Innovations

Incidence, Aetiology and Preventive Mechanisms of Musculoskeletal Injuries in Military Basic Trainees: In Reference to Amhara Public Police and Special Force Training Camps

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Abstract: *The primary purpose of this study was to assess the incidence and aetiology of musculoskeletal disorders in military trainees of the Amhara Public Police and special force training camps. This cross-sectional study identified the injury incidence rate, severity, diagnosis, and anatomical location of the injuries that occurred during military training in a full season of 24 weeks recorded retrospectively during 2022–2023. A total of 646 police recruits from a Police College and a training center participated in the study. The overall injury incidence was 0.51 injuries per 1000 training hours, with 0.55 injuries per 1000 training hours for males and 0.47 injuries per 1000 training hours for females. During the season, 334 (88.83%) were acute injuries, and 42 (11.17%) were overuse syndromes. In the present study, the most common injury was the ankle (120 cases, 31.9%), followed by the knee (106 cases, 27.66%), elbow (60 cases, 15.96%), and wrist (24 cases, 6.4%). Regarding the factors of injury, 30.85% (116 cases) were due to running on farms, 27.66% (104 cases) were caused by passing through a dangerous zone, 23.4% (88 cases) were caused by ladder climbing, 13.3% (50 cases) were caused by mountain climbing, and the remaining 4.79% (18 cases) were due to self-defense training. Regarding the types of injuries, the majority of 131 cases (20.28%) were dislocations, 60 cases (9.29%) were sprains, 51 injuries (7.89%) were lacerations, 26 cases (4.02%) were fracture-traumatic, 25 cases (3.87%) were contusions, and the rest (83 cases, 12.85%) were other different types of injuries.*

Keywords: *Injury,Severity,Incidence,Riskfactors,Prevention, public police, special force*

Introduction

Military training is a global endeavor preparing individuals for national armed forces through basic recruit training and specialized roles. International programs also foster cooperation and democratic values. In Ethiopia, the Ethiopian National

Defense Force (ENDF) has a history of international training ties, and the Ethiopian Defense Command and Staff College (EDCSC)serves as a senior military education institution. Ethiopia is also expanding regional military training. The Ethiopian Maritime Training Institute (EMTI) in Amhara focuses on marine engineering training. Ethiopia has federal and regional security structures. The EFP includes a Special Force, while regions historically had their own Special Forces. Efforts to dismantle these regional forces, including in Amhara, and integrate them into federal and regional structures have led to conflict. Public police in Amhara now operate regionally, with increased activity. While specific Special Forces training centers in Amhara aren't detailed, the Amhara Region Police College in Debremarkos provides basic police training. Amid the recent crisis, the Tiru Birhan Basic Paramilitary Training Center is training large numbers as anti-riot militia and regular police, suggesting similar facilities likely trained the former Amhara Special Forces.

For military personnel, musculoskeletal problems resulting from training exercises pose a serious risk and impede their capacity to exercise and stay physically fit. The injury rate among military personnel varies as a result of differences in training curricula, selection procedures, and physical standards for recruiting (Kaufman, Brodine, and Shaffer, 2000). Several studies have been conducted in different military forces across the globe to identify the factors associated with injuries, the kinds of injuries experienced by military personnel, and to reduce the pain caused by injuries (Anderson et al., 2013; Knapik et al., 2001; Friedl & Deuster, 1999; Knapik et al., 1994; Jones et al., 1993).
Recruits who are involved in training accidents miss out on training, become less physically fit, and may possibly be discharged from the military(Knapik et al., 2001). Both the institution and the recruits suffer financial losses as a result of this. Injury-related factors differ by nation because of differences in recruit characteristics, training regimens, and environmental factors (Blacker et al., 2008). In 303 men undergoing a 12-week army infantry basic training course, Cowan et al. (1993) found that the five most common injuries were strains of the muscles (8.6%), sprains of the ankle (6.3%), patella-femoral syndrome (5.9%), overuse knee injuries (like these), and stress fractures (3.0%).

