Injury Epidemiological Investigations in Army Special Populations

Anna Renner, PhD

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Injury Prevention Epidemiologic Investigations & Special Studies

- *Assessments of injuries and injury risk for:*
  - Infantry units
  - Military police
  - Army Wheeled Vehicle Mechanics
  - Medical (Leonard Wood Army Community Hospital staff)
  - Armor Brigade
  - Chemical Brigade
  - Paratroopers
  - Quartermaster Brigade
  - U.S. Army Band
  - Special Operations Forces
  - Army War College
  - Command and General Staff College
  - Sergeants Major Course
  - Ordnance School
  - Combat Medic Advanced Individual Training
  - Military Working Dogs
  - Federal Bureau of Investigation
  - Running Shoe Study: Marine Corps Officer Basic Training, Air Force Basic Military Training

Special Population #1: U.S. Army Band

Background

- Fulfilled a 2018 request from unit Commanders to **investigate musculoskeletal injuries** among members in the 42S MOS in the Military District of Washington/National Capital Region (MDW/NCR):
  - The U.S. Army Band (TUSAB), The U.S. Army Field Band (TUSAFB), The U.S. Army Old Guard Fife & Drum Corps (OGFDC)

- Unique population - injuries and risk factors may differ from other Army populations
- Extends previous work by DCPH-A Injury Prevention, 2004-2005

Demographics (n=465 Army Band Members, rosters)

Variable	Characteristic	All Band Members n=465 n (%)
Sex	Female	113 (24.3)
	Male	352 (75.7)
Age (years)	18–24	12 (2.6)
	25–34	144 (31.0)
	35–44	192 (41.2)
	≥ 45	117 (25.2)
	Mean ± SD	38.9 ± 8.0
Rank	E1–E4	4 (0.9)
	E5–E9	449 (96.6)
	O1–O6	9 (1.9)
	W1–W5	3 (0.6)

Instruments were predominantly brass and woodwinds in all groups; more percussion in Old Guard Fife & Drum

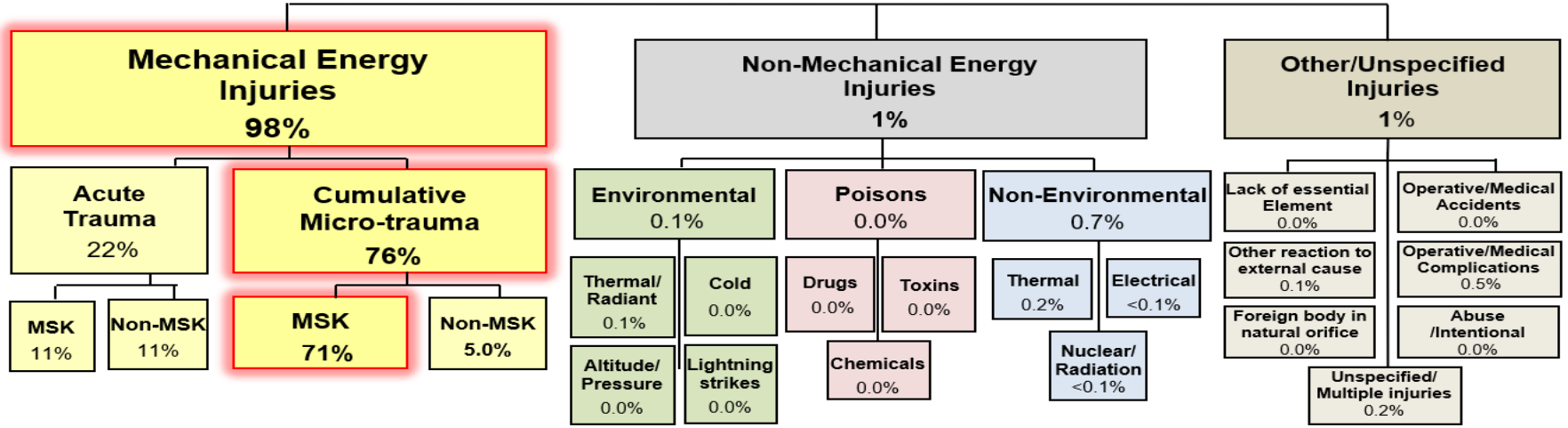
Unique Population Characteristics

	Impacts on injuries and injury risk factors
Older average age (39 ± 8)	Guesses?
24% female	
Extended standing, sitting, marching	
Non-neutral playing postures	
Loading/unloading instruments and equipment for performances (*some)	

Discussion: How might these unique population characteristics impact injuries and injury risks?

