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Prevalence, Causes and Mechanism of Athletic Injuries in Elite Women Volleyball Players

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Abstract: The aim of the present study is to determine the prevalence rate, causes and mechanism of sports injuries in elite women volleyball players according to the post as well as the competition and practice situation. 61 female players including 15 passers, 15 liberos and 31 spikers participated in this study with the average age of 22.19 ± 4.81 years and the athletic background of 8.27 ±4.32 years in premier league and national matches in 2008. Overall, the subjects reported 156 sports injuries in their career. Personal information inventory and sports injuries report standard inventory were used to gather needed information. One-way variance analysis, descriptive statistics and t-test for dependent groups and Chi square with the reliability of 95% were used to analyze the data. The results of the study showed that the prevalence of the injuries for passers, liberos and spikers were 1.229, 1.362 and 1.162 per 1000 hours of practice, respectfully. Bad falling 18.7%, jump for defend or spike 17.9% and being hit by ball 17.2% were the most dangerous causes for injuries. The danger for the injury was reported to be 28.3%, 39.6% and 32.1% for internal factors, external factors and stimulant events, respectfully. No significant difference was observed between the prevalence of the injuries of different body parts, as well as the type, intensity, recovery situation, causes and the influential factors in sports injuries in passers, liberos and spikers on one hand and practicing and competitive situations on the other hand. The findings showed that prevalence of injuries in Iranian elite women volleyball players is in lower rate in comparison with other countries. The most prevalent injuries were ankle injuries as well as sprain and chronic injuries in tendons. Most injuries are in the range of low and medium intensity which are mostly followed by returning to the games. The major causes for the injuries are low physical fitness and readiness, bad falls as well as external factors.

Key words: Sports injuries · Women elite volleyball players · Injury prevalence · Playing post · Match situation

INTRODUCTION

Iranian volleyball has improved significantly in international level in recent years. This improvement is the result of a successful management and planning as well as proper investing in championship levels. Elite players, as the human resources of the championship system, are always exposed to several types of injuries during the competitions as well as training. A professional volleyball player hits the ball approximately 40 thousand times in a year, which is a great potential for being injured [1]. Being a combination of technical, tactical and physical needs, volleyball is a high risk sport regarding to injuries. Reviewing 227 studies from 38 countries between the years 1977 and 2005 regarding to the injuries in 70 sports fields revealed that the injuries related to ankles in volleyball are in the rank three [2]. The investigations of the injuries related to ankles in American high school athletes show that 10.6% of all injuries are related to the female volleyball players [3]. It was reported that the prevalence rate of the injuries was between 1.7 and 3.5% per hour of games [4-9]. Schafle *et al.* (1990) reported the injuries for female athletes 1.97% for 1000 hours of games while studying the injuries related to the amateur volleyball players in the U.S. in 1987 [5]. Agaard and Jorgensen (1996) reported the prevalence rate of the injuries in both men and women elite Swedish players to be 2.4 injuries in 1000 hours [6]. Bahr and bahr (1997) reported the prevalence of acute volleyball injuries in 727 Norwegian level two players to be 1.7 injuries during practices and 3.5 injuries during competitions in 1000 hours of games [4]. Verhagen *et al.* (2004) reported the

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overall prevalence of the injuries in the season 2001 in Netherlands volleyball to be 2.6 injuries in 1000 hours [7]. Zetou *et al.* reported the annual prevalence of the injuries for each player to be 0.63 [8]. Finally, Malliou *et al.* (2008) reported the prevalence of the injuries in season 2005-2006 in Greece volleyball in adults, adolescence and youth to be 2.5 injuries in 1000 hours of games [9]. This high rate of prevalence of injuries in a sports field shows that in order to prevent the injuries in players whose roles are vital in the teams' success, different aspects of these injuries should be determined.

Little is known about the differences in injuries regarding to the playing posts. Also, no good agreement can be found among the different studies in this regard. For instance, Malliou *et al.* (2008) have reported that in Greece, the side receivers and the passer are exposed to injuries in volleyball more than other posts [9]. In the study done on American high school volleyball players in 2006, the highest risk of injuries was report for middle blockers (40.2%). It was reported that highest amount of injuries regarding to the playing post is 32.5% for middle forwards, 20.7and for right forward and 14.4% for left forward [3].

