

The Frequency of Knee-Joint Injuries Caused by Sports Activities Among the Armed Forces Personnel

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Abstract

Background: Doing hard physical exercises help empowering military forces to carry out their duties and missions. However, blindly following this aim may cause physical damages which lead to their temporary or permanent disability.

Objectives: The current study aimed to investigate the prevalence of knee injuries resulting from sports activities among the armed forces personnel in 2010.

Methods: It was a descriptive and retrospective study. All the armed forces personnel (n = 4203) covered by Kosar insurance in 2010 participated in the study. Data were analyzed using Excel and SPSS version 18 at the significant level of $P \leq 0.05$.

Results: The most frequent injuries were observed in the lower limbs (73%) and ankles (38.7%), respectively. The third most common injury was observed in knees (13.4%). Among the knee injuries, anterior cruciate ligament (ACL) (77.82%) and meniscus (63.8%) were most prevalent. Also, posterior cruciate ligament (PCL) (6.6%) and medial collateral ligament (3.8%), the lateral collateral ligament (2.3%) and other injuries, including chondromalacia, osteoarthritis, etc. were reported.

Conclusions: The prevalence of injuries in lower limbs is more frequent than other limbs. Ligament injury is high among the armed forces personnel. Among the ligament injuries, the most frequently observed case was anterior cruciate ligament (ACL). Most knee injuries in this research were observed in the dominant leg and the muscle injuries in the dominant leg can be reduced through appropriate strength training program and muscle balancing to oppose muscles.

Keywords: Injuries, Sports Injuries, Knee Joint

1. Background

An important goal of physical exercise is to acquire and maintain practical fitness. For each system, some degrees of physical fitness are required, which can only be achieved through physical activities. Through strengthening fitness programs, people can well take over their duties and missions in the war time or maneuvers (1). In addition to all the benefits supposed for sports and physical education, physical injury always is and grows in association with it. However, it should be considered that the overall benefits of exercise for each individual in the community are far higher than its losses (2). Physical injuries have a significant effect on the fitness of the armed forces; for example, fractures can interrupt an individual's activity for more than 100 days (3). Therefore, any physical injury occurring among the military forces can lead to their temporary or permanent disability (1). Recognition, prediction and evaluation of injury risk factors in athletes are important. Today, recognition and identification of injury risk factors is an important component of prevention management for sports injuries (4).

Results of previous studies show that the main reason

to visit the clinics of training camps was physical injuries and the most common ones were musculoskeletal injuries (5). In a study entitled "epidemiology of physical injuries resulted from military exercises" by Najafi Mehri et al. (6), the major cause of visiting clinics was physical injury and the most common ones were musculoskeletal injuries and the most affected limbs were lower limbs. Based on this study, the most common sites of injuries resulted from military training for the military forces were ankles and knees, respectively (7). Due to the long duration, the rehabilitation of sports injuries is important. Therefore, their prevention and rehabilitation methods are always considered as one of the research subjects by sport scientists and sports medicine specialists (8). In the department of physical medicine at the US Army, research was conducted on 120-420 files of patients hospitalized because of physical injuries. Of these patients, 11% of physical injuries were due to different sports or physical training. In this study, the most common sites of injury were also knees and ankles, respectively (9). After ankle, knee is the most common site of injury (8). In addition to the need for long rest after injury, particularly ACL injuries which require four to eleven

months of rest to be fully recovered, high incidence of knee injuries imposes enormous costs (5). In sport traumas, injuries are mainly related to the ligaments and meniscus. However, in general, most injuries occur in knees, meniscus, and knee ligaments, respectively. Knee injury mainly occurs following its rotation; however, it can also appear due to hitting, falling on foot, incorrect jumping, long running and inadequate warming up (5).

Given the sensitivity and the importance of preserving and strengthening physical stamina and preventing injuries among the military forces resulted from training exercises, and since according to previous studies, most of the injuries occurred in the knee joint, the current study investigated the prevalence of many sports-related knee injuries and their causes among the armed forces personnel in 2010 to decrease the incidence through providing preventive strategies.

2. Objectives

The results of the current study and similar studies would be used to address the causes of injuries and design appropriate preventative programs such as preparation of prevention programs for injuries occurring during training and reforming training programs, to design and implement programs compatible with the forces, to frequently carry out fitness tests, to create appropriate training and sports environment, to do warm-up exercises before sporting, to provide safety equipment for each exercise to prevent such injuries in the future.

