Original Research Article

Knowledge Assessment of Stress Bone Fractures Among Soldiers in Saudi Arabia

Abstract:

Background: Stress fractures are well perceived in military preparing and athletes. Aside from knowledge of the frequency of these fractures and their impact on the economy and lost training hours, there are just a few studies in Saudi Arabia that show the real incidence of these fractures. The precise incidence must be known in order to provide recommendations for future preventative initiatives. This study aims to assess the knowledge of stress fractures among Saudi soldiers.

Methodology: An observational cross-sectional study was conducted in medical centers; these centers are located in Saudi Arabia on male and female patients of all ages who are in Saudi military society to assess the knowledge of stress fractures among Saudi military society. Data collection was done by questionnaire that distributed between Saudi soldiers. Data was entered and analyzed using (SPSS) program, version 20 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.).

Results: Of all 1178 studied participants, 51.5% aged between 20- 30 years old. 91.7% were males. 47.5% of all participants had never heard of stress fractures before, 26.2% heard about it when joined military and 17.4% heard about it before joining the military field. 20.8% of all participants had stress fractures before, 10.4% were diagnosed through x-rays and medical history with the doctor, 4.6% were diagnosed through medical history only, and 2.4% diagnosed themselves. 85.3% of all participants agreed that stress fractures occur due to repetitive loading on the bones, 76.6% agreed that predominance of stress fractures of the lower extremities, over fractures of the upper extremities, 67.6% reported that stress fractures can be treated with painkillers, physiotherapy and reduce the risk and 78.6% agreed that stress fractures can be prevented by wearing appropriate footwear.

Conclusion: Participants and relatively good knowledge of stress fractures. Knowledge of stress fracture was significantly associated with years of experience of participants, military sector, and residence area in the kingdom.

Introduction:

Stress fractures are well perceived in military preparing and athletes, with the primary detailed case being recognized in 1855 by Breithaupt and the first imaging of a stress fracture recorded by Stechow in 1897.[1]

Fractures, occurring mostly in weight-bearing bones as a consequence of repetitive and immoderate efforts, which might also additionally development to a entire fracture if left untreated.[2] This harm happens as a result of tall numbers of occurrences of patterned over-burdening of concentrated lower than the greatest bone quality, on non-pathological bone tissue.[3]SFs have been detailed in about any bone within the limits.[2] Accurate diagnosis for stress fractures is dependent on the anatomical space. Regardless, early recognition is that the optimum goal to attenuate the potential for microfractures to become macro fractures. [4] Special tests and treatment regimes, however, square measure similar among most stress fractures with resolution between 4weeks to a year.[4]

The first description of stress fractures was by Prussian military physician called Breithaupt in 1855, he described soldiers with oedematous painful feet. Then, in 1897 Stechow found an evidence of fractures on imaging, so he called these fractures by "march fractures". [3,5] The incidence of stress fractures among military recruits has been estimated to be in the range of 1.9%-31% [6]. In other studies, reported in India the incidences were 11.4% and 7.04% in two different military training centers, The occurrence of SFs was higher during their initial training period and reached its peak at 12 weeks of training. [7] Despite the fact that the clinical prevalence of stress fractures decreased after 8 weeks, incident lower limbs stress fractures persisted for over 20 weeks. [8] Actually, the incidence of stress fractures were higher in female soldiers than men.[6]

The incidence of sustained stress fractures in military
recruits may be as excessive as 12%, compared with a charge of 21.1% of elite athletes and 1% of the overall populace.[1] In the USA, the incidence of stress fractures in military recruits during training has been estimated to be in the range of 0.9%–12.3% Stress fractures in military recruits during training are estimated to occur in the range of 0.9 percent to 12.3 percent in the United States.[9] Most bones have reported cases of stress fractures, but the lower extremities have the highest prevalence. In a study of 320 athletes, the tibia (49.1%), tarsals (25.3%), and metatarsals (8.8%) were the most frequently involved bones affected by a stress fracture have been reported in most bones, but the lower extremities have the highest occurrence. The tibia (49.1%), tarsals (25.3%), and metatarsals (8.8%) were the most commonly involved bones damaged by a stress fracture in a sample of 320 athletes.[10] The incidence of SFs ranges from 1.5% to 31% depending on the population studied and the occurrence of SFs varies from 1.5% to 31% relying at the populace studied.[5]. The number of studies on stress fractures in Saudi Army recruits is minimal, particularly in terms of invalidments. Furthermore, data on the actual occurrence is necessary to establish a foundation for future prevention initiatives and to improve the overall health of the troops. Aside from knowledge of the frequency of these fractures and their impact on the economy and lost training hours, there are just a few studies in Saudi Arabia