Some researchers believe that the occurrence of the injuries in practices is more than in competitive situations. Taddayoni (2008) and Fallah Kheiri (2008) from Iran reported that the occurrence of the injuries in women volleyball in practical situations is more than in competitive ones [10,11]. Malliou *et al.* claimed that 24.3% of the injuries happen prior to the beginning of the season and 69.3% happen during the season. Previously, Agel *et al.* (2007) investigating the occurred injuries in the National Academic Sports Association, showed that the prevalence rate of the injuries in matches is lower than in practices [12]. In another research that was done to compare the occurred injuries in practices and in matches epidemiologically in five fields for men and four fields for women in high schools, it was revealed that the prevalence rate during practices was higher than during the matches [13]. In a study on 114 Greek volleyball players, Zetou *et al.* (2006) showed that most of the injuries happen during the practices [8]. Investigating the occurred injuries in Sweden for elite volleyball players in 2002-2003 seasons, researchers discovered that most of the injuries happen during the practices [15]. The researches done out of Iran showed that most of the injuries happen during practicing and lower body parts are exposed to these injuries more than other parts. Pulling and twists were the most common injuries during the practices [13]. According to Agel *et al.* (2007), the ankle ligament strain (44.1%), the inner knee disorder (14.1%), shoulder muscle strain 5.2% and back muscle pulling 4.8% occurred more than others in competitive situations. Also, according to the same study, the ankle ligament twist (29.4%), leg muscles tendon sprain (12.3%), back leg muscles tendon sprain (7.9%) and inner knee disorder (7.8%) are the major injuries in practices. In this study, the injury incidence for inner knee disorder and ankle twist in competition was twice as in practice [12]. It seems that the injury risk in practice is higher than in competition in volleyball. It should be noted that the time spent on practice is higher than the time spent on competition. Therefore, it can be claimed that the question that whether there is a difference between the prevalence of injuries for elite women volleyball players in practice and competition remains without answer. The present study aims to investigate the prevalence and the reasons for sports injuries in elite women volleyball players in Iran according to their playing posts as well as practice and competition situations.

MATERIALS AND METHODS

This study uses the descriptive method in its practical goals and considers the past in its time aspect. The statistical universe in this study is all the players in volleyball premiere league and national competitions in 2008 that is 61 players (15 passers, 15 liberos and 31 spakers) with the average age and standard deviation of 22.19 ± 4.81 and the athletic background of 8.27 ± 4.32 years. The participants filled in the personal information and athletic injuries reports questionnaires gathered from sport medicine site of Australia, along with their written informed consent. The athletic injuries reports questionnaire determines the injuries according to the injured part, the injury type, the intensity, the recovery situation, the incidence mechanism, the factors involved, the injury situation, the activity type during injuries, the injuries background, use of protective equipment during the injury and the paramedic actions after the injury. The liability and durability of this study was investigated and confirmed by Tadayoni (2008) [10].

The data analysis was done by descriptive method to summarize and classify the information. Also, deductive statistics and unilateral variance analysis was used to compare the prevalence of sports injuries among passers, liberos and spikers. Independent t-test was used to compare the prevalence of sports injuries in practice and competition and Chi Square was used to compare the injured body part, intensity, the injury type, recovery

situation, the incidence mechanism and involved factors in the injury in the three different posts in practices as well as in competitions up to 95% of reliability.