Results: U.S. Army Band Injuries

- Medical record
  - n=766 medical record injuries, October 2017-December 2018
  - 71% of injuries were MSK overuse



Injury Rates and Prevalence, October 2017–2018

	All Band Members n=465	All Army n=465k
Crude injury rate per 1,000 person-years	1,328	1,821
Age- and gender-adjusted injury rate per 1,000 person-years	1,040	1,821
Percent with at least one medical encounter for injury	60	56
Total medical encounters for injuries (including follow-up visits and long-term effects of MSK injuries)	1,919	2.2M

Results: U.S. Army Band Injuries

- Self-reported via electronic survey
  - 48% response rate (n=221, total n=465)
  - 80% of respondents reported at least one injury in the previous 12 months (n=176)
  - Most frequently injured body regions were the lower back (26%), foot/toe (13%) and knee (9%)

Top activities associated with injury (self-report, n=174 injuries)	Top mechanisms of injury (self-report, n=174 injuries)
21% running for physical training	30% band-related overuse/repetitive motions
11% repetitive movements associated with playing	25% other overuse/repetitive motions
11% standing while practicing, rehearsing, or performing	15% overexertion/over-extension/twisting effort

Results: Risk Factors for Injury among U.S. Army Band Musicians (Multivariable, Men Only)

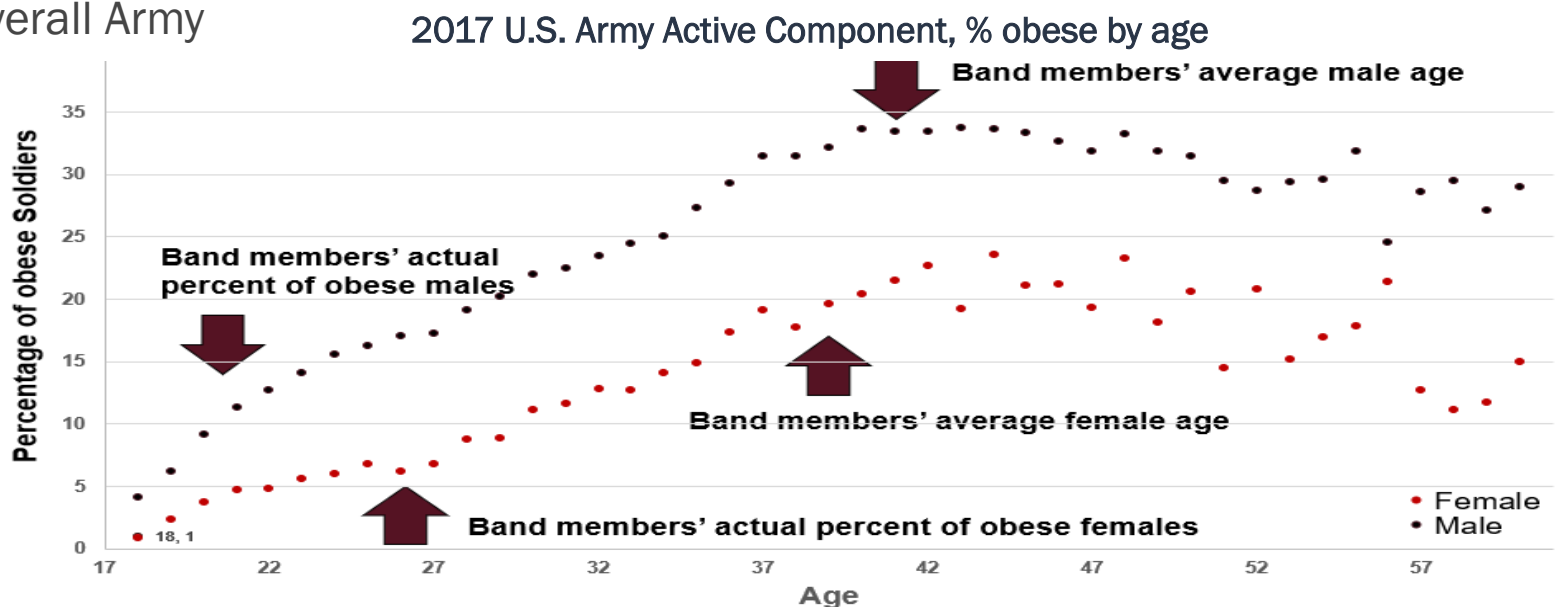
		Total n	% with any injury	Odds Ratio (95% CI)	Category p-values
Fitness test 2-mile run time	<15.4 minutes	100	63%	Ref	
	15.4–16.9 minutes	101	70%	1.33 (0.73–2.42)	0.36
	>16.9 minutes	**102**	**84%**	**2.23 (1.07–4.67)**	**0.04**
	No data	49	90%	N/A	N/A
Estimated body fat percentage	<20.5	113	69%	Ref	
	20.5–23.5	120	68%	0.87 (0.48–1.63)	0.66
	>23.5	**117**	**89%**	**2.30 (1.02–5.18)**	**0.04**
	No data	2	0%	N/A	N/A
Age (years)	18–34	56	79%	Ref	
	35–44	64	86%	0.88 (0.48–1.63)	0.69
	≥45	38	92%	1.04 (0.47–2.31)	0.93