In 2007, among Bangladesh Army recruits in two selected training centers, Mohsin's (2018) descriptive cross-sectional study found that shin splints accounted for 36.7% of all cases, making them the most common injury. Stress fractures (12.8%), knee injuries (12.8%), muscle strains (12.8%), contusions (11%), plantar fasciitis (2.7%), fractures caused by violent events (1.8%), and other injuries (5.5%) were the next most common injuries.

Materials and Methods

Study design and participants

This retrospective study was conducted from 01 November 2022 to 30 June 2023 at West and East Gojjam Zones, where two of the largest training centres of the Amhara Regional State police force are situated; one is Debremarkos Police College (DMPC)and the other is Tirubirhan Training Centre (TBTC). Data were collected from the centre's clinic and the trainees purposively. The study populations were 150 and 6000 in DMPC and TBTC, respectively. In this study, the centres were purposively selected, and the participants were systematically (every 10^{th}) selected.The sample comprised 646 participants.

Ethical Clearance

This study had receivedethical clearance from the University of Gondar College of Natural and Computational Sciences Research and Ethics Committee. Approval was granted on June 15, 2022, under reference number CNCS/UIL & TT 008/2022. All research procedures adhered to the ethical guidelines and principles outlined in this approval, ensuring the protection and well-being of all participants.

Data Collection Tools

An interviewer-administered questionnaire, adapted from S.R. Augustsoon (2006), and an exposure form were employed for data collection. The questionnaire was divided into two sections: the first section collected baseline information, and the second section detailed injury registration.

Statistical Analysis

The collected injury data underwent comprehensive statistical analysis using IBM SPSS Statistics(version 20) and theonline MedCalc statistical software. The primary objective of this analysis was to identify any statistically significant associations between injury occurrences and several other relevant variables when comparing the two participating centers.

To assess these associations, both adjusted odds ratios (AOR)andrelative risks (RR) were calculated. The AOR provides an estimate of the odds of an outcome occurring in one group compared to another, while accounting for the influence of confounding variables. The RR, on the other hand, quantifies the likelihood of an event in an exposed group relative to an unexposed group. For all analyses, a p-value of less than 0.05 ($p<0.05$**)** was established as the threshold for statistical significance, meaning that results with a p-value below this level were considered unlikely to have occurred by chance.

Results

A total of 150 and 6000 recruits joined inDebremarkos Police College and Tirubirhan Training Centers for recruit entry training from September 2022 respectively for a total period of 06 months. From the total 646 recruits 376 injuries were recorded. Among the 646 respondents, 546(84.52%) were from TBTC (Tirubirhan training center) and 100(15.48%) were from DMPC(Debremarkos police College).

During the period of the study (6 months) the total sample (n=646) reported 376 injuries. Of this, 32.98 % (124/376) of injury cases were registered from public police recruits and 67.02 % (252/376) cases occurred on special force recruit armies. It is notable that, according to the records, 262 recruits (40.56% of the total trainees) were injured. Of these, 25.19 % (n =66) were public police recruits (m=36,f=30) and 74.81 % (n=196) recruits were special forces (m=90,f=106). The adjusted odds ratio (AOR) of injury exposure between SFR and PPR was 0.29,Cl:0.1841-0.4521,p<0.0001. This figure indicates that SFR are more vulnerable than PPR. The same is true on relative risk (RR=0.82,Cl:0.7600-0.8863,p≤0.0001).The injury rate in public police recruits was not statistically different in comparison to the injury rate in special force recruits (x^2 = 31.76, p>0.05). (Table 1)

		Injury			
Specialization	**Sex**	**Injury Cases (%)**	**Injured (%)**	**Non injured (%)**	x^2
	Female	136 (36.17%)	106 (40.46%)	182(47.39%)	0.218,p=0.64
SFR	Male	116 (30.85%)	90 (34.35%	168 (43.75%)	
	Total	**252 (67.02%)**	**196 (74.81%)**	**350 (91.15%)**	
	Female	46 (12.23%)	30 (11.45%)	18 (4.69%)	0.25,p=0.62
PPR	Male	78 (20.75%)	36 (13.74)	16 (4.17%)	
	Total	**124 (32.98%)**	**66 (25.19%)**	**34 (8.86%)**	
		x^2=31.76,p≤1.74;			
SFR vs PPR		AOR=0.29,Cl:0.1841-0.4521,p<0.0001			
		RR=0.82,Cl:0.7600-0.8863,p<0.0001			