RESULTS

After gathering information, 61 participants reported 156 injuries during their overall championship sports career. The findings indicate that 39.3% of the participants have experienced injuries just once. 16.4% have experienced twice, 13.1% three times, 19.7% four times and 11.5% five times. The average annual of the samples is 506.04 hours and the average practice in their athletic career was 4268.5 hours. According to the 156 reported injuries, the prevalence of injuries in elite women volleyball players, 36.55 injuries happened per 1000 hours of practice and the annual prevalence of the injuries was 18.86 injuries per year. Regarding the injured parts, the prevalence for upper body parts was 17.75, for lower parts 14.99, for body and pelvic 2.58 and neck and head 1.41 injuries per 1000 hours of practice. The injury risk for fingers was 17.9%, for ankle 17.9% for shoulders 14.1% for wrist 7.7% and for elbow 5.1%. According to the injury type, the prevalence of edema and inflammation was 7.26, contusion and bruise 5.62, abrasion and irritation 3.05, sprain 3.05, chronic tendon injury 3.05, strain of joints 2.81, spasm and cramp 2.81, bone breaking 2.34 and meniscus 2.34 injuries per 1000 hours of practice. Inflammation and edema 18.3%, contusion and bruise 14.2%, abrasion and irritation 7.7%, sprain 7.7%, chronic tendon injury 7.7%, strain of joints 7.1%, spasm and cramp 7.1%, bone fracture 5.9%, meniscus 5.9% were the most dangerous injuries for elite women volleyball players. According to the intensity, per 1000 hours of practice, 15.7 of injuries with average intensity, 11.25 with high intensity and 9.61 with low intensity was reported. So, the incidence risk for the intense injuries was 30.6%, for the average ones 46% and for the low intensity ones was 26.4%. According to investigations on the recovery situation of the injuries, the improvement chance of the injuries without limitation is 50% and the demission chance as a result of an injury in 2% and the limited recovery is 48%. Recovery from 18.27 injuris without limitation, 17.57 limited recoveries and 0.7 demission was observed per 1000 hours of practice. Investigating the injuries mechanisms showed that per 1000 hours of practice and competition for elite female players, 6.79 injuries happen because of bad landing (falling), 6.56 because of jumping for defending or spiking, 6.33 injuries because of being hit by ball and 4.45 injuries because of repeating the actions. According to this, bad landing (falling) 18.7%, jumping for defending or spiking 17.9%, being hit by ball 17.2%, repeating the actions 12.4%, were the most dangerous causes of the injuries. Analyzing the involved factors showed that the likelihood of the incidence of injuries because of external factors was 39.6%, because of moving factors 32.1% and internal factor 27.3%. Physical factors 21.6%, improper performance 17.9%, teammates 14.2% and the playground 10.4% were the most dangerous factors involved in injuries. According to the findings, 71.4% of the reported injuries were in practice situations in comparison with 27.6 of injuries in competitions.

The mean prevalence of injuries for passers, liberos and spikers are 1.229, 1.362 and 1.162 per 1000 hours of practice, respectively. The mean prevalence of injuries for practice and competition are 1.28 and 1.12 per 1000 hours of practice, respectively. The results of the unilateral

Table 1: The average and standard deviation of the characteristics of participants

	Passer (N=15)	Libero (N=15)	Spiker (N=31)	Total (N=61)
(year) age	23.14±6.03	19.66±2.54	22.55±4.89	22.19±4.81
(year) background	9.42±5.22	7±2.82	8.35±4.45	8.27±45.32
(hours per week) weekly practice	10.92±4.93	9.51±5.18	10.68±4.5	10.54±4.59
(hours per year) practice annual	5243.5±126.9	456.5±148.9	513.06±116.2	506.04±120.5
(hours) practice in learning	1878.8±1349.1	3428.8±1464.01	4341.5±1009.8	4268.5±954.3

Table 2: Mean and the standard deviation of injury prevalence among elite female volleyball players according to their playing post

variable	level	Prevalence per 1000 hours of practice	Annual prevalence
Playing post	Passer(N=15)	1.229± 1.04	0.408±0.36
	libero(N=15)	1.362±0.93	0.368±0.31
	spiker(N=31)	1.162±0.93	0.483±0.37
	total(N=61)	1.199±0.97	0.457±0.33
Performance situation	practice	1.28±1.38	0.57±4.43
	competition	1.12±1.6	0.52±0.48

variance analysis in order to compare the injury prevalence for players in different playing posts show that playing post doesn't have a significant influence on injury prevalence for 1000 hours of games as well as on annual prevalence. The results of t-test in order to compare the injury prevalence in practice and competition showed that the injury prevalence in 1000 hours as well as annual prevalence doesn't differ significantly from practice situation to competition situation. The results of Chi Square test in order to compare the distribution of different aspects of injuries among passers, liberos and spikers also showed that the distribution of injuries in body parts, the injuries mechanism and the involved factors, don't differ among passers, liberos and spikers.

The results of Chi Square test in order to compare the distribution of different aspects of injuries in practice and competition show that the injury distribution in body parts, the injury type, the injury intensity, recovery situation, injury mechanism and involved factors don't differ between practice and competition situations.