that show the real incidence of these fractures. The precise incidence must be known in order to provide recommendations for future preventative initiatives.[7]

Study Objective:

To assess the knowledge of stress fractures among Saudi soldiers.

Methodology:

Study design: This is an observational cross-sectional study was conducted in military medical centers, in different areas of Saudi Arabia, during the period from July to November, 202.

Subjects and sample size: Study included 1178 male and female patients of all ages who are in Saudi military society, who had stress fracture, to assess the knowledge of stress fractures among Saudi military society. The sample size was estimated using the Qualtrics calculator with a confidence level of 95%.

Inclusion criteria:

Inclusion criteria are as follow:

(1) Age between 20-40

(2) males and females

(3) In military fields

Exclusion criteria:

Exclusion criteria are as follow:

(1) Not a soldier

(2) No previous history of stress fractures.

Data collection and study tool:

Data collection was done by questionnaire that distributed between Saudi soldiers. The questionnaire contains demographic data such as age, region, education level, profession, and how long in occupation. The participants were asked if they hearing about stress fractures (SF), if they recognize stress fractures in military, where the predominance of stress fractures, most cause of stress fractures. Also, they were asked if the pain & swelling are symptoms of SF, treatment and prevention of stress fractures.

Analysis and entry data:

Data was entered on the computer using the “Microsoft Office Excel Software” program (2016) for windows. Data was then transferred to the Statistical Package of Social Science Software (SPSS) program, version 20 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.) to be statistically analyzed.

Results:

Of all 1178 studied participants, 51.5% aged between 20- 30 years old, 24.2% aged between 31- 40 years old and 13.8% aged between 41- 50 years old. 91.7% were males. 24.8% live in the western region and 23.8% live in the southern area of the kingdom. 40.2% had university education, and 34.8% had secondary school education. 43% of all participants work in the ministry of Interior (Public Security), 37.4% work in ministry of Defense while 13.1% work in ministry of National Guard. Regarding years of experience, 34.5% were employed for more than 10 years, 31.7% were less than 5 years, while 19.9% had 5- 10 years of experience.

According to table (2); 47.5% of all participants had never heard of stress fractures before,26.2% heard about it when joined military and 17.4% heard about it before joining the military field. 20.8% of participants had stress fractures before, 10.4% were diagnosed through x-rays and medical history with the doctor, 4.6% were diagnosed through medical history only, and 2.4% diagnosed themselves.

Regarding knowledge of diagnosis method; half of participants reported medical history, X-ray, MRI, or bone scan, 11.8% reported patient history only, and 33.8% didn't know. Only 73.8% agreed that stress fractures are well recognized in military armies and athletes.

Table (3) show that 85.3% of all participants agreed that stress fractures occur due to repetitive loading on the bones, 76.6% agreed that predominance of stress fractures of the lower extremities, over fractures of the upper extremities, 76.3% agreed that most common cause of stress fractures is repetitive weight-bearing activities, 77.2% agreed that pain and swelling a symptom of stress fractures, 67.6% reported that stress fractures can be treated with painkillers, physiotherapy and reduce the risk and 78.6% agreed that stress fractures can be prevented by wearing appropriate footwear.

Table (4) shows that; knowledge of stress fracture was significantly associated with years of experience of participants, military sector, and residence area in the kingdom (P value<0.05).