Recommended Injury Prevention Strategies U.S. Army Band Musicians

- Increase physical training, with a variety of activities
  - Leadership support needed, scheduled around occupational expectations (rehearsals, performances, practicing, etc.)
  - Armed Forces Wellness Center services can be utilized for training support and education
  - Support from athletic trainers, physical therapists, occupational therapists have been shown to improve injury risk among musicians
- Request ergonomic assessments to address non-neutral and maladaptive postures
- Use relaxation techniques, take breaks while rehearsing

Other interesting findings - U.S. Army Band Musicians

Army Band Soldiers had comparable average BMI (26kg/m^2 men, 24kg/m^2 women) and lower proportion of obese (12% men; 7% women), compared to the overall Army



Discussion

- Thoughts, insights, questions about injuries among Army Band members?

Special Population #2: U.S. Army Reserves

Background

- Fulfilled a 2020 request from the U.S. Army Reserve Command to investigate impacts of a new fitness program Pilot among 21 selected Reserve units in the southeast U.S.
  - Baseline phase 2021 – summarize pre-implementation injuries, risk factors, health behaviors
  - Follow-up phase 2023 – in progress; will compare injuries, risk factors, and health behaviors before and after new fitness program

- Unique population – not typically included in Army medical surveillance; sparse literature about injuries and fitness among Reservists

Background

- A novel Pilot program was necessary for the geographically-diverse and part-time Reserve population
- USARC Pilot design includes two groups with differing degrees of support, plus a comparison group

Year 1: 1 AUG 2021 Year 2: 1 AUG 2022	Pilot A Pilot A and B common elements in red	Pilot B	Control Group
Participating Units	7 units, southeast U.S.	7 units, southeast U.S.	7 units, southeast U.S.
Pilot Resources	• Virtual Holistic Health and Fitness (H2F) education 2x/year, 8 hours via Contracted H2F team (Year 1) • Access to CoachMe Plus- mobile app to deliver customized physical training programs (Year 1) • Access to H2F Education via All Partners Access Network (APAN) website • Link to Troop Program Unit (TPU) Physical Therapist, Occupational Therapist, and Dietitian • 1:100 Instructor-to-Soldier ratio for Master Fitness Trainers (MFTs)/Master Resilience Trainers (MRTs) • Human Performance Advisor • Eight 90-minute education sessions by O2X© (Year 2) • O2X© mobile application (Year 2) • 3-day H2F Summit events, education, resources, and Individual assessments provided on H2F domains (Year 2)	• Access to H2F Education via APAN website • Link to TPU Physical Therapist, Occupational Therapist, and Dietitian • 1:100 Instructor-to-Soldier ratio for MFT/MRT • Human Performance Advisor • O2X© mobile application (Year 2) • 3-day H2F Summit events, education, resources, and Individual assessments provided on H2F domains (Year 2)	No access to H2F Pilot Resources

Demographics summary (n=2,095 survey respondents)

- 73% male, 27% female
- Average age 31 ± 10 years
- Average BMI 27 ± 4 kg/m2
- 60% white, 28% black, 12% other
- 36% Bachelor's degree or higher
- 47% E1-E4
- 50% Single/never married
- Leading military occupations: military police (21%), medical (21%), engineers (19%)

Unique Population Characteristics

	Impacts on injuries and injury risk factors
Older average age (31 ± 10)	Guesses?
27% female	
Higher average BMI	
Little or no unit training	

Discussion: How might these unique population characteristics impact injuries and injury risks?

