

**Case Report**

# Volleyball Injuries: A Survey of Injuries Among Male Players of the Chinese Taipei National Volleyball Team

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**To cite this article:**Hung-Yu Huang, Tso-Liang Teng, Cho-Chung Liang. Volleyball Injuries: A Survey of Injuries Among Male Players of the Chinese Taipei National Volleyball Team. *American Journal of Sports Science*. Vol. 3, No. 6, 2015, pp. 109-114. doi: 10.11648/j.ajss.20150306.12

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**Abstract:** Volleyball is a sport involving rapid and forceful movements of the body as a whole. Because of the large forces involved in such movements, it is inevitable that injuries occur. If injuries are inflicted during a game, they primarily occur in the lower extremities, and particularly in the ankles, knees, and feet, which are used for jumping and landing. Previous studies have recorded only the frequency with which various injuries occurred during matches; the type and severity of injury during training sessions were not explored. In this study, questionnaires were designed to discover the injuries that the players sustained during training for the 2014 Asian Games in Incheon, South Korea. This study aimed to identify and analyze the types and locations of frequent injuries in volleyball players during varying training phases. The results revealed that the percentage of incidences of injuries in the second session was greater than that in the first session in terms of affecting training, whereas the percentage of incidences of injuries in the first session was greater than that in the second session in terms of preventing players from playing in competitions. Furthermore, coaches should be aware of the types and location of injuries that players may sustain during various sessions of training, and accordingly advise players on how to prevent injuries before they occur. The analytical results obtained here have potential for guiding the injury-preventive measures in volleyball.

**Keywords:** Volleyball, Injuries, Training Phase, Injury-Preventive Measures

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## 1. Introduction

Volleyball is one of the most popular sports in the world. It is played by approximately 200 million players worldwide [1] with more than 200 member countries in the Federation International de Volleyball (FIVB) and about 150 million players. In Norway, volleyball is the 8th largest sport with about 33,000 registered players. Considering the popularity of the sport, there is a lack of information about volleyball injuries and their mechanisms. Volleyball is a non-contact game which players from the opposing teams are separated by a net. Therefore, the incidence of injuries might be expected to be low. Nevertheless, volleyball is a sport involving rapid and forceful movements of the body as a whole, both horizontally and vertically, and of the arm and hand when spiking the ball. Because of the large forces involved in such movements, it is inevitable that injuries occur [2].

Volleyball is a sport in which two teams are separated by a

net according to international volleyball rules. Apart from showing team spirit, players should perform within their abilities, exert their strengths, and focus on tactical skills. Players now more often jump serving, blocking, attacking, and dink shooting. In addition, volleyball relies highly on the anaerobic energy system to be effective for short periods of time. The number of jumps serving, blocking, and attacking were recorded as up to 250 in a game. If injuries are inflicted during a game, they primarily occur in the lower extremities, and particularly in the ankles, knees, and feet, which are used for jumping and landing. Gerberich et al. (1987) [3] evaluated the injuries of volleyball players. Their findings revealed that nearly 90% of injuries were concentrated in the lower extremities. Knee injuries accounted for 59% of all injuries for both sexes, and ankle injuries accounted for 22% of all injuries in female players and 24% in male players. Injuries due to impact after continual jumping, landing, and twisting accounted for 63% of injuries. De Loe's (1995) [4] presented

