Incidence of fractures in a cohort of military personnel followed for over two decades

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Summary

***Objectives*. The epidemiological data of fractures are scarce and we studied the incidence of all fractures in a cohort of young military personnel followed for a long duration.**
***Methods*. The data for this descriptive epidemiologic study was derived from the electronic medical records of the military personnel enrolled between 1990 and 2015. They were recruited before 18 years of age in good health and their morbidity data were derived from the medical records. We calculated the incidence rates per person years using appropriate statistical methods.**
***Results*. Our analysis includes 51,217 participants (median age 33 years, range 17-54) with a mean follow-up of 12.5 years. Yearly evaluation of the data gave a cumulative follow-up duration of 613,925 person-years (py). A total of 1534 fractures occurred during the observation period, giving an incidence rate of 2.49 per 1,000 py (95% CI 2.38-2.63). The distribution of fractures consists of the inferior extremity (n=769, 50%), superior extremity (n=516, 34%) and the skull, spine and trunk (n=249, 16%) in the descending order.**
***Conclusion*. Our cohort had lower incidence rates of fractures when compared with the western population. Long-term studies are required to confirm the findings of our study.**

KEY WORDS: prevalence; fractures; trauma; epidemiology; India.

Introduction

Fractures are a significant cause of the morbidity and mortality in the population. Besides the physical impediment, the fractures also led to the loss of productivity and affect the health related quality of life (1). The major etiologies of fractures differ according to the age of the population. Road traffic accidents (RTA) and injuries account for the majority of the fractures in the young age, whereas osteoporosis and falls are responsible for the fractures in the elderly population (2). The factors that could affect the prevalence of the fractures include the urbanization, obesity and vitamin D status of the population (3). The detailed analysis of the skeletal fractures is the essence of the fracture epidemiology. A comprehensive study of the patterns of fractures is an important epidemiological tool to determine the resource allocation (4). This data also helps in identifying the relevant risk factors and also in defining strategies to mitigate the risk through population education.
Few epidemiological studies are available describing the fractures from India (5-7). These reports mostly looked at the population prevalence of the osteoporotic fractures or the fracture epidemiology derived from the emergency room admissions. Few studies have restricted themselves to the region specific prevalence of the fractures in a hospital or a particular geographic area (8, 9). However, there are no comprehensive epidemiological data available from our country about the secular trends of fractures in the adult population. Similar reports are scarce even from the western world with a good registry based health record maintenance (10). These reports are also limited to the elderly population, where the data is influenced by the osteoporosis. The data about the fractures in young population can only be derived from a large database with a closed follow-up system. Hence, we conducted this study to assess the incidence of the fractures in young adult male population.

Materials and methods

Study population

We conducted this retrospective study using the data pertaining to the health care personnel (HCP) of our organization. The participants of this study were enrolled in the active military service from the year 1990 onwards. They were recruited before the age of 18 years in good physical and mental health. Each year the number of enrollees varies based on the requirement and vacancy. We have data pertaining to the 51,217 participants who were recruited over the past 25 years till December 2015. The sickness and hospitalization record of all the HCP is captured in the electronic medical records (EMR) database. The study population is educated below graduate level and is mostly derived from the lower socioeconomic strata with a rural background. Our organization does not enlist females in the personnel below officer rank, thereby limiting our data to males only.

Study procedure

Our organization consists of HCP working at various primary, secondary and tertiary level health care centers. HCP denotes the support staff working in the medical establishments that includes nursing technicians, nursing assistants, specialty trained people assisting the physicians in their work

and also the staff that are required in the maintenance of the hospital. The EMR provided the data on occupational and demographic particulars that includes age, educational level, marital status, medical condition and the date of diagnosis. The disorders are entered in the EMR database as per the standard International Classification of Diseases (ICD) classification.

Study definitions

The diagnosis of a fracture was identified from the EMR and not by perusing the individual medical records. The patients were managed across the health centers located in our country and the EMR database of the HCP is updated every day. We identified the initial date of record of the fracture for calculating the incidence. The EMR does not give information about the etiology and the outcomes of the fractures. The data pertaining to the deceased population is maintained separately and not available for calculating the effect of fractures on the mortality.