3. Methods

The current study was descriptive and retrospective. The study population (n = 4203) included all employees of the armed forces covered by Kosar Insurance in 2010. After receiving the formal introduction letter, the researcher referred to Kosar Insurance Fund to collect the data recorded in medical files. The demographic information and injury checklists were used to collect data. Reviewing the medical records, some cases including type of injury, injury code, site of injury and rate of injury, according to the medical councils, as well as the date of occurrence were recorded. After reviewing medical records, the research data was collected and analyzed using the Excel and SPSS version 18.

4. Results

The total population of the study consisted of 4203 male subjects (834 military personnel, 1349 police forces, 1852 Iranian revolutionary guards and 159 persons from

the department of defense) (Figure 1). Regarding the distribution of subjects based on the site of injury, it was observed that the ankle injury with 1628 cases (38.7%) had the highest frequency among the injuries and hands and arms with 1461 cases (34.8%) and knee with 565 cases (13.4%) followed (Table 1). The site of injuries resulted from sports events are divided into three parts: 1) Lower limbs; 2) Waist and torso and 3) Upper limbs. The frequency of affected people based on the affected site is shown in Table 2; noting that the injuries for some cases had occurred in multiple sites of the body. Among those affected, events leading to maiming included those described in Table 3. In this regard, the incidents caused by accidents (1312 cases, 31.2%) led to the highest frequency of maiming among the participants. The deaths caused by training programs (41 cases, 1.1%) had the lowest rate. Moreover, sports events with 742 cases (17.6%) were the third factor of maiming (Table 3).

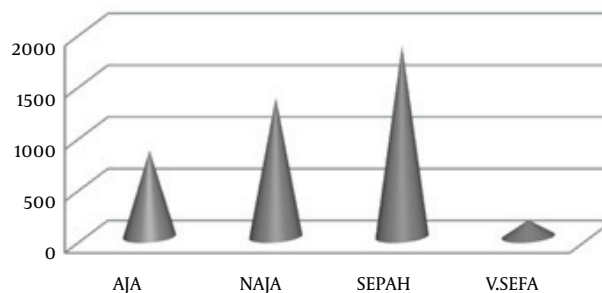


Figure 1. Distribution of Subjects Based on Military Force

Table 1. Distribution of Participants Based on Injury Site

Injury	Frequency (%)
Knee	565 (13.4)
Thigh	148 (3.5)
Basin	120 (2.9)
Ankle	1628 (38.7)
Leg	325 (8.4)
Waist and spine	132 (3.1)
Hand and arm	1461 (34.8)
Shoulder and scapular	135 (3.2)
Head and face	331 (7.9)
Total	4203 (100)

As shown in Table 4, among the subjects maimed as a result of sports activities, 257 (35%) had been affected by knee injury. It should be noted that, among the 257 (35%) patients with knee injuries, some had been maimed both

Table 2. The Frequency of Injuries Based on the Affected Site Caused by Sports Events

Injury	Frequency (%)
Upper limbs	163 (22)
Waist and torso	38 (5)
Lower limbs	541 (73)
Total	741 (100)

Table 3. The Frequency of Injuries

Injury	Frequency (%)
	281 (6.7)
Hitting by an object	1312 (31.2)
Accident	41 (1.1)
Training losses	742 (17.6)
Sports events	1107 (26.3)
Stumble	250 (5.9)
Accidents at work	464 (11)
Other	4203 (100)

from knee and other limbs. Based on the separation of forces, sports-related knee injury distribution is shown in Table 5. The maximum and the minimum cases of knee injuries were observed among Iranian revolutionary guards with 125 (48.6%) cases and the armed forces of the department of defense with 7 (2.7%) cases (Table 5).

Table 4. Comparing the Frequency of Injuries Between Different Limbs and Knee

Injury	Frequency (%)
Knees	257 (35)
Other limbs	474 (65)
Total	741 (100)

Table 5. Distribution of Knee-Injured Armed Forces

Injury	Frequency (%)
Army	65 (25.3)
Police	60 (23.3)
The revolutionary guards	125 (48.6)
Department of defense	7 (2.7)
Total	257 (100)

The frequency of persons affected by sports-related knee injury, with regard to sports fields, is shown in Table