Key: X^2=chi square; AOR=Adjusted odds ratio; RR=relative risk; SFR=special force recruits; PPR=public police recruits

Among the 376 recorded injuries 131(20.28%) was dislocation, 60(9.29%) sprain, 51(7.89%) was laceration, 26(4.02%) fracture, 25(3.87%) contusion, and 83(12.85%) injury cases were other different types of injuries (strain, bursitis, cramp, tendonitis,

and abrasion). Of the total 646 respondents from both centers, 252(46.15%) injury cases were recorded from TBTC and 124(124%) were from DMPC.

Out of 376 injury cases, most of them 248 (65.96%) got injury to the lower extremity and 128(34.04%) cases to the upper extremity. The Adjusted odds ratio (AOR) of injuries in the lower extremities in the season versus upper extremities was AOR=1.01 (95% Cl: 0.72 to 1.40) p=0.02≤0.05, significant difference was observed. The probability of lower extremity for injury is 38.4%. For upper extremities the probability is 19.8% with a relative risk of 1.0039 (95%Cl: 0.82 to 1.22) p=0.02≤0.0003, it is statistically significant.

In terms of military training during 24 weeks, the trainer and data recorders reported a total of 376 injuries during 744 192 training-hours, and the overall injury incidence was estimated to be 0.51 per 1000 training hours.

Of the 310 male recruited armies, 194 reported injuries over a total exposure time of 357 120 hours per six months, representing an overall incidence of 0.54 injuries and from 336 female recruited armies, 182 recorded injuries over a total exposure time of 387 072 hours per year, representing an overall incidence of 0.47 injuries per a soldier per six months.

In terms of type of their specialization, from the total number of injuries (n=376), 252 (67.02%) injuries were occurred on special force recruited armies during training time in an exposure time of 625 536 hours per six months, with an injury incidence of 0.4. Of these 136 (36.17%) of recorded injuries happened on females, within 331 776 hours, representing an incidence of 0.41 injuries and 116 (30.85%) of them were on male recruited armies in 293 760 hours per six months training with an incidence of 0.39 injuries. (Table 2)

On the other hand, the public police recruited armies reported 124 injuries during a total exposure time of 115 200 hours per six months training period, representing an overall incidence of 1.07 injuries. Of these 46 (37.10%) of recorded injuries happened on females, within 55 296 hours, representing an incidence of 0.83 injuries and 78 (62.90%) of them were on male recruited armies in 59 904 hours per six months training with an incidence of 1.3 injuries.

There were 334 (88.83%) acute injuries estimated an incidence of 0.45 per 1000 training hours and 42 (11.17%) overuse syndromes which had an incidence of 0.06 per 1000 training hours. For the total sample, injuries were distributed throughout the body.

		Injury					
Gender	**Specialization**	**Injury Cases** (%)	**Injured (%)**	**Non-injured (%)**	**Row Total** (%)	**Exposure Soldier-Hours**	**Incidence Rate**
Female	SFR	136 (28.19)	106 (37.4)	182 (33.33)	288 (67.26)	331 776	0.41
	PPR	46 (20.21)	30 (14.5)	18 (18.75)	48 (32.74)	55 296	0.83
	Total	182 (48.40)	136 (51.9)	200 (52.08)	336 (100)	387 072	0.47
X^2=1.19,p=0.27 RR=1.25, 95% Cl:,0.82-1.91 OR=1.45, 95% Cl:,0.74-2.83							
Male	SFR	116 (30.85)	90 (34.35)	168 (27.6)	258 (61.95)	293 760	0.39
	PPR	78 (20.74)	36 (13.74)	16 (20.31)	52 (34.05)	59 904	1.3
	Total	194 (51.60)	126 (48.1)	184 (47.92)	310 (100)	353 664	0.55
X^2=0.02,p=0.88 RR=1.02, 95% Cl:,0.69-1.51 OR=1.04, 95% Cl:,0.54-2.01							
Total Values	SFR	252 (67.02)	196 (74.81)	350 (66.00)	546 (62.85)	625 536	4.03
	PPR	124 (32.98)	66 (25.19)	34 (34.00)	100 (37.15)	115 200	1.07
	Total	376 (100)	262 (100)	384 (100)	646 (100)	744 192	0.51
X^2=0.74,p=0.39 RR=1.12, 95% Cl:, 0.85-1.49 OR=1.22,95% Cl: 0.77-1.94							

