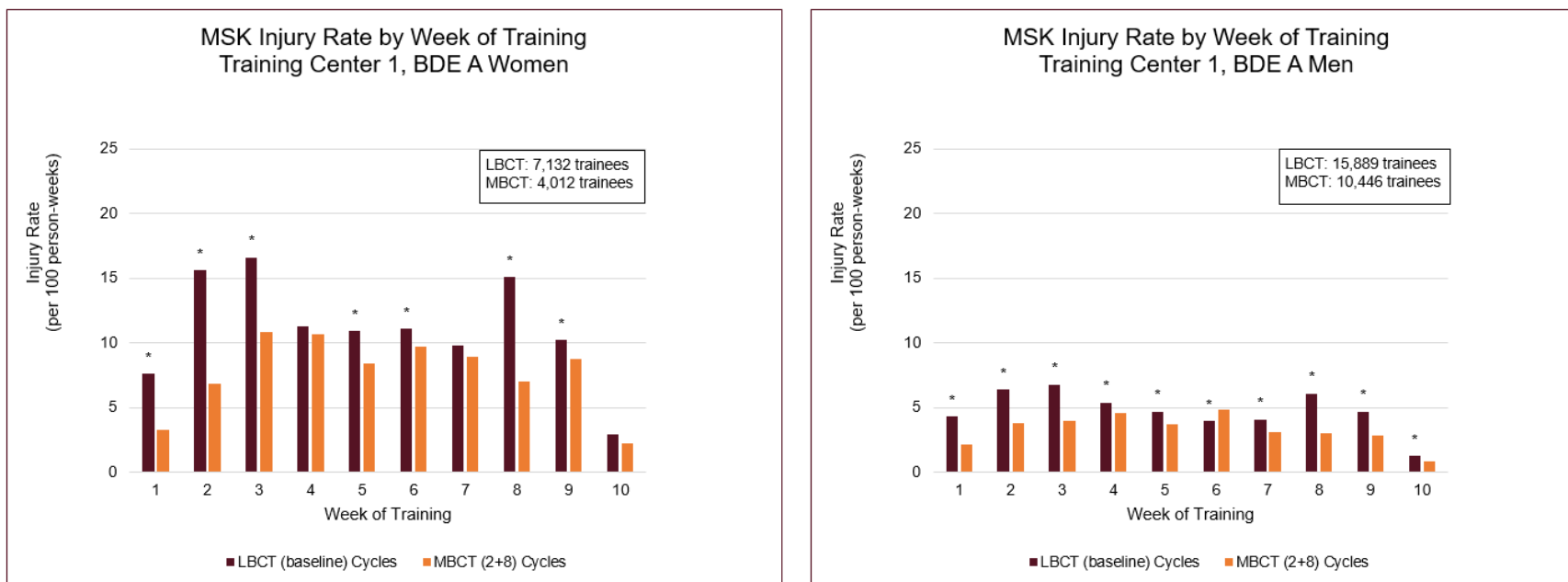
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APPENDIX A

MSK INJURY RATES BY WEEK OF TRAINING FOR LBCT AND MBCT CYCLES BY BDE AND SEX

Figures A-1 to A-4 show sex-specific MSK injury rates for “legacy” basic combat training (BCT) (LBCT) and modified BCT (MCBT) cycles by week of training for BCT BDEs at training center 1 (BDEs A and B), training center 2 (BDE C), and training center 3 (BDE D), respectively.¹⁹ The asterisks in the figures indicate a significant difference between the weekly rate in LBCT and MBCT cycles.

Figure A-1 shows MSK injury rates at training center 1 were highest for men and women in week 3 of LBCT cycles and week 4 of MBCT cycles. With few exceptions, weekly injury rates in MBCT cycles were lower than rates in LBCT cycles, but the rate ratios were not statistically significantly different in all cases. Overall, weekly MSK injury rates in MBCT cycles were lower than rates in LBCT except for women during week 4 and for men during week 6.



Notes:

* Statistically significant difference between MBCT cycles vs. LBCT cycles; $p < 0.05$.

Number of trainees in each training cycle is shown in the inset box.

Figure A-1. BCT MSK Injury Rates by Week of Training at Training Center 1, BDE A

Figure A-2 shows women in LBCT cycles experienced the highest MSK injury rates during week 3, while the injury rate among men in LBCT cycles was highest during week 5; injury rates were 2.3 times higher for LBCT cycles during these weeks. The highest MSK injury rate for MBCT cycles occurred during week 6 for both men and women, but rates were not statistically significantly lower than LBCT cycles (p-values equaled 0.08 and 0.15 for women and men, respectively). However, MSK injury rates for MBCT cycles were statistically significantly lower than LBCT cycles for all other weeks for both men and women (p-values <0.01).