Table (1): Sociodemographic characteristics of participants (n=1178)

Parameter		No.	Percent
Age	• **Less than 20**	36	3.1
	• **20 - 30 years old**	607	51.5
	• **31 - 40 years old**	285	24.2
	• **41 – 50 years old**	163	13.8
	• **51 - 60 years old**	79	6.7
	• **more than 60**	8	.7

Gender	• **Male**	1080	91.7
	• **Female**	98	8.3
Residence area	• **Southern area**	280	23.8
	• **Eastern Region**	237	20.1
	• **The northern area**	169	14.3
	• **Western Region**	292	24.8
	• **Central Region**	200	17.0
Education level	• **primary**	8	.7
	• **middle school**	27	2.3
	• **secondary**	410	34.8
	• **university**	474	40.2
	• **diploma**	187	15.9
	• **Postgraduate**	72	6.1
Military sector	• **General Intelligence Presidency**	76	6.5
	• **Ministry of National Guard**	154	13.1
	• **Ministry of Interior (Public Security)**	507	43.0
	• **Ministry of Defense**	441	37.4
Years of experience in military	• **trainee**	163	13.8
	• **Employee less than 5 years**	374	31.7
	• **5-10 years employee**	235	19.9
	• **Employed for more than 10 years**	406	34.5

Table (2): Knowledge of participants of stress bone fractures (n=1178)

Parameter		No.	Percent
Have you ever heard of stress fractures?	• **I have not heard of it before**	559	47.5
	• **Yes, I've had it before**	105	8.9

	• **Yes, I heard about it when I joined the military**	309	26.2
	• **Yes, I heard about it before I joined the military field**	205	17.4
If you have ever had a stress fracture, how were you diagnosed?	• **I diagnosed myself**	28	2.4
	• **One of my co-workers mentioned me**	41	3.5
	• **Through x-rays and your medical history with the doctor**	122	10.4
	• **By showing your medical history to the doctor**	54	4.6
	• **I didn't hit**	933	79.2
As far as you know, stress fractures can be diagnosed by:	• **Patient history only**	139	11.8
	• **Medical history, X-ray, MRI, or bone scan**	589	50.0
	• **You do not need a medical diagnosis**	52	4.4
	• **I do not know**	398	33.8
To your knowledge, stress fractures are well recognized in military armies and athletes	• **agree**	869	73.8
	• **Disagree**	288	24.4
	• **I do not know**	21	1.8

Table (3): Knowledge of participants to Stress Bone Fractures (n=1178).

	Agree	Disagree
Stress fractures occur due to repetitive loading on the bones	**1005 85.3%**	**173 14.7%**
The predominance of stress fractures of the lower extremities, over fractures of the upper extremities	**902 76.6%**	**276 23.4%**
Wearing non-fitting shoes is a risk factor for stress fractures	**981 83.3%**	**197 16.7%**
The most common cause of stress fractures is repetitive weight-bearing activities (such as running and walking)	**899 76.3%**	**279 23.7%**
Pain and swelling a symptom of stress fractures	**910 77.2%**	**268 22.8%**
Stress fractures occur more often in females than in males	**637 54.1%**	**541 45.9%**
Magnetic resonance imaging (MRI) is the most sensitive and specific imaging test for diagnosing stress fractures	**921 78.2%**	**257 21.8%**
Stress fractures can be treated with painkillers, physiotherapy and reduce the risk	**796 67.6%**	**382 32.4%**
Stress fractures can be prevented by wearing appropriate footwear	**926 78.6%**	**252 21.4%**

Table (4): The relationship between having knowledge about stress fracture and the sociodemographic characteristics of the studied population