Results: U.S. Army Reservist Injuries

- Did not focus on medical records; Reservists can seek care outside of the Military Health System
- Self-reported via electronic survey
  - 61% response rate (n=2,095, total n=3,414)
  - 30% of respondents reported at least one injury in the previous 12 months (n=626)

Leading injury types	Leading injured body areas	Leading injury activities
Strained muscle (19%)	Lower back (21%)	Running (22%)
Sprained joint (12%)	Knee (20%)	Weightlifting (18%)
Pain in body part (11%)	Shoulder (12%)	Lifting heavy objects (12%)

Results: Risk Factors for Injury among U.S. Army Reservists

Among men (n=1,517), independent factors significantly associated with a PT-limiting injury were:

- Age ≥35 (p<0.01)
- High overweight or obese BMI (≥27.5, p<0.01)
- ≤5 hours of sleep per night on weekdays (p<0.01)
- No weekly sprint training (p=0.03)
- Moderate weekly exercise minutes for PT (156–360 minutes, p<0.01)

Among women (n=563), independent factors significantly associated with PT-limiting injury were:

- Age ≥35 (p=0.01)
- Obese BMI (≥30, p=0.02)
- Moderate or high perceived stress (p=0.02)

Recommended Injury Prevention Strategies U.S. Army Reservists

- Will be based on follow-up phase comparisons assessing the impacts of the new fitness program
  - Will assess impacts of lower fitness and higher body mass

Other interesting findings - U.S. Army Reservists

- This Reserves population had lower proportions of Soldiers reporting tobacco use, compared to the overall Army
- A higher proportion of Reservists were obese (27% of men, 17% of women), compared to AD Army
- Lower proportion of Reservists passed their most recent ACFT test (78% of men, 38% of women), compared to AD Army

Discussion

- Thoughts, insights, questions about injuries among Army Reservists?

Special Population #3: Employees at the General Leonard Wood Army Community Hospital (GLWACH)

Background

- Fulfilled a 2014 request from GLWACH leadership to **investigate injuries and health behaviors** among hospital staff

- Unique population – employees include both civilians and Active-Duty

Demographics summary (n=380 survey respondents)

- 44% male, 56% female
- 47% were 26-39 years
- 53% military, 45% DA Civilians, 2% other
- 49% Bachelor's degree or higher
- A variety of occupations were represented, including nurses (16%), hospital administration staff (14%), medics (13%), technicians (10%), physicians (6%), and pharmacists (2%)

Unique Population Characteristics

	Impacts on injuries and injury risk factors
Older average age (47% were 26-39)	Guesses?
56% female	
Variety of occupations represented	

Discussion: How might these unique population characteristics impact injuries and injury risks?

Results: Military Hospital Employee Injuries

- Did not focus on medical records, civilian medical records not captured in the Military Health System
- Self-reported via electronic survey
  - 33% response rate (n=380, total n=1,147)
  - 47% of respondents reported at least one injury in the previous 12 months (n=178)

Leading injury types	Leading injured body areas	Leading injury activities
Sprain/strain (30%)	Knee (22%)	Running (34%)
Tear (14%)	Lower back (17%)	Other physical training (11%)
Dislocation (8%)	Shoulder (9%)	Lifting heavy objects (9%)