6. In this regard, football and futsal with a frequency of 86 (33.5%) cases had the highest frequency among the other sports fields and morning exercises with 75 (30.7%) cases were the second traumatic sport among other sport fields (Table 6). Regarding the frequency distribution based on the percentage of sports-related knee injury and maiming after the division of injury percentage in the desired range, the results are shown in Table 7. It was found that 11% - 15% injury with 109 (42.4%) cases had the highest frequency. The frequency of accidents leading to sports-related knee injuries among armed forces personnel is shown in Table 8. As it can be observed in Table 8, accidents caused through collision with the opposing player (37.7%) and maiming caused by sprains (35.8%) had the highest frequencies. The highest frequency of sports-related knee injuries among the armed forces was ACL with 200 (77.82%) cases and meniscus injury with a frequency of 164 (63.8%) cases was the second common knee injury (Table 9).

Table 6. The Frequency of Knee Injuries Based on Sports Disciplines

Injury	Frequency (%)
Football and futsal	86 (33.5)
Volleyball	22 (8.6)
Martial arts	35 (13.6)
Training	13 (5.1)
Morning exercises	79 (30.7)
Mountaineering	10 (3.9)
Other	12 (4.7)
Total	257 (100)

Table 7. The Frequency of Repeated Knee Injury

Times of Injury	Frequency (%)
0 - 5	39 (15.2)
6 - 10	95 (37)
11 - 15	109 (42.4)
16 - 20	7 (2.7)
Over 21	7 (2.7)
Total	257 (100)

5. Discussion

Heir et al. investigated the rate of musculoskeletal traumas occurred in soldiers receiving training and the rate of such injuries was higher in the army than in the

Table 8. The Frequency of Knee Injury Causes

Cause of Injury	Frequency (%)
Hitting	30 (11.7)
Collision with other players	97 (37.7)
Loss of balance	22 (8.6)
Torsion	92 (35.8)
Other factors	16 (6.2)
Total	257 (100)

Table 9. The Frequency of Knee Injury Sites

Injury Site	Frequency (%)
Partial ACL	11 (3.4)
Partial meniscus	6 (2.3)
Full ACL tear of the right knee	108 (42)
Full ACL tear of the left knee	74 (28.8)
Partial ACL tear of the right knee	6 (2.3)
Partial ACL tear of the left knee	12 (4.7)
PCL tear of the right knee	11 (3.4)
PCL tear of the left knee	6 (2.3)
MCL tear of the right knee	6 (2.3)
MCL tear of the left knee	4 (1.6)
LCL tear of the right knee	5 (1.9)
LCL tear of the left knee	1 (0.4)
Internal meniscus tear of the right knee	35 (13.6)
Internal meniscus tear of the left knee	39 (15.2)
External meniscus tear of the right knee	7 (2.7)
External meniscus tear of the left knee	3 (1.2)
tear of both meniscus	80 (31.1)
Meniscus tear grade 1	4 (1.6)
Meniscus tear grade 2	27 (10.5)
Meniscus tear grade 3	32 (12.5)
Other injuries	4 (1.6)

Abbreviations: ACL, anterior cruciate ligament; PCL, posterior cruciate ligament.

other military forces (7). Similarly, the results obtained in this study revealed that the highest rates of injuries were respectively in the Islamic revolutionary guard corps (IRGC) (44.1%), the NAJA (law enforcement force of Islamic Republic of Iran) (32.1%), the AJA (Islamic Republic of Iran army) (20.1%) and the Ministry of Defense (3.7%). In the study conducted by the United States army's department of physical medicine, the most common injury sites were