		Yes	No		
Age	**Less than 20**	18	18	36	**0.095**
		2.9%	3.2%	3.1%	
	20 - 30 years old	332	275	607	
		53.6%	49.2%	51.5%	
	31 - 40 years old	157	128	285	
		25.4%	22.9%	24.2%	
	41 – 50 years old	72	91	163	
		11.6%	16.3%	13.8%	
	51 - 60 years old	35	44	79	
		5.7%	7.9%	6.7%	
	more than 60	5	2	7	
		0.8%	0.4%	0.6%	
Gender	**Male**	576	504	1080	**0.073**
		93.1%	90.2%	91.7%	
	Female	43	55	98	
		6.9%	9.8%	8.3%	
Residence area	**Southern area**	169	111	280	**0.003**
		27.3%	19.9%	23.8%	
	Eastern Region	105	132	237	
		17.0%	23.6%	20.1%	
	The northern area	86	83	169	
		13.9%	14.8%	14.3%	
	Western Region	145	147	292	
		23.4%	26.3%	24.8%	
	Central Region	114	86	200	
		18.4%	15.4%	17.0%	
Education level	**primary**	4	4	8	**0.104**
		0.6%	0.7%	0.7%	

	middle school	15	12	27	
		2.4%	2.1%	2.3%	
	secondary	228	182	410	
		36.8%	32.6%	34.8%	
	university	256	218	474	
		41.4%	39.0%	40.2%	
	diploma	87	100	187	
		14.1%	17.9%	15.9%	
	Postgraduate	29	43	72	
		4.7%	7.7%	6.1%	
Military sector	**General Intelligence Presidency**	51	25	76	**0.036**
		8.2%	4.5%	6.5%	
	Ministry of National Guard	82	72	154	
		13.2%	12.9%	13.1%	
	Ministry of Interior (Public Security)	269	238	507	
		43.5%	42.6%	43.0%	
	Ministry of Defense	217	224	441	
		35.1%	40.1%	37.4%	
Years of experience in the military sector	**trainee**	72	91	163	**0.001**
		11.6%	16.3%	13.8%	
	Employee less than 5 years	221	153	374	
		35.7%	27.4%	31.7%	
	5-10 years employee	141	94	235	
		22.8%	16.8%	19.9%	
	Employed for more than 10 years	185	221	406	
		29.9%	39.5%	34.5%	

Discussion:

Stress fractures occur when bone, typically in the lower extremities, is subjected to repeated mechanical stress that results in microscopic fractures. They often occur when the frequency or degree of physical activity is significantly increased [11]. The threshold value of stress that places an individual bone at high risk for stress fracture has not been identified. The activities involved in the diverse types of military training may put personnel at different injury risks. The most frequently reported cause of these fractures is repetitive weight-bearing activities such as running and marching, a recent increase in physical activity, beginning of a new activity or some other change in their routine can also result in increase of these fractures [12].

Due to the repetitive nature of military training, stress fractures common in members of the military. From 2009 to 2012, US military members had 5.69 stress fractures per 1000 person-years [13]. In our study, 20.8% of all participants had stress fractures before. However, in India two studies by Agrawal PK and Dash N et al., reported high incidence of 11.4% and 7.04% in two different military training centers [14, 15]. Another study reported 15% incidence of SFs which far exceeds those figures or those reported from any previous study [15].

In our study,76.6% of participants agreed that predominance of stress fractures of the lower extremities, over fractures of the upper extremities. Previous studies reported most common stress fractures in decreasing order of occurrence are the tibia (23.6%), tarsal navicular (17.6%), metatarsals (16.2%), femur (6.6%), and pelvis (1.6%) [16]. Another previous study reported that commonest site involved in our cases was tibia (87.66%) followed by fibula and metatarsal [17]. The distribution of sites of SF was similar to the study by Singh SC, et al., [18]. However, in contrast Alexander M Wood et al., reported metatarsals as the most common site for stress fracture [19] The majority (75%) of fatigue fractures detected in another cohort study were located in the tibial shaft or metatarsals [20]. This finding is consistent with those of previous studies of both Finnish athletes and conscripts [21, 22]. In a previous study of US Marine Corps recruits, bone stress injuries were less commonly detected in the pelvis, hip, thigh, and knee [23].

The pathophysiology of a stress fracture is usually related to repetitive loading of the bone that leads to an imbalance between the micro damaged bone and the processes of bone remodelling and repair. Several risk factors, including reduced body weight, decreased body mass index, increased height (or tallness), poor physical condition, low bone mineral density and high serum parathyroid hormone levels have been suggested as being associated with the development of stress fractures. In addition, indirect evidence supports the existence of genetic factors in the pathogenesis of stress fractures [25]. This was in agreement with most participants' knowledge as 76.3% agreed that most common cause of stress fractures is repetitive weight-bearing activities.