Statistical analysis

We calculated the incidence rate as the number of new cases diagnosed per year divided by the total number of person years follow-up. We have calculated the incidence per year based on the number of the new cases per year divided by the number of enrollees for the same year. The index year was noted based on the first entry of the medical condition in the service record of the individual. We did not calculate the incidence rate as per the age wise groups for the small patients in the group.

Results

The study participants consist of 51,217 males followed up for a mean duration of 12.5 years. The median age of the participants was 33 years, with a range between 18 and 54 years. Our data gave a total cumulative follow-up duration of 6,13,925 person-years (py). A total of 1534 fractures occurred during the observation period, giving a crude incidence rate of 2.49 per 1,000 py (95% CI 2.38-2.63). There were 38 patients who had multiple fractures due to the RTA in our database. The analysis of distribution of sites of fractures reveals that the extremity fractures were common in comparison to other sites. The distribution of fractures consists of the inferior extremity (n=769, 50%), superior extremity (n=516, 34%) and the skull, spine and trunk (n=249, 16%) in the descending order of frequency.

Discussion

Our study gives a glimpse of the fracture rates pertaining to a large number of young Indian males. Population studies of a similar nature are not available from our country for direct comparison of our incidence rates. Amin et al. has studied the trends of fracture incidence for over two decades irrespective of osteoporosis in a population based study from United States (11). The comparison of incidence rates with our data is shown in Table 1. Their fracture incidence rates were high because of the elderly study population. The top three sites of fractures also vary between these two studies as shown in Figure 1 due to the effect of osteoporosis. A community study identified the incidence rates of hip fracture from India (12). The crude incidence of hip fracture was 129 per 100,000 py and the data was not comparable due to the difference in the age of the study population.

Several Authors have studied the regional specific fracture incidence rates from the community or a hospital setting (13, 14). In a large series from Taiwan, Pan et al. has showed

Table 1 - Comparison between our data and Amin et al. (11) of fracture incidence.

Site	IR (95% CI)	N (%) n=1534	IR (95% CI) (Ref No 11)	N (%) N=5244
Skull & Face	3.91 (2.5 – 5.7)	24 (1.6)	160 (125 – 195)	178 (3.4)
Humerus	8.31 (6.3 – 10.8)	51 (3.3)	95 (69 – 121)	209 (4)
Forearm	38.8 (34.1 – 43.9)	238 (15.5)	152 (120 – 183)	609 (11.6)
Hands & Fingers	36.9 (32.4 – 42)	227 (14.8)	261 (221 – 302)	367 (7)
Clavicle/ Scapula/ Sternum/ Ribs	30.1 (26 – 34.7)	185 (12.1)	156 (123 – 189)	601 (13.4)
Any vertebrae & Pelvis	6.5 (4.7 – 8.8)	40 (2.6)	798 (719 – 876)	1644 (31.4)
Femur	12.2 (9.7 – 15.2)	75 (4.9)	247 (200 – 294)	378 (7.2)
Tibia, Fibula & Patella	46.6 (41.4 – 52.2)	286 (18.6)	69 (47 – 91)	589 (11.2)
Feet & Toes	47.7 (42.5 – 53.4)	293 (19.1)	205 (168 – 241)	569 (10.9)
Stress fracture	18.7 (15.5 – 22.4)	115 (7.5)	Not available	Not available
All sites	249 (238 – 263)		3145 (2994 – 3297)	