that per year Swiss are close to 350,000 participants (age 14-20 years) during 13.2 million hours causing more than 5,000 injuries. Schafle *et al.* (1990) [5] found an overall injury incidence of 2.3 per 1000 hours during the United States Volleyball Association's (USVBA) 6-day national tournament. An injury was defined as one causing at least 1 day of missed participation, and both overuse injuries and acute injuries were included in their estimate. R. Bahr *et al.* (1997) [6] examined the incidence and mechanisms of acute volleyball injuries, with particular reference to possible risk factors for ankle injuries. This results indicated that external supports should be worn for 6~12 months after an ankle sprain. Ferretti *et al.* (1992) [7] reported that severe knee ligament injuries occurred when landing after a jump and attack, causing 73% of all injuries. Volleyball is a dynamic sport in which musculoskeletal injuries occur frequently. Knee joints experience the most injuries of all the lower extremities. Julie *et al.* (2007) [8] reviewed 16 years of injury surveillance data for volleyball players reported by the National Collegiate Athletic Association from 1988 to 2004. The most frequent injury demonstrated was the ankle ligament sprain, representing 44% of all injuries, which is caused by stepping on another player or incorrect landing. The second most common injury was an internal derangement of the knee (14%), such as damage of the knee particular cartilage or of the knee ligament caused by excessive use of the knee during training and matches. Previous studies have indicated that ankle sprains may be the most common injury type in volleyball, accounting for one-quarter to one-half of all acute injuries [1, 9-12]. We also have some evidence that these injuries mainly occur at the net, when landing after blocking or attacking [13]. Although we have some information about injury mechanisms on which to form hypotheses about possible intervention strategies, we know less about individual risk factors. Our previous study also showed that in 78% of the cases, the players had a history of at least one previous ankle injury during their career [13]. However, since we did not have any information on the uninjured players, this study could not establish the role of previous injury as an independent risk factor. We therefore wanted to study the effects of previous ankle injury as a risk factor for new ankle sprains using a prospective season-long study on a population of high level volleyball players. With this design we also wanted to examine the incidence and mechanisms of other acute volleyball injuries.

However, the aforementioned studies have recorded only the frequency with which various injuries occurred during matches; the type and severity of injury during training sessions were not explored. The training of a national volleyball team typically includes three parts: training, adjustment, and competition. Physical strengths and techniques of players are enhanced during training, and suitable tactics are designed on the basis of the characteristics of the players. Considerable time is invested into physical training, endurance running, sprints, and ball training in an effort to correct players' posture. Deficiencies in strength and skill are improved through game practices and dual matches,

which also help to examine a player's condition before competition. Drills are also used to develop a tacit understanding among players. An important purpose of sports injury epidemiology is to supply information about injuries that occur frequently and have serious consequences, and to describe their aetiology [14]. In view of the global participation rate and the relatively high incidence of volleyball injuries when comparing volleyball with high intensity contact sports, preventive measures are definitely warranted in volleyball [5-6, 12-17].

However, injuries that occur during training have not been clearly distinguished in the literature. In this study, questionnaires were designed to discover the injuries that the players sustained during training for the 2014 Asian Games in Incheon, South Korea. This study aimed to identify and analyze the types and locations of frequent injuries in volleyball players during varying training phases. The analytical results obtained here have potential for guiding the injury-preventive measures in volleyball.

## 2. Methodology

### 2.1. Subject

The subjects were volleyball players representing the Chinese Taipei during the 2014 Asian Games in Incheon, South Korea from September 19, 2014 to October 4, 2014. They were outstanding players who had been selected from the Enterprise Volleyball League by their head coach. Eighteen players were selected by a screening committee to train at the National Sports Training Center in Zuoying, Kaohsiung City, for more than 6 months.

### 2.2. Method

Questionnaires were designed to discover the injuries that the players sustained during training. The definition of injury is bodily damage sustained during drills or training, resulting in the deterioration of the player's performance or the need for forced rest or medical treatment. The definition of injury incidence is the number of injuries sustained during training from March 2014 to August 2014. One hour of training was counted as one unit.

### 2.3. Training

Training period was divided into two sessions.

(1) The first session was from March to May, during which the training focused on basic movements and skills, including physical and skills training. The 18 players were elite players from the Enterprise Volleyball League who were competing across the nation. Therefore, players were required to undergo aerobic and anaerobic training sessions to enhance their physical fitness. Aerobic training involved 3000-m and 5000-m distance running, and anaerobic training included 10 sets of 30-m, 60-m, 100-m, and 200-m sprints or interval training, as well as 10-m and 30-m uphill sprint training (Fig. 1).



Figure 1. Uphill sprint training.



Figure 2. Physical training.

(2) The second session was from June to August. The training focused on integrated skills and tactics. Players were instructed in various technical skills regarding offensive and defensive strategies, including various physical training (Fig.2), group training, attacking skills (Fig.3), and defensive formations. In addition, players were required to complete 3000 m and 5000 m of distance running, anaerobic training involving 10 sets of 30-m, 60-m, 100-m, and 200-m sprints or interval training, and 10-m and 30-m uphill sprint training.



Figure 3. Attacking skills.

(3) This study investigated the injuries that occurred during this training; therefore, physiological and psychological problems were not discussed.