Symptom includes pain which increases on bearing weight and swelling. Typical findings include localized tenderness, swelling and erythema. Preliminary diagnosis of these fractures is through history assessment and clinical diagnosis. 77.2% of our participants agreed that pain and swelling a symptom of stress fractures.

Radiological diagnosis provides a reliable confirmation of these fractures and site associated. SFs may heal completely, slowly or incompletely. In our study, of all participants who had stress fracture,10.4% were diagnosed through x-rays and medical history with the doctor, 4.6% were diagnosed through medical history only, and 2.4% diagnosed themselves.

Regarding knowledge of diagnosis method, half of participants reported medical history, X-ray, MRI, or bone scan, 11.8% reported patient history only, and 33.8% didn't know. Only 73.8% agreed that stress fractures are well recognized in military armies and athletes. Giladi et al. [26] advocate a high clinical index of suspicion and early referral for MRI to enable prompt diagnosis among at-risk populations, though definitive evidence is lacking as to whether early diagnostic MRI has significant effect on rehabilitation time from injury and further research into this is necessary.

According to our results, 67.6% reported that stress fractures can be treated with painkillers, physiotherapy and reduce the risk and 78.6% agreed that stress fractures can be prevented by wearing appropriate footwear. Prevention, however difficult is the best approach for avoiding SFs. Treatment strategies includes early identification of the symptoms, early diagnosis, a sufficiently long training pause and in special cases consultation of experts in the field. Surgical treatment may be needed in some cases [6].

Conclusion:

Participants and relatively good knowledge of stress fractures. Knowledge of stress fracture was significantly associated with years of experience of participants, military sector, and residence area in the kingdom. The cornerstone in avoiding SF is prevention. Education of trainees, trainers and instructors, modification in training procedures, use of better equipments can reduce occurrence of these fractures. Early reporting to hospital and treatment is also necessary as it can help in early return to full activity.

Informed consent

Informed consent was obtained from all participants included in the study.

Ethical approval: the was approved from the research ethics committee of Majmaah University, with ethical approval number (MUREC-October.28/COM-2021/9-2).

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

References:

1. Wood AM, Hales R, Keenan A, Moss A, Chapman M, Davey T, et al. Incidence and Time to Return to Training for Stress Fractures during Military Basic Training. J Sports Med. 2014;2014:1–5.
2. Itskoviz D, Marom T, Ostfeld I. Trends of stress fracture prevalence among Israel Defense Forces basic trainees. Mil Med. 2011;176(1):56–9.
3. Astur DC, Zanatta F, Arliani GG, Moraes ER, Pochini A de C, Ejnisman B. Stress fractures: definition, diagnosis and treatment. Rev Bras Ortop (English Ed. 2016;51(1):3–10.
4. Kahanov L, Eberman L, Games K, Wasik M. Diagnosis, treatment, and rehabilitation of stress fractures in the lower extremity in runners. Open Access J Sport Med. 2015;87.
5. Takkar P, Prabhakar R. Stress fractures in military recruits: A prospective study for evaluation of incidence, patterns of injury and invalidments out of service. Med J Armed Forces India. 2019 Jul 1;75(3):330–4.
6. Shapiro M, Zubkov K, Landau R. Diagnosis of stress fractures in military trainees: A large-scale cohort. BMJ Mil Heal. 2020;
7. Bhatnagar A, Kumar M, Shivanna D, Bahubali A, Manjunath D. High incidence of stress fractures in military cadets during training: A point of concern. J Clin Diagnostic Res. 2015;9(8):RC01–3.
8. Kardouni JR, McKinnon CJ, Taylor KM, Hughes JM, Taylor -Kathrynm KM. Timing of stress fracture in soldiers during the first 6 career months: a retrospective cohort study. Available from: http://meridian.allenpress.com/jat/article-pdf/doi/10.4085/1062-6050-0380.19. Journal of Athletic Training, 11 May 2021, PMID: 33975344
9. Zhao L, Chang Q, Huang T, Huang C. Prospective cohort study of the risk factors for stress fractures in Chinese male infantry recruits. J Int Med Res. 2016;44(4):787–95.
10. Mayer SW, Joyner PW, Almekinders LC, Parekh SG. Stress Fractures of the Foot and Ankle in Athletes. Sports Health. 2014;6(6):481–91.
11. McCormick F, Nwachukwu BU, Provencher MT. Stress fractures in runners. Clin Sports Med. 2012 Apr;31(2):291-306.
12. Jones BH, Thacker SB, Gilchrist J, Kimsey CD Jr, Sosin DM. Prevention of lower extremity stress fractures in athletes and soldiers: a systematic review. Epidemiol Rev. 2002;24(2):228–47.