Key: X^2=chi square; OR=odds ratio; RR=relative risk; SFR=special force recruits; PPR=public police recruits

Discussion

A study by Cowan et al. (1993) found that stress fractures (3.0%), overuse or stress syndrome (23.8%), muscle strains (8.6%), ankle sprains (6.3%), overuse knee injuries (5.9%), and muscle strains (6.3%) were the top five injuries sustained by US army recruits during basic training. The most common injuries among US male recruits were low back pain (7.3%), tendinitis (6.5%), sprains (4.8%), muscular strains (3.2%), and stress fractures (2.4%), according to another study by Jones et al. (1993). The most common injuries among recruits were ankle sprains (6.2%), ITBS (5.3%), stress fractures (4.0%), patellar tendinitis (2.4%), and shin splints (1.8%), per a Kaufman et al. 2000 study. According to a study by Sharma et al. (2015), the five most common diagnoses among British trainees were combined upper body, head, and neck injuries (4.0%), ankle sprains (5.0%), low back discomfort (4.6%), ITBS (6.2%), and Medial Tibial Stress Syndrome (5.7%). A 2013 Alam study conducted in Pakistan found that 67.9% of the 305 recruits required surgical admissions. Among the injuries sustained during training were fractures,

dislocations, trauma, and more. A study by Hu G et al. (2012) found that sprain, strain, and rub injuries were the most common types of injuries in China, accounting for 65.4% of all injuries. Wang X et al. (2003) reported that stress fractures accounted for 77.7% of all skeletal and soft tissue injuries, making them the most common type of overuse injury.

The only descriptive cross-sectional study found to date was conducted in 2007 in two selected training facilities among Bangladesh Army recruits by Mohsin (2018). He found that the most frequent injuries were shin splints, which were followed by sprains of the ankle (19.3%), stress fractures (12.8%), injuries to the knee (12.8%), and strains of the muscles (36.7%).12.8%, plantar fasciitis 2.7%, a contusion in the leg or foot 11%, a fracture brought on by a forceful event 1.8%, and a total of 5.5% of injuries were other miscellaneous. There was some variation in these results. The obvious differences in injury diagnosis patterns, the sociodemographic context, and the training environments between these study locations may help to explain why there is such variation.

Of the 376 injury cases and 262 injured respondents in the current study, 248 cases (or 65.96%) involved the lower extremities, and 128 cases (34.04%) involved the upper limb. As observed in other studies involving army recruits, the lower limbs sustained the most injuries in both centers. The majority of injuries, as per Kaufman's 2000 study, were lower extremity MSKIs. According to the Robinson et al. (2016) study, the knee (27%), foot (26%), ankle (18%), and shin (10%) were the most frequently reported injury sites. According to Bhalwar's (2004) study of Indian trainees, lower limb fractures and joint injuries accounted for the majority of training-related injuries. A 2013 Alam study conducted in Pakistan found that lower limb fractures accounted for the majority of fracture cases, accounting for 20.9% of all fracture cases.