### 3. Results and Discussion

#### 3.1. Basic Information

This study investigated the injury patterns of 18 male players from the Chinese Taipei National Volleyball Team. Table 1 presents the basic information of the players. Table 2 provides the statistical data about the pertaining warm-up exercises.

Table 1. Information about Chinese Taipei Men's National Volleyball Team.

	Age	Height	Weight	Attack point	Block point (both hands)	Playing experience	Daily training duration	Weekly training frequency
Mean	23.22	187.06	84	318.61	305.67	11.67	5.11	7.67
SEM	0.56	2.20	2.57	3.66	3.54	0.82	0.36	0.52
Total	418	3367	1512	5735	5502	210	92	138

Table 2. Total number of warm-up exercises performed before competition or training.

	Frequency	Percentage
Not at all	1	5.6
0-20 min	10	55.6
20-40 min	7	38.9
Total	18	100

#### 3.2. Injuries Sustained During Training

A total of 46 injuries were sustained by the players during training; 25 injuries occurred during the first session of the

training and 21 injuries occurred during the second session. The average daily training was  $5.11 \pm 0.36$  h, and the average number of weekly training was  $7.67 \pm 0.52$  times. Incidences of injuries occurred each hour during training, which was 0.11 times/h and 0.17 times/week.

During the first (second) session of training, 40% (78.6%) of the players sustained injuries that prevented them from practicing volleyball, and 60% (14.3%) of the players sustained injuries that prevented them from playing in competitions. In addition, 7.1% of the players were injured during the second training session, affecting their lifestyle. The results revealed that the percentage of incidences of

injuries in the second session was greater than that in the first session in terms of affecting training, and the percentage of incidences of injuries in the first session was greater than that in the second session in terms of preventing players from playing in competitions, as shown in Table 3.

A total of 89 injuries were reported during the first and second sessions of training. Thirty-five injuries were sustained during the first session and 54 injuries were sustained during the second session. According to the collected statistics, the average incidences of injuries occurring during training were 0.05 times/h and 0.08 times/week. In 78.6% of the cases, the players were unable to complete the second training session because of their injuries; this shows that several players did not obtain sufficient training in the second session, causing players to exhibit decreased performance during the adjustment period and during competitions.

**Table 3.** Percentage of incidences of injuries in various training sessions.

	First session		Second session	
	frequency	%	frequency	%
Training	6	40	11	78.6
Competition	9	60	2	14.3
Daily routines			1	7.1
Total	15	100	14	100

### 3.3. Types of Injuries

Table 4 shows the types of injuries in both training sessions. In the first session, the most common injury was muscular strain (46.7%), followed by sprains (40%), bone fractures (6.7%), and other injuries (6.7%). In the second session, the most common injury was muscular strain (69.2%), followed by sprains (23.1%) and traumatic injuries (7.7%).

**Table 4.** Percentage of types of injuries in each training session.

	First session		Second session	
	frequency	%	frequency	%
Sprains	6	40	3	23.1
Strains	7	46.7	9	69.2
Bone fracture	1	6.7		
Other injuries	1	6.7		
Traumatic injuries			1	7.7
Total	15	100	14	100

Muscular strain was the most common injury sustained in both sessions, followed by sprains, the frequency of which increased by 22.5% during the second session. These results vary from the findings of Gerberich *et al.* (1987) [10], indicating that the injuries that players sustained depended on the training they received. Muscular strain affected the players of the Chinese Taipei National Volleyball Team, possibly because of insufficient warm-up exercises and an increase in training intensity. Lin (1999) [18] reported that approximately 96.2% of players did warm-up exercises before matches; 70.9% of players finished warm-up exercises in 20 min and only 3.5% of players performed warm-up exercises for more than 40 min.

