Journal of Athletic Training 2021;56(2):134–140
doi: 10.4085/1062-6050-0498.19

www.natajournals.org



# Outcomes of Embedded Athletic Training Services Within United States Air Force Basic Military Training

**Reid Fisher, EdD, LAT, ATC*; Shandra Esparza, EdD, LAT, ATC*; Nathaniel S. Nye, MD†; Ryan Gottfredson, DO, MPH†; Mary T. Pawlak, MD, MPH†; Thomas Leo Cropper, DVM, MPH†; Theresa Casey, DVM, MPH†; Juste Tchandja, PhD, MPH†; Sarah J. de la Motte, PhD, MPH, ATC‡; Bryant J. Webber, MD, MPH§**

*University of the Incarnate Word, San Antonio, TX; †Trainee Health Surveillance, Joint Base San Antonio (JBSA)-Lackland, TX; ‡Uniformed Services University of the Health Sciences, Bethesda, MD; §United States Air Force School of Aerospace Medicine, Wright-Patterson Air Force Base, OH

***Context:*** Musculoskeletal injury is the leading cause of attrition from military training.

***Objective:*** To assess the effect of an embedded athletic training musculoskeletal care model within a basic military training unit.

***Design:*** Cluster randomized trial.

***Setting:*** United States Air Force Basic Military Training, Joint Base San Antonio—Lackland.

***Patients or Other Participants:*** Military recruits randomly assigned to 1 of 3 training squadrons, 2 control and 1 experimental, between January 2016 and December 2018.

***Intervention(s):*** A sports medicine care model was established in 1 squadron by embedding 2 certified athletic trainers overseen by a sports medicine fellowship-trained physician. The athletic trainers diagnosed and coordinated rehabilitation as the primary point of contact for recruits and developed interventions with medical and military leadership based on injury trends.

***Main Outcome Measure(s):*** Recruit attrition from basic training due to a musculoskeletal injury. Secondary outcomes were all-cause attrition, on-time graduation, rates of lower extremity injury and stress fracture, rates of specialty care appointments, and fiscal costs.

***Results:*** Recruits in the athletic training musculoskeletal care arm experienced 25% lower musculoskeletal-related attrition (risk ratio = 0.75 [95% CI = 0.64, 0.89]) and 15% lower all-cause attrition (risk ratio = 0.85 [95% CI = 0.80, 0.91]), translating to a net saving of more than $10 million. The intervention reduced the incidence of lower extremity stress fracture by 16% (rate ratio = 0.84 [95% CI = 0.73, 0.97]).

***Conclusions:*** An embedded athletic training musculoskeletal care model outperformed usual care across operational, medical, and fiscal outcomes.

***Key Words:*** injury prevention, musculoskeletal injury, stress fracture, cost avoidance

**Key Points**

- Musculoskeletal injuries are the leading cause of morbidity among US service members.
- Embedding an athletic training musculoskeletal care model within a basic military training unit resulted in less attrition due to both musculoskeletal injuries and all causes and financial savings of more than $10 million.
- This model can be improved by ongoing consideration of the unique needs and desired outcomes of the patient population.

Each year, approximately 35 000 citizens and permanent residents of the United States seek entrance into the US Air Force through enlistment. This pathway requires that several baseline eligibility criteria[1] be met and an intensive 8-week basic military training (BMT) course be completed. This transformation of civilian volunteers into uniformed members of the Armed Forces carries significant expense. To maintain a ready military force, US taxpayers cover the costs of recruiting, transporting, processing, housing, feeding, clothing, and training thousands of new recruits each year. Attrition from US Air Force BMT—ie, recruit discharge before graduation—measures around 6% and costs approximately $46 million annually.[2]

Overuse musculoskeletal injury is the leading medical diagnosis among US military recruits[3] and a primary cause of discharge from basic training.[4–6] Traditionally, enlisted medical technicians evaluate a recruit's initial complaints of pain. Practicing within an established scope of care and using clear protocols, US Air Force independent duty medical technicians can diagnose and treat some acute conditions, dispense certain medications, and conduct minor surgical procedures. As needed or as required in certain protocols, technicians refer patients to credentialed health care providers at the local military treatment facility.[7] Based on their clinical workup, providers can excuse recruits from certain physical activities, administer treatments such as medications or crutches, recommend complete removal from training into a medical hold unit, or refer the patient for specialty care, such as orthopaedics or physical therapy. This traditional model of care is reactive and time consuming. Given their significant effect and high incidence during training,[6,8–11] and considering their insidious progression,[11] overuse injuries offer a potential target for intervention and cost reduction.