reported knees and ankles, respectively. The results of the research by Najafi Mehri et al. (6) showed that the most injured sites in the armed forces were reported in the lower extremity and ankles (26.6%) and in knees and shins (17.8%). Heir et al. (7) in their study on soldiers receiving training showed that the most common injured site was in the lower extremity consisted of knee injuries, joint capsule or ligament sprain and lower extremity compartment syndrome. Zigheymat et al. (10) investigated the frequency of musculoskeletal complaints among motor boats employees and its relationship with their demographic characteristics, revealed that the most musculoskeletal complaints were in the areas of back (61.1%) and knees (60.4%). Yet another study by Williams et al. entitled the epidemiological pattern of musculoskeletal injuries and physical exercises showed that 82% of injuries occurred in the lower extremities and the most frequent injury sites were in the feet and ankles (34.3%), followed by knees (28.1%) (11). The results of the study by Hare showed that a quarter of males liable to military service were subject to one or more musculoskeletal injuries during a training period and back pain, severe knee injuries, inflammation of the Achilles tendon, and sprains of joint capsules or ligament were the most frequent injuries. The study by Morgan and Oberlander (12) on the English soccer players reported that 77% of injuries occurred in the lower body, being mostly in knees with 54% injuries. In addition, 59% of the injuries were reported mild, 28% moderate and 13% severe. The results of this study showed that most musculoskeletal injuries occurred in the lower extremities with ankles and knees as the most affected sites. The current study results also showed that the most injured sites among the military personnel was in lower extremity (73%), where ankles with 38.7%, hands and arms with 34.8% followed by knees with 13.4% had the maximum injuries. The differences in the prevalence of injuries in the current study and the literature can be attributed to differences in the study population and participants' type of activity. Although, the knee joint is one of the biggest and most important body joints, and is considered the most pivotal joint in terms of creating stability and balance and bearing weight as well as mobility, it may be subjected to severe injuries while being extremely involved in sports due to insufficient protective layers such as adipose tissue or imbalanced muscle tissue, meaning the imbalance between the hamstring and quadriceps muscles as well as the weak joint between their bones (13).

Bollen showed that 40% of knee injuries were associated with ligaments, 24% with patella, 11% with meniscus, and 25% with other types, and among the ligament injuries, the most common ones were related to anterior cruciate ligament (46%); 29% of injuries were in the medial collateral ligament, 13% in medial collateral ligament and

anterior cruciate ligament, 4% in posterior cruciate ligament, 2% in external lateral ligaments, and 6% of joint injuries occurred in a few other ligaments (14). In a study by Rahbar Kahkhzhaleh and Shojae Al-Din (13) entitled "investigating the prevalence and causes of knee injuries in male soccer players participating in professional leagues of the year 2005 - 2006", most knee injuries were observed in ligaments, and among the ligaments, the highest rate of injury belonged to the anterior cruciate ligament. Web Curie concluded that the most common knee injuries occurred in ligaments, especially the anterior cruciate ligament. Stevelin also examined the prevalence of knee injuries in England and mentioned that most knee injuries were in ligaments, especially anterior cruciate ligament. The results of the current study on the armed forces also showed that, regarding the sports-related knee injuries among the armed forces personnel, ACL injuries (77.82%) and the meniscus (63.8%) had the highest frequency among the general types of knee injuries, respectively. The number of tear was reported for PCL (6.6%), MCL (3.8%) and LCL (2.3%). As observed in the literature, the highest rate of knee injury belonged to the ACL tear. From the orthopedic perspective, the hamstring muscle is in close cooperation with ACL in the anteroposterior knee stability and strengthening this muscle should form an important part of training programs (8). Paying more attention to the strength of the quadriceps muscles compared with hamstring increases the likelihood of injury to the ACL. ACL injury prevention program should be based on the development of knee dynamic control, with an emphasis on strengthening the hamstring muscles (15).

Among the common sports disciplines of the armed forces, the highest percentage of injuries was observed in football and futsal (33.5%); since the sudden turnaround, direction reversions, and collision with players increase in the power speed sports such as football (8). On the other hand, the relatively low stability of the ankle and knee, and lack of physical fitness in these limbs cause the higher prevalence of injuries in lower limbs, especially in these two joints (8). The prevalence injuries of morning exercises can be also attributed to improper warm-up. It seems that, due to the lack of body readiness at this time, the rate of injuries increase during the early hours of the morning. Due to the low temperature of the body at this time and the direct correlation between increased body temperature during warm-up and reaching the peak of physical capabilities, there is a need to pay more attention to warming up the body in the morning.

5.1. Conclusion

The results of the current study could significantly contribute to the prevention of sports injuries among armed

forces personnel. One of the limitations of the study was that the exact details of injuries had not been recorded in all medical files.

Certain factors may have a major role to prevent injuries, including the presence of medical personnel, which are highly influential in appropriate treatment of injuries and play an active role in prevention through identifying risk factors. Moreover, the specifications and quality of sport venues, safety of facilities and equipment, as well as the surrounding environment should give security to the users (athletes, coaches and staff). Other injury prevention factors include appropriate warm-up and fitness levels proportional to people's activities and sports disciplines. According to the impact of these factors, it is recommended to conduct researches on the safety of sporting venues for the armed forces as well as the fitness programs appropriate to employees' activities.

Footnote

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