DISCUSSION

The aim of this study was to investigate the prevalence and the causes of athletic injuries in elite women volleyball players in Iran according to their playing posts in practice and competition situations. The findings of the study show that the prevalence of the injuries is 1.19 injuries per 1000 hours of practice, regardless of their posts. This rate is lower in the studies by Malliou *et al.* (2008), Zetou *et al.* (2006), Verhagen *et al.* (2004). Bahr and Bahr (1997), Agaard *et al.* (19960), Agaard and Jorgensen (1996), Bahr *et al.* (1994) and Schafle *et al.* (1990), Malliou *et al.* (2008), reported the prevalence rate to be 2.5 injuries per 1000 hours of practice for Greek volleyball players. Zetou *et al.* (2006) reported the annual injuries in 114 volleyball players to be 0.63 for the 363 injuries as overall number of injuries. Verhagen *et al.* (2004) reported the total prevalence of injuries to be 2.6 injuries per 1000 hours of practice for Dutch players. Bahr and Bahr (2007) reported the total acute injuries to be 1.7 injuries during practices and 3.5 injuries per 1000 hours of playing. Agaard and Jorgensen (1996) calculated the injury prevalence in elite men and women to be 2.4 injuries per 1000 hours of playing. Also, Schafle *et al.* (2001) reported the injury prevalence rate to be 1.97 injuries per 1000 hours of playing in female players. The low prevalence rate of the injuries in elite female volleyball players in Iran may be due to their physical properness and their playing level (the players' commitment in the game).

According to the findings of this study, passer, liberos and spikers are exposed to 1.229, 1.362 and 1.462 injuries per 1000 hours of practice, respectively. They are also exposed to 0.408, 0.368 and 0.483 injuries per one year of playing, respectively. No significant difference was found between different prevalence rates although liberos had higher rates. Malliou *et al.* (2008) also reported that the side receivers and passers are exposed to injuries more than other players. Nelson *et al.* (2007) reported that the highest prevalence rate belonged to ankle injuries in middle blockers.

In general, according to the available data and evidences, the injury rate in the investigated posts is different that makes it difficult to make conclusion about the prevalence rate of injuries in different posts. This can be related to the disagreement among the results. It is possible that the main reason for this disagreement could be found in the strategies used in different countries as well as the playing level of the different players. The findings of the study show that there was no significant difference between injury prevalence in practice and competition situations. These findings are in agreement with the results of the studies done by Tadayoni and Fallah Kheiri (2008), as well as studies done by foreign researchers. However, these findings were in disagreement with the ones by Malliou *et al.* (2008) that reported 24.3% of the injuries to occur before the sports seasons and 69.3% during the matches. Agel *et al.* (2007) and Reel *et al.* (2008), in high school female players, Benka *et al.* (2007) in elite players in local devision league in Greece, Zetou *et al.* (2006), in Greece's volleyball and Augustsson *et al.* (2006) in elite Swedish player in season 2002-2003 showed that the prevalence rate of injuries in matches is lower than in practices.

According to the 156 reported injuries in different body parts, the results show that the injury risk in the upper body is 48%, in body and pelvic 3.8% and in lower body 41.2%. This distribution can be seen similarly in all three posts in both practice and competition. According to the present study, the injuries related to ankle and toes (17.9) and shoulder (14.1%) are the most prevalent injuries. Parallel to this study, Tadayoni and Fallah Kheyri (2008) reported the injuries in ankle as the most prevalent ones in female players in Iran. Also, Rajabi and Alizadeh (2008) believe that the injuries in lower body are the most dangerous ones. Zetou *et al.* (2006), Beneka *et al.* (2007), Rauh *et al.* (2007), Tik-poi Fong *et al.* (2007) and Maliou *et al.* (2008) reported that the most endangered body part in volleyball is lower extremities. In a study done by Torkan *et al.* (2004) the injury prevalence in ankle and knee were the most endangered parts in lower part

with 60% and 40% of prevalence respectively. In general, most studies believe that the injury risk for ankle is highest among all body parts regardless of the playing post.

The results showed that injuries such as inflammation and edema (18.3%), contusion and bruise (14.2%), abrasion and irritation (7.7%), sprain (7.7%) and chronic tendon injuries are the most prevalent injuries in different playing post. These rates were similar in practice and competition situations. Rajabi and Alizadeh (2006) reported twist as the most prevalent joint injuries in practice and competition with 46.8% and 36.6% respectively. Also they reported the cramp as the most prevalent muscle effect in practice and competition situations with 42 and 37.53% respectively [16]. Jalali (2007) believes that the most prevalent joints injury in students' volleyball is finger strain (42.8%), the most prevalent muscle-tendon injury is being hit in fingers (87.12%) and the most prevalent bone injury is nicking in arm (49.1%). Alizadeh (2000) showed that contusion (86.19%) and tear (83.2%) are the most and the least prevalent injuries in volleyball, respectively [20]. The present study was in disagreement with the one done by Kheyri (2008) which reported the most prevalent injury to be the twist [11]. In studies done by foreign researchers, Reel *et al.* found out that most of the contusions happen during practice and the parts exposed to this type of injuries were mostly lower body parts. The most prevalent injury was the twist [13]. According to Agel *et al.* (2007) the ankle ligament pulling in matches (44.1%) and the ankle ligament twist in practices (29.4%) were the most prevalent injuries. While investigating the prevalence of injuries among elite volleyball players in local division league in Greece, Beneka found that the ankle twist was the most prevalent injury in both groups [14]. The differences among the studies may be due to the mixed gender samples as well as the difference in playing level.