Certified athletic trainers (ATs), whose skillset spans prevention, treatment, and management of musculoskeletal injuries, have been employed successfully in occupational[12–14] and military[15–17] settings. For example, an AT-based rehabilitation program for injured employees in a large health care system significantly reduced lost work days and more than doubled the odds of return to work within 3 weeks.[12] In-house rehabilitation provided by 2 ATs at a major industrial plant saved $3.5 million over a 4-year period.[13] In US Army training at Fort Leonard Wood, Missouri, AT teams and larger musculoskeletal action teams reduced medical attrition compared with the historical baseline.[15] Similarly, in US Marine Corps training at Camp Lejeune, North Carolina, a sports medicine and reconditioning team model reduced orthopaedic surgeon referrals and progression of limited-duty profiles to physical evaluation boards, as compared with historical controls.[16] Therefore, ATs embedded within BMT in the US Air Force may have positive operational and financial effects on military readiness.

Using a randomized approach with a concurrent comparison group, we sought to determine if establishing an athletic training musculoskeletal care model would affect operational, medical, and fiscal outcomes in US Air Force BMT. Over a 3-year period, we compared outcomes in the athletic training model arm with those in the usual-care control arm. We hypothesized that earlier recognition of overuse injuries, in conjunction with corrective therapeutic and rehabilitative care, might curtail injury progression, reduce attrition, and save money. Furthermore, we postulated that embedding ATs within the squadron—the core functional unit of the US Air Force—would provide a unique opportunity for collaboration with military and medical leadership.

## METHODS

### Setting and Population

United States Air Force BMT is conducted exclusively at Joint Base San Antonio—Lackland. As many as 8000 recruits are in various stages of training at any given time. Approximately one-quarter of recruits are female. Upon arrival to the base, new recruits are randomly assigned to training squadrons. Each squadron has its own dormitory building and adjacent fitness complex. In addition to daily marching and drilling, recruits participate in 55 to 60 minutes of physical training within their squadron 5 to 6 days per week; these workouts have been described previously.[6]

### Project Design

In this cluster randomized community intervention trial, 2 certified ATs hired within 6 months of graduation from a Commission on Accreditation of Athletic Training Education–accredited program provided full-time care in 1 training squadron from January 2016 through December 2018. A board-certified sports medicine physician 1.5 years postfellowship and 2 athletic training faculty members with more than 13 years of professional experience provided oversight.

### Standard Medical Care, Medical Hold, and Attrition

For recruits in both the control and intervention arms, medical care was provided at a primary care clinic within walking distance of the BMT campus, with specialty care (eg, orthopaedic surgery and physical therapy) available at other facilities on or off the Joint Base San Antonio—Lackland installation. Whereas both arms had access to this standard medical care, recruits in the intervention arm had additional access to the aforementioned sports medicine care.

For both the control and intervention arms, recruits who sustained minor injuries could be returned to training with temporary duty restrictions for predetermined lengths of time, usually less than a week. Recruits deemed unsafe to continue training by the medical provider—whether due to injury severity or another medical or mental health concern—were removed from their squadron and referred to the medical hold unit. Recruits who could not pass their final fitness assessment but who otherwise qualified for graduation were transitioned into the Get Fit program, in which they focused on improving their fitness scores. Recruits in medical hold or Get Fit could eventually return to and graduate from training or be discharged. All medical discharge decisions were made by Air Force medical leadership at Joint Base San Antonio—Randolph, in accordance with Department of Defense accessions policy.[1]

Attrition from BMT is coded based on the underlying cause, with medical, mental health, and administrative codes predominating. Medical attrition is further classified by organ system and diagnosis, and musculoskeletal attrition is subclassified by anatomic site. Although the dichotomous outcome of attrition or graduation is of supreme importance for military readiness, the Air Force is also concerned with timely graduation and graduates' fitness for duty; recruits assigned to medical hold or Get Fit who return to training may graduate later than expected, which delays advanced training and affects operational units. Recruits who graduate with a low level of fitness may be more likely to fail subsequent fitness tests or fail to complete their term of enlistment.