IR: Incidence Rate; CI: Confidence Interval

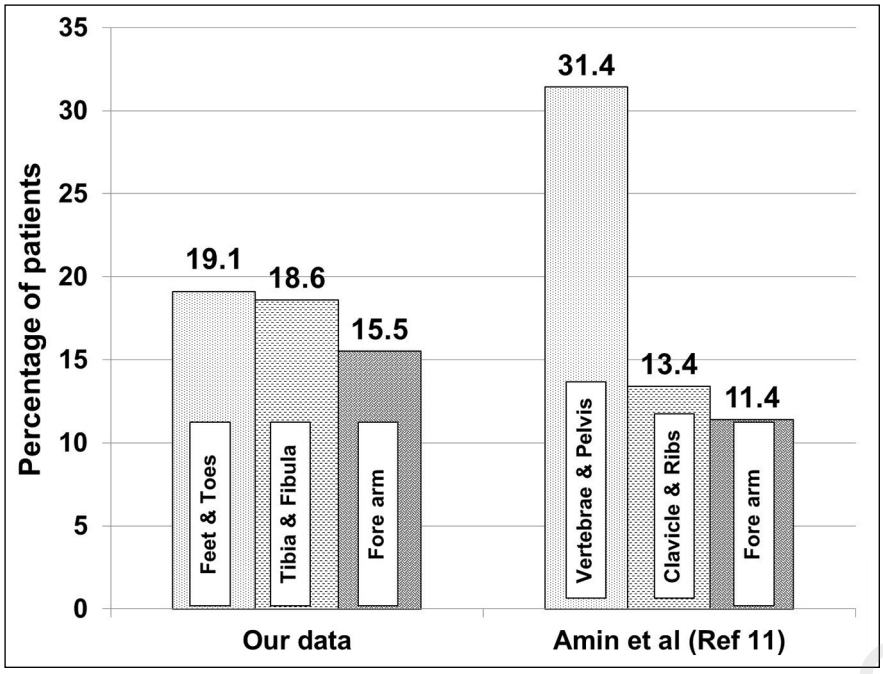

Figure 1 - Comparison between common sites of fractures.

that the skull injuries were common, followed by the extremity fractures in patients admitted after RTA (15). A long-term study analyzed the trends of the humerus fracture rates spread over two decades (16). The incidence rate (40 per 100,000 py) was higher when compared with our data on humerus fractures (8.7 per 100,000) and the majority of their patients was above 50 years of age (16). The comparison of incidence rates between different nations is difficult due to the differences in the population, vitamin D intake and genetic predisposition. However, a population registry of similar nature gives an advantage to identify the fracture burden of the community and also helps in devising the relevant public awareness programs for prevention of the fractures.

Another interesting observation is the reduced incidence rate of the stress fracture in our study. Few studies from India reported 15-20% prevalence of stress fractures in young recruits of paramilitary forces (17, 18). The low prevalence in our study could be due to the better training methods adopted and the emphasis on proper rest during the interim periods. Awasthi et al. reported that the upper limb fractures were more common than the lower extremity fractures in a hospital based study (19). Military personnel are commonly injured during outdoor contact sports and vehicle accidents, and falls are the most common injury observed in the previous report (19). A limited number of studies exists that describe the epidemiology of the fractures in younger population. Tandon et al. showed that increased physical activity in children is a direct risk factor for the fractures in the Indian pediatric population (20). The nature of the military job involves a high degree of physical strain and outdoor activity, which could increase the fracture rate.

The strength of our study includes the long-term follow-up of a healthy young population with pan-Indian representation. The institutionalized therapy and registry data contributes to the validity and the robustness of our study. However, the limitations include absence of important data about the fractures (mode of injury, simple or compound, seasonal variation and outcomes) and the omission of information about the patients treated outside our hospitals, thereby not generating an entry into the EMR data. Our data do not include female population, making it less representative of the general population. Another limitation is that our study population being relatively young, is yet to achieve the peak bone mass which may affect the incidence rates of the fracture.

To conclude, we describe the incidence rates of various fractures from a large population. This information is useful for planning the orthopedic training requirement, hospital beds and also for the calculation of the power of a study using different types of interventions.

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Authorship

All named Authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for Authorship for this manuscript, take responsibility for the integrity of the work as a whole, and have given final approval to the version to be published.

Disclosure

All the Authors declare that they have no conflict of interest.

Compliance with ethics guidelines

This article is compliant with all the ethical guidelines and we did not take permission from the ethics committee as the data was derived from the available medical records only. Our study does a repeat analysis of the known information, thereby precluding a requirement of the approval from the Institutional Review Board. Our article is based on the previously conducted studies and does not involve any new studies of human or animal subjects performed by any of the Authors.

Data availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the data pertaining to the military service personnel but are available from the corresponding Author on reasonable request.

Authors' contributions

KVS designed the study. KVS and SKP analyzed the data and did statistical analyses. SKP created the figures and KVS wrote the report. Both the Authors read and revised the report, and approved the final submitted version. KVS assumes responsibility for the completeness and accuracy of the data and analyses.

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