13. DeFroda SF, Cameron KL, Posner M, Kriz PK, Owens BD. Bone Stress Injuries in the Military: Diagnosis, Management, and Prevention. Am J Orthop (Belle Mead NJ). 2017 Jul/Aug;46(4):176-183.
14. Agarwal PK. Stress fractures-management using a new classification. Indian J Orthop. 2004;38:118–20.
15. Dash N, Kushwaha AS. Stress fractures–a prospective study amongst recruits. MJAFI. 2012;68:118–22.
16. Moreira CA, Bilezikian JP. Stress Fractures: Concepts and Therapeutics. J Clin Endocrinol Metab. 2017 Feb 01;102(2):525-534.
17. High Incidence of Stress Fractures in Military Cadets During Training: A Point of Concern. J Clin Diagn Res. 2015 Aug; 9(8): RC01–RC03. Published online 2015 Aug 1. doi: 10.7860/JCDR/2015/12535.6282
18. Singh SC, Banerjee A. Stress fractures: effect of prior physical activity, sports participation and military training. MJAFI. 2000;56:24–26.
19. Wood AM, Hales R, Keenan A, Moss A, Chapman M, Davey T, et al. Incidence and time to return to training for stress fractures during military basic training. Journal of Sports Medicine. 2014;2014:282980.
20. Pihlajamäki H, Parviainen M, Kyröläinen H, Kautiainen H, Kiviranta I. Regular physical exercise before entering military service may protect young adult men from fatigue fractures. BMC Musculoskelet Disord. 2019;20(1):126. Published 2019 Mar 25. https://doi.org/10.1186/s12891-019-2513-4
21. Korpelainen R, Orava S, Karpakka J, Siira P, Hulkko A. Risk factors for recurrent stress fractures in athletes. Am J Sports Med. 2001;29:304–310. https://journals.sagepub.com/doi/10.1177/03635465010290030901
22. Ruohola JP, Kiuru MJ, Pihlajamäki HK. Fatigue bone injuries causing anterior lower leg pain. Clin Orthop Relat Res. 2006 Mar;444:216–223. doi: 10.1097/01.blo.0000194668.70225.24.
23. Schneiders AG, Sullivan SJ, Hendrick PA, Hones BD, McMaster AR, Sugden BA, Tomlinson C. The ability of clinical tests to diagnose stress fractures: a systematic review and meta-analysis. J Orthop Sports Phys Ther. 2012 Sep;42(9):760–71. doi: 10.2519/jospt.2012.4000.
24. Cosman F, Ruffing J, Zion M, et al. Determinants of stress fracture risk in United States military academy cadets. Bone 2013; 55: 359–366.
25. Zhao L, Chang Q, Huang T, Huang C. Prospective cohort study of the risk factors for stress fractures in Chinese male infantry recruits. J Int Med Res. 2016 Aug;44(4):787-95. doi:10.1177/0300060516639751. Epub 2016 May 20.
26. Giladi M., Milgrom C., Kashtan H. Recurrent stress fractures in military recruits: one-year follow-up of 66 recruits. Journal of Bone and Joint Surgery B. 1986;68(3):439–441.