### Intervention

The intervention squadron was selected randomly and approved by training leadership. Two other training squadrons served as the control arm and received usual medical care (see following paragraphs). All remaining policies (eg, discharge rules and fitness requirements) were held constant between the intervention and control arms. Random assignment of new recruits into the 3 study squadrons was not affected by the intervention.

Intervention ATs worked within the squadron dormitory on the ground floor, just inside the fitness complex, thereby providing convenient access to recruits. The dedicated athletic training space, approximately 300 square feet (91.5 $m^2$), contained a gait-analysis treadmill, examination tables, therapeutic electrical modalities, and standard rehabilitation equipment. Two workstations for documenting encounters in the outpatient electronic health record of the Military Health System were installed. A separate outdoor space contained 20 stationary bicycles, 2 motorless treadmills, and an outdoor treatment table or storage cart. Two full-time, bachelor's-level, certified ATs supplied care for 8 hours per day. The local military treatment facility approved them to deliver care within their scope of practice, as outlined in the Texas Administrative Code[18] and guidance published by the National Athletic Trainers' Association.[19,20] Two doctoral-level athletic training faculty members from a nearby university provided leadership to support continuous process improvement. The team focused on establishing communication protocols across various providers and prioritized patient encounter scheduling, adaptive treatment interventions, and advanced rehabilitation program development to optimize patient outcomes. The sports medicine physician cosigned many clinical notes, offered consultations, and evaluated patients with more challenging conditions in the sports medicine clinic. In comparison, control-arm recruits sought care through the established primary care facility. None of their providers were specifically trained in sports medicine.

In addition to delivering outpatient care, the ATs were present for most daily physical training sessions. During these periods, the ATs led alternative, low-impact, tailored exercise regimens for injured recruits who could not participate with their peers. They were also accessible to recruits who developed or presented with a musculoskeletal concern during the regular training session. Alternative regimens included stationary cycling, core strength training, stretching, and other forms of rehabilitation. The ATs also taught running technique to recruits and instructors, and they supplied individualized gait training to select recruits who were slow runners, had particularly poor running technique, or sustained gait-related injuries. Gait-analysis and gait-retraining principles and methods were taught and overseen by an athletic training faculty member and board-certified sports medicine physician, both of whom had experience and training in this area. Though individualized to the recruit, gait instruction was focused on increasing the cadence, improving gluteal activation, and landing under the center of mass.

## Outcomes

We compared operational, medical, and fiscal outcomes in the intervention and control arms. The primary outcome of interest was *musculoskeletal attrition*, which was the percentage of recruits discharged due to a musculoskeletal injury. Secondary operational outcomes were all-cause attrition, other (nonmusculoskeletal) medical attrition, mental health attrition, administrative attrition, referral to medical hold and Get Fit, on-time graduation, and change in Air Force Fitness Assessment[20] performance between the entry (week 1) and exit (week 7) exams.

We defined a *musculoskeletal injury* as receipt of an *International Classification of Diseases, Tenth Revision*[21] (ICD-10) code in any diagnostic position during an outpatient medical encounter. Injuries were categorized according to an ICD-10 update of a published matrix, in which each cell corresponds to 1 body part and 1 injury type, without distinction by laterality.[6,22] To capture only incident injuries, rather than recounting prevalent injuries, recruits could receive only 1 diagnosis per matrix cell during their training period. We calculated rates of lower extremity musculoskeletal injuries and stress fractures by dividing the count by person-days in training. Stress fractures were selected a priori as an outcome of interest because of their high incidence in military training,[6,8] significant fiscal cost,[9] and operational ramifications.[23–25] To assess the burden of care, we also determined the number of outpatient encounters for musculoskeletal injuries. For burden, encounters were limited to 1 per recruit per matrix cell per day. This was determined overall and by specialty clinic type. We computed rates of encounters for inflammation and pain, lower extremity musculoskeletal injuries, and lower extremity stress fractures by dividing the count by person-days in training.