The findings of the present study showed that the risk of being injured with mean intensity was 43%. The injuries with high intensity and low intensity had the occurrence probability of 30.6 and 26.4% respectively. Also, the findings showed that the treatment chance without limitation was 50% while limited treatment chance was 48% and the probability for demission was 2%. In this regard, Nejati (1385) showed that the injury intensity in students' volleyball is 80% low, 11.6% mean and 8.4% high [21]. Maliou *et al.* (2008) showed that 54.3% of injuries among women players were with mean intensity and 32.4% were with low intensity. According to Zetou *et al.* (2006) most of the injuries were classified as mean intensity [8]. Augustsson *et al.* (2006) found out that most of the injuries were with low intensity among Swedish elite volleyball players [15]. In general, it seems that most of the injuries occurred in volleyball are classified as injuries with low and mean intensity, in most of the cases with coming back to the matches after recovery. The findings of the current study show that the incidence risk of the injuries caused by bad landing (falling) 18.7%, jumping for defense or spike 17.9% and being hit by ball 17.2% are highest among all risks. In this study the incidence risk of injuries cause by internal factors were calculated to be 28.3%, by external factors to be 39.6% and by stimulant events to be 32.1%. Taddayoni (2008) while investigating the female players reported jumping for defense or spike to be the most prevalent injury mechanism as well as bad landing to be the most prevalent involved factor in injuries before the matches [10]. Also, Fallah Kheiri (2008) reported improper shoes as well as improper equipment to be the most prevalent factor involved in injuries among female volleyball players [11]. Shamsabadi (2006) showed that there are significant correlations between age, experience, warm up time, body building season, proper fitness, fatigue situations, insufficient sleep, use or not use of glucose nd water, injured feet and not preferred body side on one hand and injury prevalence in injured groups on the other hand [22]. Qarakhanloo (2000) believed the improper fitness as the most important cause of injury prevalence when investigating volleyball, basketball, handball, wrestling, football, karate from the coaches' and elite athletes' point of view. Beneka *et al.* (2007) while investigating the injury prevalence among elite volleyball players as well as players in local division league in Greece found out that putting a foot on other players' feet for elite layers and fatigue for local division players are the most important factors involved in injuries. Besides they found out that improper diving as well as false techniques are also the most important factors [14]. Unfortunately, little is known about the mechanism and factors involved in injuries in volleyball. However it seems that low physical fitness along with bad landing mechanism combined with some external factors are the most prevalent factors that cause injury in volleyball. Given the high prevalence of injuries in ankles and fingers, it is strongly recommended that protective equipment be used for body parts. Also, given the high proportion of high and mean intensity injuries and the risk of repeating the previous injuries, it is strongly recommended to coaches and players that pay special attention to the resting and recovery time after being injured and come back to practices with the doctor's advice and with

considering their recovery situation. On the other hand, given the injury risk in bad landing it is recommended that special attention be paid to the strategies used to prevent injuries related to the mentioned mechanism. Also given the high risk of being injured by repeating an action too much, it is recommended to players and coaches that pay attention to the players' abilities when giving assignments.

CONCLUSION

According to the results of the present study, the injury prevalence in elite female volleyball players in Iran is 1.999 injuries per 1000 hours of practice. While most of the injuries reported to be in practice situations, no significant difference could be found between practice and competition situations. The results show that the injuries in different body parts, the injury type, recovery situation, mechanism and the involved factors are not different among passers, liberos and spikers. Also, regardless of playing post, ankle injuries, contusion, sprain and tendon chronicle injuries are the most prevalent injuries in volleyball. Most of the injuries which occur among elite female players are with low and mean intensity. Also, most of these injuries are followed by recovery and coming back to games. Low physical fitness, bad landing mechanism combined with some external factors are the most important factors involved in injuries in volleyball.