Results: Risk Factors for Injury among Military Hospital Employees

Variable	Variable category	Total n	% injured	Injury OR (95% CI)	Category p-value
Employee status	**Enlisted**	**117**	**60%**	**2.75 (1.32–5.71)**	**<0.01**
	Officer	**88**	**47%**	**2.98 (1.44–6.17)**	**<0.01**
	DA civilian	169	38%	1.00	
	Other	6	50%	1.11 (0.18–6.72)	0.91
Occupational group	Nurse	61	39%	1.00	
	Physician	**23**	**13%**	**0.11 (0.03–0.46)**	**<0.01**
	Technician	38	58%	2.08 (0.79–5.50)	0.14
	Pharmacy	8	50%	1.00 (0.18–5.57)	>0.99
	Medic	50	58%	1.43 (0.51–4.00)	0.50
	Other Medical Providers	77	53%	1.35 (0.59–3.10)	0.48
	Admin	53	47%	1.79 (0.77–4.18)	0.18
	Other non-medical/Unspecified	70	43%	1.57 (0.69–3.54)	0.28

Results: Risk Factors for Injury among Military Hospital Employees (continued)

Variable	Variable category	Total n	% injured	Injury OR (95% CI)	Category p-value
Stress	**Yes**	**119**	**58%**	**2.10 (1.30-3.40)**	**<0.01**
	No	261	42%	1.00	
Education level	GED or High School	86	48%	1.32 (0.65-2.64)	0.44
	Associate's	**80**	**58%**	**2.32 (1.16-4.65)**	**0.02**
	Bachelor's	83	38%	1.00	
	Master's or Doctorate	102	43%	1.87 (0.93-3.76)	0.08
	Other Professional Degree	29	52%	2.27 (0.87-5.90)	0.09

Recommended Injury Prevention Strategies Military Hospital Employees

- Leadership should focus on initiatives to address sprains and strains, from activities like heavy lifting and physical training
- Health education should focus on health behaviors contributing to injury risk, like stress management
- Targeted prevention strategies could be used for subpopulations at greater risk (e.g., Active Duty)

Other interesting findings - Military Hospital Employees

- Also looked at barriers to physical activity
- ≥4 reported barriers to physical activity were associated with lower perceived health
- Leading reported barriers to physical activity:
  - Lack of time (65% of respondents)
  - Lack of motivation (45%)
  - Pain or previous medical condition (27%)

Discussion

- Thoughts, insights, questions about injuries among military hospital employees?

Special Population #4: U.S. Army Road Marching Participants

Background

- Sub-analysis of an investigation of injuries among Soldiers in an infantry brigade, exploring road marching injuries

- Unique population – road marching participants only

Demographics summary (n=831 survey respondents)

Variable	Category	n (% of total)
Gender	Female	6 (1)
	Male	825 (99)
Age (years) Mean age: 25±5	18-24	474 (57)
	25-34	297 (36)
	35-54	60 (7)
Rank	E1-E4	553 (67)
	E5-E9	200 (24)
	O1-O5	78 (9)
Occupation	Combat Arms	681 (82)
	Combat Services	41 (5)
	Combat Services Support	108 (13)

Unique Population Characteristics

	Impacts on injuries and injury risk factors
Infantry unit	Guesses?
All males	
Frequent road marching participation	

Discussion: How might these unique population characteristics impact injuries and injury risks?

Results: Leading Injury Activities in an Infantry Brigade (n=831 survey respondents)

- Road marching was the second highest reported cause of injury

Activity associated with injury	Total injuries n (%)	# injuries resulting in limited duty n (%)	Total limited duty days	Average # limited duty days per injury
Physical training (running)	113 (27)	74 (32)	2,514 (28)	31
Road marching	96 (23)	49 (21)	1,840 (20)	33
Physical training (weightlifting)	43 (10)	19 (8)	678 (8)	36
Lifting or moving heavy objects	35 (8)	18 (8)	957 (11)	49
Other physical training	31 (8)	17 (7)	482 (5)	28

Results: Injury Rates per Mile of Exposure

- Commanders may be tempted to replace running with road marching to address high injury rates during running
- In this population, the relative risk of injury during road marching was higher

Activity associated with injury	Total injuries in prior 6 months	Total injuries resulting in limited duty in prior 6 months	Total miles exposed in prior 6 months	Rate of injury per 10,000 miles	Rate of injury per 10,000 miles resulting in limited duty per mile	Relative risk of injury (95% CI)	Relative risk of injury resulting in limited duty (95% CI)
Running	113	74	347,537	**3.3**	**2.1**	-	-
Road marching	96	49	163,392	**5.9**	**3.0**	1.81 (1.38–2.37)	1.41 (0.98–2.02)