To assess the fiscal effect of the intervention, we compared the expected and observed counts of attrition, missed training days, and specialty clinic appointments in the intervention arm, using the control arm to determine the expected counts. *Missed training days* were defined as the discrepancy between the total days in training and the days required to complete training. We assessed the operational cost as the sum of the attrition cost ($25 376 per recruit, which includes recruiting, processing, and training) and the missed training time cost ($496 per missed day), the costs of which were provided by the BMT command. *Direct specialty medical cost* was identified as the sum of orthopaedic ($837) and physical and occupational therapy ($104) encounters, the costs of which were provided by the military treatment facility administrator. All rates used actual training days to account for the differences in size between the intervention and control arms.

## Funding and Participant Protection

The study was funded exclusively through a grant from the Congressionally Directed Medical Research Programs (award No. FMBB100884757). The study was characterized as a program evaluation by the 59th Medical Wing Institutional Review Board, with concurrence by the Human Research Protection Office of the US Army Medical Research and Materiel Command, obviating the requirement of signed informed consent. Program evaluation oversight was provided by the commander, US Air Force BMT, to whom we delivered quarterly updates. Recruits assigned to the intervention arm were given oral and written orientations to the athletic training clinic and were entitled to all patient protections under the Patients' Bill of Rights, including the right to refuse care.

## Data Sources and Statistical Analysis

The Basic Training Management System stores squadron assignment, age, sex, body mass index (BMI; weight in kg/height in m$^2$), fitness scores, and operational outcomes data (ie, attrition, on-time graduation, and referral to medical hold and Get Fit). We accessed the Trainee Health Surveillance database for attrition information and the Armed Forces Health Longitudinal Technology Application for diagnostic and clinic codes. Although recruits were randomly assigned to the intervention and control arms irrespective of their demographic, anthropometric, and fitness profiles, we compared the intervention and control

Table 1. Demographic and Baseline Characteristics of Participants in the Intervention and Control Arms

| Characteristic | Intervention Arm (n = 20 810) | Control Arm (n = 35 590) | *P* Value |
|---|---|---|---|
| Sex, No. (%) | | | <.001 |
| Male | 15 897 (76.4) | 26 165 (73.5) | |
| Female | 4913 (23.6) | 9425 (26.5) | |
| | Mean ± SD | | |
| Age, y | 22.3 ± 3.6 | 22.4 ± 3.6 | .001 |
| Body mass index | 23.9 ± 3.8 | 24.0 ± 2.8 | <.001 |
| Initial fitness score[a] | 72.6 ± 23.6 | 68.8 ± 24.3 | <.001 |

[a] Scored as *excellent* (≥90.0), *satisfactory* (75.0–89.9), or *unsatisfactory* (≤74.9).

populations for baseline similarity. Using OpenEpi (version 3.01; Atlanta, GA)[26] for our calculations, we compared attrition, medical hold and Get Fit referrals, and on-time graduation between the arms using risk ratios with 95% CIs. We also compared rates of diagnoses and encounters using rate ratios with 95% CIs. Risks and rates were considered higher in the intervention arm if the CI was greater than 1, lower if the CI was less than 1, and statistically equivalent if the CI crossed 1. For the continuous variables of age, BMI, and fitness scores, we compared the arms using unpaired *t* tests, with significance levels set a priori at $P < .05$. We evaluated fitness score changes using Cohen d, which provides a method for evaluating the effect size of differences between group means; Cohen suggested that effect sizes can be considered *small* (d = 0.20), *medium* (d = 0.50), or *large* (d = 0.80).[27]

## RESULTS

Over the study period, 20 810 recruits were randomly assigned to the intervention squadron and 35 590 recruits to the control squadrons (Table 1), accruing 1 206 445 training days and 2 173 218 training days, respectively. The intervention arm outperformed the control arm across most operational (Table 2) and medical (Table 3) outcomes. Specifically, 0.94% of recruits (n = 195) were discharged for a musculoskeletal injury in the intervention arm versus 1.25% of recruits (n = 444) in the control arm, for a 25% lower musculoskeletal attrition risk (risk ratio = 0.75 [95% CI = 0.64, 0.89]). An increase in the total number of encounters for inflammation and pain occurred in the experimental squadron as compared with the control squadrons (risk ratio = 1.46 [95% CI = 1.41, 1.50]), and a subsequent 11% increased risk was shown in lower extremity injury diagnosis as well (risk ratio = 1.11 [95% CI = 1.05, 1.17]). From the beginning to the end of BMT, recruits in the intervention arm improved their fitness assessment scores by a mean of 19.7 ± 19.2 points versus 11.9 ± 34.0 points among recruits in the control arm ($P <$ .001; Cohen d = 0.284).