REFERENCES

1. Kugler, A., M. Kruger-Franke, S. Reininger, H.H. Trouillier. and B. Rosemeyer, 1996. Muscular imbalance and shoulder pain in volleyball attackers. Br. Sports. Med., 30: 256-256.
2. Tik-Pui Fong, D., Y. Hong, L.K. Chan, P. Shu-Hang and K.M. Chan, 2007. A systematic review on ankle injury and ankle sprain in sports . Sports Med., 37(1): 73-94.
3. Nelson, A.J., C.L. Collins, E.E. Yard, S.K. Fields and R.D. Comstock, 2007. Ankle injuries among United States high school sports athletes. 2005-2006. J. Athl. Train, 42(3): 381-387.
4. Bahr, R. and I.A. Bahr, 1997. Incidence of acute volleyball injuries: a prospective cohort study of injury mechanisms and risk factors. Scand. J. Med. Sci. Sports, 7: 166-171.
5. Schafle, M.D., R.K. Requa and W.L. Patton, 1990. Injuries in the 1987 National Amateur Volleyball Tournament. Am. J. Sports. Med., 18: 624-31.
6. Aagaard, H. and U. Jorgensen, 1996. Injuries in elite volleyball. Scand J. Ed. Sports, 6: 228-232.
7. Verhagen, E., A. Van der Beek, L. Bouter, R.M. Bahr and W. Van Mechelen, 2004. A one seasonprospective cohort study of volleyball injuries. Br. J. Sports. Med., 38(4): 477-481.
8. Zetou, A., P. Malliou, A. Lola, G. Tsigganos and G. Godolias, 2006. Factors related to the incidence of injuries' appearance to volleyball players. J. Back and Musculokeletal Rehabil, 19: 129-134.
9. Malliou, P., A. Beneka and G. Tsigganos, 2008. Are injury rates in female volleyball players' age related? J. Sports Sci. Health, 2: 113-17.
10. Tadayoni, T., 2008. Sport injury mechanisms in Iranian athletes. Sport medicine thesis in Iran.
11. Fallahkheiri, S.A., 2008. Prevalence of injury in Iranian different sports. Thesis in Tehran markaz university of Iran.
12. Agel, J., R.M. Palmieri-Smith, R. Dick, E.M. Wojtys and S.W. Marshall, 2007. Descriptive epidemiology of collegiate women's volleyball injuries: national collegiate athletic association injury surveillance system, 1988-1989 through 2003-2004. J. Athl. Train, 42(2): 295-302.
13. Reel, J.A., E.E. Yard and R.D. Comstock, 2008. An epidemiologic comparison of high school sports injuries sustained in practice and competition. J. Athl. Train, 43(2): 197-204.
14. Benela, A., P. Malliou, G. Tsigganos, A. Giofrsiou, M. Michalopoulou, E. Germanou and G. Godolias, 2007. A prospective study of injury incidence among elite and local division volleyball players in Greece. J. Back and Musculoskeletal Reh., 20: 115-121.
15. Augustsson, S.R., J. Augustsson, R. Thomee and U. Svantesson, 2006. Injuries and preventive actions in elite Swedish volleyball. Scand J. Med. Sci. Sports, 16: 433-440.
16. Benekal, A., P. Malliou, A. Gioftsidou, G. Tsigganos, H. Zetou and G. Godolias, 2009. Injury incidence rate, severity and diagnosis in male volleyball players. Sport Sciences for Health. 5(3): 1825-1234.
17. Torkan F., 2004. Islamic nations sport injury mechanisms. Guilan Medicine J., 10(39): 40.
18. Jalali, R., 2005. Prevalence of injury among girl students. MA thesis in sport medicine, university of Tehran Markaz.
19. Rauh, M.J., C.A. Macera and M. JI, 2007. Subsequent injury patterns in girls high school sports. J. Athl. Train, 42(4): 786-98.

20. Alizadeh, M.H., 2003. Injury prevalence among Iranian national volleyball league. Thesis in Tehran University.
21. Nejati, V., 2005. Prevalence and rate of sport injury in girl students. J. Rehabilit.,
22. Shamsabadi, S.M., 2006. Volleyball injury: mechanism and rate. Thesis in sport medicine, university of Tehran.
23. Gharakhanloo, R., 2000. Injury prevalence in Iranian elite athletes, manuscript in sport medicine, university of tarbiat Modarres.