In their study on the change of heart rate during volleyball matches, found that the libero had a heart rate of 111–130 beats/min, the middle hitter had a heart rate of 131–150

beats/min, and the outside hitter had a heart rate of 131–150 beats/min. Injuries were likely to occur if players had not performed sufficient warm-up exercises lasting more than 40 min. However, players often performed high intensity training immediately after stretching in their morning training sessions, during which times they experienced numerous incidences of tendonitis in the lower calves and muscle sprains in the thighs. The training sessions were held for more than half a year, and the duration of daily training sessions was up to 5.11 h. As a result, incidences of patellar tendinitis were frequent, especially in players whose main team roles required jumping. In addition, sprains caused a mental and physical burden on players, which raised the incidences of injuries, particularly for the front row players. The main cause of sprains was imbalance and players landing on other players. McKay *et al.* (2001) [19] suggested that wearing good shoes and stretching the muscle groups around the ankle could prevent sprains. Zelisko *et al.* (1982) [20] reported that players could reduce incidences of ankle sprain and maintain the stability of their ankles when moving if they had strong muscle groups around the ankles. Therefore, strengthening the muscles around the ankle through exercise (e.g., single-leg jumps) is crucial during routine training. Moreover, sufficient warm-up exercises and ankle taping before training may reduce incidences of ankle injuries.

### 3.4. Location of Injuries

The locations of injuries sustained in each training session are shown in Table 5. In the first session, 24%, 16%, 16%, and 16% of all injuries occurred in the knees, waists, fingers, and ankles, respectively. In the second session, knees and waists were the most common injury locations, which accounted for 33.3% and 23.8% of all injuries, respectively.

Based on the statistics, knee injuries were the most severe and frequent injuries of the lower extremities, which accounted for 33.3% of all injuries, followed by waists (23.8%), ankles (16%), fingers (16%), and shoulders (12%). These results differed from the findings of Julie *et al.* [8]. Therefore, players should pay attention to preventing injuries in these two areas in future training.

Volleyball requires physical fitness, height, and skills; therefore, players must have immense strength, power, and agility. Various types of training are often designed on the basis of a player's personal skills and physical fitness level; as a result, they are more likely to become injured during training. Therefore, players should pay particular attention to their own bodies starting from the beginning of their training. Increasing muscle strength through weight lifting can effectively enhance the body's resistance and reduce the occurrence of injuries.

Todd (1993) [21] reported that deceleration runs and jumping exercises require eccentric strength in the quadriceps extensor of the frontal thigh. The soft tissue covering the patella of players with insufficient eccentric strength is often injured resulting from increased tension, leading to inflammation, pain, and swelling at the early periods and fibrosis and calcification at later periods. Therefore, a great amount of training, and particularly training for enhancing eccentric muscle strength,

becomes critical for players. In addition, stretching the quadriceps extensor after training is also crucial for protecting knees that are often subjected to jumping exercises.

## 4. Conclusion

The results revealed that the percentage of incidences of injuries in the second session was greater than that in the first session in terms of affecting training, whereas the percentage of incidences of injuries in the first session was greater than that in the second session in terms of preventing players from playing in competitions. Comparing injuries sustained in each session, muscular strain was the most common injury sustained in both sessions, followed by sprains, the frequency of which increased by 22.5% in the second session. The most commonly injured body parts in volleyball are the knees, the waists, and the ankles. Coaches should be aware of the types and location of injuries that players may sustain during various sessions of training, and accordingly advise players on

how to prevent injuries before they occur. For example, a high incidence of muscle strain is likely because of insufficient warm-up exercises. Coaches should advise players to modify their warm-up practice and to extend their warm-up period to reduce the occurrence of injury. Volleyball requires a sufficient level of physical fitness; therefore, coaches should explain to players the cause and the possible prevention of injuries when assigning specific weight lifting and training exercises. Coaches should also improve the deficiencies in players' skills, convey correct concepts regarding injury prevention, provide immediate treatment to injured players, and assist doctors by reporting the recovery process of injured players. In addition, athletic trainers function as a communication bridge between players and coaches. They should report the physical condition of players every day, which would enable the coach to modify individual training to achieve the most effective results, thereby preventing the occurrence of injuries and improving the performance of players during competitions.

*Table 5. Location of injuries by body part in each training session.*

		Shoulder	Back	Waist	Arm	Finger	Elbow
First session	Frequency	3	1	4			1
	Total (%)	12	4	16			4
Second session	Frequency	1	1	5	2	1	
	Total (%)	4.8	4.8	23.8	9.5	4.8	
		Finger	Knee	Thigh	Lower leg	Ankle	Total
First session	Frequency	4	6		2	4	25
	Total (%)	16	24		8	16	100
Second session	Frequency		7	1	1	2	21
	Total (%)		33.3	4.8	4.8	9.5	100

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