Using the musculoskeletal attrition percentage in the control arm (1.25%) and the amount of associated lost duty time (13.7 per 1000 training days), we found that the intervention arm was expected to experience 260 cases of musculoskeletal attrition and 16 820 lost duty days. In reality, participants experienced 195 cases and 7506 lost duty days. The recouping of 65 recruits and 9314 training days resulted in a musculoskeletal cost savings of $6 259 326 compared with standard care. When assessed by all-cause attrition (which includes musculoskeletal attrition), the intervention arm prevented 207 discharges and 11 513 lost training days, for a total operational savings of $10 957 132. Additionally, the intervention squadron had 119 fewer orthopaedic visits and 3988 fewer physical and occupational therapy visits than would have been expected with standard care, for a total direct medical cost savings of $495 823. Total cost avoidance, when factoring in all-cause attrition and medical costs, was $11 452 955. Subtracting the $979 874 spent on personnel, equipment, and supplies, the net savings to the US Air Force was $10 473 081.

## DISCUSSION

Over a 3-year period, US Air Force recruits randomly assigned to a squadron with an embedded athletic training model experienced 25% less musculoskeletal attrition and 15% less all-cause attrition compared with their peers assigned to squadrons receiving usual care, resulting in a net savings of more than $10 million. This is the first rigorously controlled interventional study of embedding athletic training services in a military basic training environment. Previous AT interventions have demonstrated effectiveness in US Army[15] and Marine Corps[16] training units, but the authors of those studies relied on historical data for comparisons.

The success of this intervention was likely multifactorial. Understanding these factors may improve reproducibility and generalizability to other populations. First, the intervention provided by the ATs and board-certified sports medicine physician took the principles of on-site access to care, early diagnosis and treatment, load progression, and a goal of keeping the athlete "in the game" from experiences with collegiate and professional athletes and adapted them for the military training environment. The proximity to

Table 2. Operational Outcomes in the Intervention and Control Arms

| Outcome | Arm, No. (%) Intervention (n = 20 810) | Control (n = 35 590) | Risk Ratio (95% CI) |
|---|---|---|---|
| Musculoskeletal attrition | 195 (0.94) | 444 (1.25) | 0.75 (0.64, 0.89) |
| All-cause attrition | 1210 (5.81) | 2423 (6.81) | 0.85 (0.80, 0.91) |
| Other medical attrition | 416 (2.00) | 885 (2.49) | 0.80 (0.72, 0.90) |
| Mental health attrition | 607 (2.92) | 1057 (2.97) | 0.98 (0.89, 1.08) |
| Administrative attrition | 214 (1.03) | 367 (1.03) | 1.00 (0.84, 1.18) |
| On-time graduation | 19 387 (93.2) | 32 984 (92.7) | 1.01 (1.00, 1.01) |
| Medical hold referral | 1199 (5.76) | 2430 (6.83) | 0.84 (0.79, 0.90) |
| Get Fit referral | 245 (1.18) | 447 (1.26) | 0.94 (0.80, 1.09) |