Results: Risk Factors for Injuries during Road Marching

ALL ROAD MARCHING PARTICIPANTS

- Age ≥ 35
- Regular occupational lifting 50–100+ pounds
- ≤4 miles of running per week during personal PT
- Road marching ≥5 times per month
- Wearing >25% of body weight during road marching

LOW MILEAGE

(1–19 miles per month)

- Rank E5–E9
- Current smokeless tobacco user

MODERATE MILEAGE

(20–32 miles per month)

- Rank O1–O5
- No personal PT running participation

As road marching mileage increased, concurrent participation in other physical activities became a risk factor for injury during road marching

HIGH MILEAGE

(≥33 miles per month)

- Regular occupational lifting 50–100+ pounds
- <1-4 miles of running per week during personal PT
- ≥31 minutes of resistance training per session during personal PT
- Wearing >25% of body weight during marching

Recommended Injury Prevention Strategies
Road Marching

- Establish a balanced, scheduled training program
  - Include a variety of exercises: aerobic, anaerobic (strength, endurance, power), agility, balance
- Use gradual progression for road march training
  - Follow recommendations in Army Field Manual 7-22 and Army Field Manual 21-18

Table 7-3. 20-week ruck marching progression

Week	*Recommended Load*	*Distance (miles)*	*Time Standard*	*Pace*
1-2	15–20 lb	2	35 min +/- 5 min	3 mph
4	25–30 lb	4	65 min +/- 5 min	3 mph
6	30–35 lb	4	90 min +/- 5 min	3 mph
8	50–60 lb	6	None	3 mph
12	60–70 lb	6	None	3 mph
16	60–80 lb	6	None	3.5 mph
20	60–80 lb	8	None	3.5 mph

lb pounds mins minutes mph miles per hour

Other interesting findings - Road marching

- In another recent exploration, road marching injuries among men and women were compared
- Women reported significantly more hip injuries during road marching, compared to men

	Male			Female			Relative risk of road marching injury Female : Male (95% CI)
	# Injuries	# Road marching participants	Rate of Injuries per 1,000 soldiers	# Injuries	# Road marching participants	Rate of Injuries per 1,000 soldiers	
Hip injuries during road marching	5	2,677	2	5	441	11	6.07 (1.76-20.97)

Discussion

- Thoughts, insights, questions about road marching injuries?

Conclusions

- It's important to explore injuries and injury risks in unique military populations to characterize population-specific injury problems
- Surveys enhance existing data and provide necessary details to inform injury investigations in special populations
- Many common Active-Duty Army injury risk factors have also applied in special Army populations (e.g., older age, low fitness, obesity, tobacco use), even when population demographics and exposures differ greatly from the overall Army

References for highlighted injury investigations

Army Band

- Technical Report (2021): https://apps.dtic.mil/sti/pdfs/AD1134062.pdf
- Manuscript (2023): In Press, *Medical Problems of Performing Artists*

- Previous investigation:
  - Technical Report: https://apps.dtic.mil/sti/citations/ADA462210
  - Manuscript: https://www.sciencedirect.com/science/article/abs/pii/S0958259210000908
  - Manuscript: https://onlinelibrary.wiley.com/doi/pdf/10.1002/ajim.20532

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Army Reserves

- Baseline Technical Information Paper (2023): https://apps.dtic.mil/sti/trecms/pdf/AD1196570.pdf
- Final Technical Report anticipated Fall 2024

Fort Leonard Wood Hospital Employees

- Technical Report (2016): https://apps.dtic.mil/sti/pdfs/ADA633025.pdf
- Manuscript (*Workplace Health & Safety*, 2018): https://journals.sagepub.com/doi/full/10.1177/2165079917736069
- Manuscript (*AMEDD Journal*, 2018) https://medcoeckapwstorprd01.blob.core.usgovcloudapi.net/pfw-images/dbimages/Jan-Jun2018.pdf

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Road Marching

- Technical Report (2017): https://apps.dtic.mil/sti/pdfs/AD1031539.pdf
- Manuscript (*Journal of Science and Medicine in Sport*, 2017): https://journals.sagepub.com/doi/full/10.1177/2165079917736069