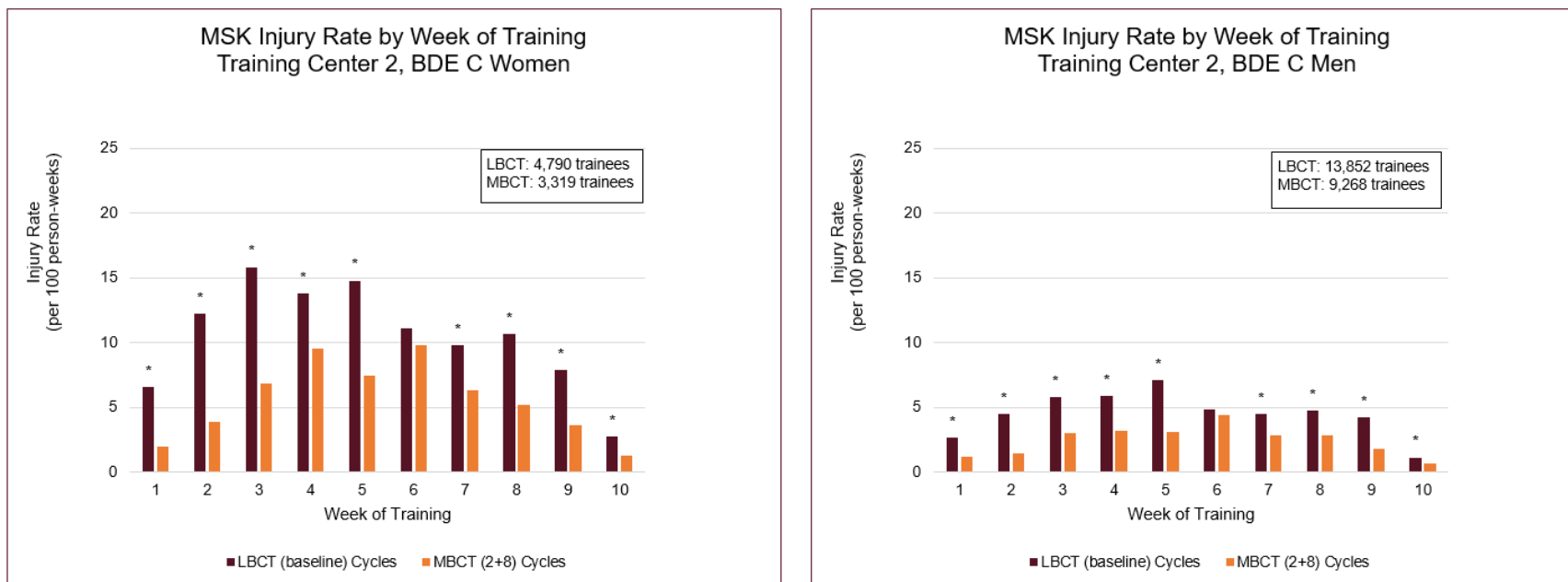
Notes:

* Statistically significant difference between MBCT cycles vs. LBCT cycles; p<0.05.

Number of trainees in each training cycle is shown in the inset box.

Figure A-2. BCT MSK Injury Rates by Week of Training at Training Center 1, BDE B

Figure A-3 shows weekly MSK injury rates in BDE B. The MSK injury rates for women during MBCT cycles were statistically significantly lower than LBCT cycles (p-values ranged from <0.01 to 0.31) for 7 out of 10 weeks. MBCT cycles were lower than rates in LBCT except for men during week 6, which was significantly higher.



Notes:

* Statistically significant difference between MBCT cycles vs. LBCT cycles; $p < 0.05$.

Number of trainees in each training cycle is shown in the inset box.

Figure A-3. BCT MSK Injury Rates by Week of Training at Training Center 2, BDE C

Figure A-4 shows at training center 3, MSK injury rates for both women and men were highest during weeks 3 and 4, respectively, during LBCT cycles. The MSK injury rate for women during week 3 for LBCT was 2.2 times higher than for MBCT; during week 4, the injury rate for men was 1.8 times higher for LBCT than MBCT. MBCT cycle injury rates were statistically significantly lower than LBCT cycles for 8 out of 10 weeks in women and 7 out of 10 weeks for men (p-values ranged from <0.01 to 0.02 for both men and women).



Notes:

* Statistically significant difference between MBCT cycles vs. LBCT cycles; $p < 0.05$.

Number of trainees in each training cycle is shown in the inset box.

Figure A-4. BCT MSK Injury Rates by Week of Training at Training Center 3, BDE D