**Table 3. Medical Outcomes in the Intervention and Control Arms**

| Outcome | Arm, No. (Rate) Intervention (n = 20 810) | Control (n = 35 590) | Rate Ratio (95% CI) |
| --- | --- | --- | --- |
| Diagnosis[a] | | | |
| Lower extremity injury[b] | 2258 (1.9) | 3668 (1.7) | 1.11 (1.05, 1.17) |
| Lower extremity stress fracture | 291 (0.2) | 621 (0.3) | 0.84 (0.73, 0.97) |
| Encounters by type[c] | | | |
| Inflammation and pain | 7396 (6.1) | 9137 (4.2) | 1.46 (1.41, 1.50) |
| Lower extremity injury[b] | 10 445 (8.7) | 20 382 (9.4) | 0.92 (0.90, 0.95) |
| Lower extremity stress fracture | 3515 (2.9) | 11 152 (5.1) | 0.57 (0.55, 0.59) |
| Appointments by clinic[d] | | | |
| Orthopaedics | 91 (0.1) | 379 (0.2) | 0.43 (0.34, 0.54) |
| Physical and occupational therapy | 2123 (1.8) | 11 008 (5.1) | 0.35 (0.33, 0.36) |

[a] Outpatient medical diagnoses per 1000 training-days and limited to 1 per person per type for the entire training period; includes all diagnostic positions.
[b] Lower extremity injuries were defined according to a previous publication.[6]
[c] Outpatient medical encounters per 1000 training-days and limited to 1 per person per type per day; includes all diagnostic positions.
[d] Outpatient appointments per 1000 training-days and limited to 1 per person per clinic per day.

training leadership and recruit living quarters engaged the ATs as a conduit for coordinated patient care, reducing a previous barrier. This allowed for earlier intervention, thereby lessening the severity of the injury and encouraging an earlier return to training. The intervention arm's higher rate of inflammation and pain encounters but lower rates of stress fractures and musculoskeletal attrition suggest that the recruits and training staff likely felt more comfortable seeking care from the sports medicine team compared with those in the control arms, who required a separate medical visit and lost additional training time. The ATs worked to redefine a culture of "pain as weakness" into one of "pain as an indication of injury," thereby providing an avenue for intervention and prevention. The 11% increased incidence of lower extremity injury diagnosis can likely be attributed to the same narrative. Easier access in a changed culture of care prompted more trainees to seek help, yielding increased injury diagnosis counts and more frequent therapy sessions that increased the number of encounters. The result was fewer injuries that progressed to training losses for the military.

Second, efforts to integrate ATs into standard military medicine were crucial. The medical and military leadership supported the intervention, but some providers were not well informed of the sports medicine model of care or the capabilities of ATs. New to the culture of US Air Force BMT, the ATs sought to enhance trust and communication, requiring both entities to adapt their perceptions. Academic leadership was crucial in this regard, accelerating the necessary learning curves and educating military training instructors to improve their understanding of physical training paradigms within the injury-prevention model. Ultimately, the providers recognized the ATs as competent, independent health care professionals and fully integrated them into the medical community. The ATs also integrated into the military unit and were both physically embedded and figuratively accepted as teammates. This integration allowed the ATs to serve as a critical link between the training staff and medical personnel, making real-time decisions and communicating directly with the training staff. The result was enhanced communication and facilitated operational integration among recruits, training staff, and medical personnel and mitigated real or perceived barriers to care.

Third, programmatic success hinged on ongoing process improvement. The sports medicine physician maintained consistent communication with the ATs to advise on more severely injured patients and improve protocols as needed. In coordination with the preventive medicine unit, the academic leads tracked injury trends and developed unique interventions in coordination with the ATs to optimize outcomes. Novel means of retraining running gait became a mainstay in curtailing the progression of bone stress injuries to fractures. Embedding ATs resulted in the sports medicine team's adaptation of practice to the areas of greatest need within the intervention arm.

Compared with their peers in the control arm, recruits in the intervention arm improved their fitness scores by a significantly greater margin—a change of 7.8 points. Although this would be considered a small to medium effect size based on the Cohen d value (0.284), 7.8 points can be an important difference on a 100-point fitness assessment scale with only 3 tiers: *excellent* ($\geq$90.0), *satisfactory* (75.0–89.9), or *unsatisfactory* ($\leq$74.9).[28] Recruits who had access to the intervention graduated as airmen with a higher level of military readiness and fitness for duty. This observation also refutes the notion that the sports medicine team mostly helped less fit, injury-prone individuals by keeping them on duty restrictions during BMT, only to be discharged later due to fitness test failures or injury. If this had been the case, we would have expected lower fitness test scores in the intervention arm. Of note, the intervention group had slightly higher mean fitness scores at the start of training, but the reason is unclear given the random allocation of recruits into squadrons. This difference would seem to favor the control arm, as their recruits had greater room for improvement. Because commanders are more interested in fitness levels at graduation than at entry, this finding supports the operational effect of the AT intervention.