Conclusion

The overall frequency of injuries at the two recruit centers (TBTC and DMPC) in this retrospective analysis was 58.2%, suggesting that the physical training program of the Amhara police forces is rigorous and does not follow scientific procedures (in terms of intensity, duration, and frequency). In Amhara police training centers, injuries were significantly decreased by using preventative measures and extending the recruit training period. Among the 262 injured respondents, fractures, sprains, lacerations, and dislocations were common injuries. To develop preventive measures that will lower injury morbidity among recruits for the Amhara police force, more prospective research is needed to minimize recall bias and identify the underlying causes of the injuries.

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References:

1. *Alam M.(2013). Morbidity Profile of Recruits during basic Military Training. Pakistan Armed Forces Medical Journal. 1(3):109-113.*
2. *Anderson, M. K.,полникова, О. В., &Bellovary, J. B. (2013). Risk factors for falls in a US Army Brigade Combat Team. Military Medicine, 178(10), 1101-1106.*
3. *BhalwarR.(2004). Prospective study on the morbidity profile of recruits over one year in three large Regimental Training Centres.Medical Journal Armed Forces India. 60(2):113-6.*
4. *Blacker SD, Wilkinson DM, Bilzon JL et al.(2008). Risk factors for training injuries among British Army recruits. Military medicine. 173(3):278-86.*
5. *Cowan DN, Jones BH, Tomlinson JP et al.(1993). Epidemiology of injuries associated with physical training among young men in the army. Army Research Institute of Environmental Medicine; 1993. Med Sci Sports Exercise. 25(2):197-203.*
6. *Friedl, K. E., & Deuster, P. A. (1999). Reductions in physical performance and alterations in body composition in physically active men consuming restricted diets. American Journal of Clinical Nutrition, 69(2 Suppl), 245S-251S.*
7. *Hu G, Tan A, Liu X et al.(2012). Injury incidence among recruits in basic militarytraining andrelated factorsin China. Injury prevention. 18 (Suppl 1):A158-9.*
8. *Jones BH, Bovee MW, Harris III JM et al.(1993). Intrinsic risk factors for exercise-related injuries among male and female army trainees. The American journal of sports medicine. 21(5):705-10.*
9. *Jones, B. H., Bovee, M. W., Harris, J. M., &ївв, С. Л. (1993). Intrinsic risk factors for exercise-related injuries among men and women. Medicine & Science in Sports & Exercise, 25(11), 1273-1281.*
10. *Kaufman KR, Brodine S, Shaffer R.(2000). Military training-related injuries: Surveillance, research, and prevention. American journal of preventive medicine.18(3):54-63.*
11. *Knapik JJ, Sharp MA, Canham-Chervak MI et al.(2001). Risk factors for training-related injuries among men and women in basic combat training. Medicine and science in sports and exercise. 33(6):946-54.*
12. *Knapik, J. J., Jones, B. H., Bauman, C. L., Harris, J. M., & Vaughan, L. (2001). Risk factors for training-related injuries among men and women in Basic Combat Training. Medicine & Science in Sports & Exercise, 33(6), 946-954.*
13. *Mohsin M.(2018). Injury pattern among Bangladesh Army Recruits. JAFMC 14(2):123-6.*

14. *Robinson M, Siddall A, Bilzon J et al.(2016). Low fitness, low body mass and prior injury predicts injury risk during military recruittraining: A prospective cohort study in the British Army. BMJ open sport & exercise medicine. 2(1):e000100.*
15. *Sharma J, Greeves JP, Byers M et al.(2015). Musculoskeletal injuries in British Army recruits: A prospective study of diagnosis- specific incidence and rehabilitation times. BMC musculoskeletal disorders. 16(1):106.*
16. *Singh SC, BanerjeeA.(2000). Stress fractures: effect of prior physical activity, sports participation and military training. Medical Journal Armed Forces India. 56(1):24-6.*
17. *Sulsky SI, Bulzacchelli MT, Zhu L et al.(2018). Risk factors for training-related injuries during US army basic combat training. Military medicine. 183(suppl_1):55-65.*
18. *Wang X, Wang PS, Zhou W.(2003). Risk factors of military. Training- related injuries in recruits of Chinese People's Armed Police Forces. Chinese journal of traumatology. Zhonghuachu- angshangzazhi. 6(1):12-7.*