Some limitations of our work should be considered. First, we did not include long-term outcome data, such as first-term enlistment completion or physical fitness scores and health care utilization rates as active duty service members. Second, by virtue of its comprehensive nature and community design, we cannot comment on specific aspects of the intervention that may or may not have been effective.

The highly standardized and codified nature of training across all US Air Force BMT squadrons suggests that universal application of this model would likely yield similar results. Future studies of an expanded model are warranted to confirm and describe these effects. An expanded multidisciplinary team, including certified strength and conditioning specialists and registered dietitians, may improve the operational effect and merits further investigation.

## CONCLUSIONS

We provided high-quality evidence that supports the embedding of sports medicine teams, including ATs, in military units. Just as this intervention was tailored to the needs of basic training, other embedded models of care should be tailored to the unique needs of each military unit. In addition to acquiring the appropriate medical, legal, and leadership oversight, we recommend a continuous process improvement paradigm focused on the unique needs and desired outcomes of the patient population. In our study, for example, the epidemiology and effects of stress fractures and the unique qualifications and abilities of athletic trainers drove our model of care. As the leading cause of morbidity among US service members, musculoskeletal injury is a major problem in the Armed Forces; unit-embedded sports medicine teams offer an evidence-based solution.

## DISCLAIMER

The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the US Air Force, the Uniformed Services University of the Health Sciences, the Department of Defense, or the US government.

## REFERENCES


1. Department of Defense instruction: qualification standards for enlistment, appointment, and induction. Executive Services Directorate Web site. https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/130426p.pdf. Published October 26, 2018. Accessed August 16, 2019.
2. Bartlett CG, Stankorb S. Physical performance and attrition among U.S. Air Force trainees participating in the basic military training fueling initiative. *Mil Med*. 2017;182(1):e1603–e1609. doi: 10.7205/MILMED-D-15-00451.
3. Surveillance snapshot: illness and injury burdens, recruit trainees, active component, U.S. Armed Forces, 2018. *MSMR*. 2019;26(5):27.
4. Reis JP, Trone DW, Macera CA, Rauh MJ. Factors associated with discharge during Marine Corps basic training. *Mil Med*. 2007;172(9):936–941. doi: 10.7205/milmed.172.9.936.
5. Knapik JJ, Canham-Chervak M, Hauret K, Hoedebecke E, Laurin MJ, Cuthie J. Discharges during U.S. Army basic training: injury rates and risk factors. *Mil Med*. 2001;166(7):641–647.
6. Nye NS, Pawlak MT, Webber BJ, Tchandja JN, Milner MR. Description and rate of musculoskeletal injuries in Air Force basic military trainees, 2012–2014. *J Athl Train*. 2016;51(11):858–865. doi: 10.4085/1062-6050-51.10.10.
7. The Air Force Independent Duty Medical Technician Program: AF Instruction 44-103. Department of the Air Force Web site. https://static.e-publishing.af.mil/production/1/af_sg/publication/afi44-103/afi44-103.pdf. Published August 20, 2018. Accessed February 13, 2020.
8. Lee D, Armed Forces Health Surveillance Center (AFHSC). Stress fractures, active component, U.S. Armed Forces, 2004–2010. *MSMR*. 2011;18(5):8–11.
9. Kupferer KR, Bush DM, Cornell JE, et al. Femoral neck stress fracture in Air Force basic trainees. *Mil Med*. 2014;179(1):56–61. doi: 10.7205/MILMED-D-13-00154.
10. Curell AM, Nye NS, Webber BJ, Pawlak MT, Boden BP. Treatment and prognosis of high- and low-risk Kaeding grade II bone stress injuries. *Transl J Am Coll Sports Med*. 2019;4(15):114–118.
11. Nye NS, Covey CJ, Sheldon L, et al. Improving diagnostic accuracy and efficiency of suspected bone stress injuries. *Sports Health*. 2016;8(3):278–283. doi: 10.1177/1941738116635558.
12. Larson MC, Renier CM, Konowalchuk BK. Reducing lost workdays after work-related injuries: the utilization of athletic trainers in a health system transitional work program. *J Occup Environ Med*. 2011;53(10):1199–1204. doi: 10.1097/JOM.0b013e31822cfab3.
13. Zimmerman GR. Industrial medicine and athletic training: cost-effectiveness in the non-traditional setting. *J Athl Train*. 1993;28(2):131–136.
14. Nicolello TS, Pecha FQ, Omdal RL, Nilsson KJ, Homaechevarria AA. Patient throughput in a sports medicine clinic with the implementation of an athletic trainer: a retrospective analysis. *Sports Health*. 2017;9(1):70–74. doi: 10.1177/1941738116676452.
15. Knapik JJ, Graham B, Cobbs J, et al. *The Soldier-Athlete Initiative: Program Evaluation of the Effectiveness of Athletic Trainers Compared to Musculoskeletal Action Teams in Initial Entry Training, Fort Leonard Wood, June 2010–December 2011*. Aberdeen Proving Ground, MD: Army Public Health Command; 2012.
16. Brawley S, Fairbanks K, Nguyen W, Blivin S, Frantz E. Sports medicine training room clinic model for the military. *Mil Med*. 2012;177(2):135–138. doi: 10.7205/milmed-d-11-00331.
17. Pizzi A, Sefton J. Warrior athletic training: unexpected benefits of army-university collaborations. *Infantry*. 2012;101(2):47–48.
18. Athletic trainers: Texas Administrative Code: Title 16, Part 4, Chapter 110. Office of the Texas Secretary of State Web site. https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=4&ti=16&pt=4&ch=110. Accessed August 16, 2019.
19. Athletic training education competencies. 5th ed. Commission on Accreditation of Athletic Training Education Web site. https://caate.net/wp-content/uploads/2014/06/5th-Edition-Competencies.pdf. Accessed August 20, 2019.
20. Athletic training services: an overview of skills and services performed by certified athletic trainers. National Athletic Trainers' Association Web site. https://www.nata.org/sites/default/files/GuideToAthleticTrainingServices.pdf. Published January 2010. Accessed August 20, 2019.
21. World Health Organization. *International Classification of Diseases*. Tenth Revision. Geneva, Switzerland: World Health Organization; 1992.
22. Nye NS, Carnahan DH, Jackson JC, et al. Abdominal circumference is superior to body mass index in estimating musculoskeletal injury risk. *Med Sci Sports Exerc*. 2014;46(10):1951–1959. doi: 10.1249/MSS.0000000000000329.
23. Lee CH, Huang GS, Chao KH, Jean JL, Wu SS. Surgical treatment of displaced stress fractures of the femoral neck in military recruits: a report of 42 cases. *Arch Orthop Trauma Surg*. 2003;123(10):527–533. doi: 10.1007/s00402-003-0579-8.
24. Pihlajamaki HK, Ruohola JP, Kiuru MJ, Visuri TI. Displaced femoral neck fatigue fractures in military recruits. *J Bone Joint Surg Am*. 2006;88(9):1989–1997. doi: 10.2106/JBJS.E.00505.
25. Webber BJ, Trueblood WE, Tchandja JN, Federinko SP, Cropper TL. Concurrent bilateral femoral neck stress fractures in a military recruit: a case report. *Mil Med*. 2015;180(1):e134–e137. doi: 10.7205/MILMED-D-14-00289.
26. Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version Web site.

www.OpenEpi.com. Updated April 6, 2013. Accessed July 31, 2020.
27. Cohen J. A power primer. *Psychol Bull*. 1992;112(1):155–159. doi: 10.1037/0033-2909.112.1.155.
28. Fitness program: AF Instruction 36-2905. Department of the Air Force Web site. https://static.e-publishing.af.mil/production/1/af_a1/publication/afi36-2905/afi36-2905.pdf. Published August 27, 2015. Accessed February 13, 2020.

*Address correspondence to Reid Fisher, EdD, LAT, ATC, University of the Incarnate Word, 4301 Broadway, CPO 300, San Antonio, TX 78209. Address email to Reid_A_Fisher@hotmail.com.*