Print ISSN 2710-0200 *Full text available online at* *Ethiop J Nat Comp Sci.*
Electronic ISSN 2710-0219 http://journal.uog.edu.et/index.php/EJNCS Vol. 1(2) 148-159 Sept. 2021

ORIGINAL RESEARCH ARTICLE

Incidences and Etiology of volleyball Injuries in Ethiopia: A search for Amhara Regional State clubs and young players

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Received: 27 February 2021/Accepted: 11 July 2021/ Published online: September 2021

Abstract

The aim of this study was to examine the incidences of acute and overuse volleyball injuries, to find the mechanisms of acute and overuse volleyball injuries and to assess the main associated factors of acute and overuse volleyball injuries. For the current study, prospective cohort research design was used. The injury incidence rate, severity, diagnosis and the anatomical location of the injuries that occurred during practice and competition in the whole season of 2015/16 were recorded prospectively in a weekly base through interviewer administered questionnaire. A total of 323 players from Amhara regional State clubs and projects volleyball players were participated in the study. During the entire season, 188 injuries were reported in 50379 playing hours, 43566 hours of training (7.03 h/week for men and 6.48 h/week for women) and 6813 hours of match play (1.09 h/week for men and 1.01 h/week for women). The overall injury incidences were 3.7 injuries/1000 hours of play out of which 4.58 injuries were for male while 3.1 injuries were for female per player per year. In addition, during match play, the incidence were 15.71 and 1.86 during training per 1000 hours of play. The finger (29.25%) was the most commonly injured anatomical region followed by the ankle (18.61%), and knee (17.55%) injuries. During the season, there were a total of 167(88.83%) acute injuries with an incidence of 3.3 per 1000 hours and 21(11.17%) overuse injuries with an incidence of 0.42 per 1000 hours of play. Back court players followed by Outside hitters were the most frequent injuries. Similarly, wrong techniques, incorrect sprawls, stepping on others' feet and fatigue were the most common injury factors. The findings of the present study revealed that the frequency of injury was high (58.2%) in the 2015/16 season of volleyball played. Finger, ankle, and knee injuries were the most frequently injured anatomical areas. Wrong techniques, incorrect sprawls and absence of preventive materials were the most important risk factors for injury.

Keywords: Etiology, Injury, Incidence, Severity, Volleyball

INTRODUCTION

Volleyball is one of the exciting, fast, dynamic and most popular sports in the world (Bahr 1997; Fattahi ., 2011; Vanderlei , 2013; Verhagen , 2004; Watkins , 1992; Zetoua , 2006). It is played by approximately 800 million people with diverse characteristics such as: indoors and outdoors, by the young and the old, by males and females (Reeser, 2006) and by both the able and disable individuals.

With regard to its worldwide popularity, many scholars showed in their studies that volleyball ranks second next to soccer (Beneka, 2007; Reeser, 2006). In Ethiopia, VB is very popular sport next to athletics and football, and it is estimated that more than two million participants are involved in organized and unorganized forms.

Volleyball is described as a "net game". This is to mean that it is a sport that does not involve any physical contact among the athletes and their opponents since the volleyball court is separated by the net (Bahr, 1997; Beneka, 2009; Zetoua, 2006).

Even though it is a non-contact game in which players from the opposing teams are separated by a net (Tsigganos, 2007), the incidences of injuries are very high (Bahr, 1997). This is because VB is a sport which involves very quick and forceful movements of the body both horizontally and vertically, and therefore, the large and repetitive forces involved in such movements caused injuries inevitably take place (Verhagen, 2004; Watkins, 1992).

Studies conducted in different countries show that injury prevalence pattern in volleyball are repetitive (Beneka, 2007; Verhagen, 2004) between sexes and among different age groups (Beneka, 2009). For instance, Schafle (1990) found an overall injury incidence of 2.3 per 1000 hours during the United States Volleyball Association's six day national tournament while there was an incidence of 1.7 per 1000 hours in Norwegian elite volleyball players. In the same way, Beneka (2009) also identified that the injury incidence of VB was between 1.7 and 4.2 per 1000 hours of play, and this ranks it to be the fourth most common sports injuries.

Even though there is an increment in the number of participants in volleyball sport under clubs, projects and for recreational purposes in Ethiopia, athletes are highly vulnerable for injuries because of lack of protective equipment, comfortable play grounds, medical facilities, efficient surveillance systems of injuries and skilled man power (coaches). So, because of the vulnerability of athletes for sport injuries, it is clearly understood that more studies are needed on the volleyball players to give a better control over the happening frequencies of these injuries.

Materials and methods

Cohort prospective design was used for this study. A total of 323 volleyball players who play for Under 15, for Under 17 and elite/club players were observed on a weekly basis for the 2015–2016 period. Out of these volleyball players, 40% were participating in the Championship. Ethical approval for the study was given from the College of Health Science Research Committee, University of KwaZulu-Natal, South Africa and from the College of Natural and Computational Science Research Committee, University of Gondar, Ethiopia.

Data collection and definition of the injury

Interviewer administered questionnaire was taken and adapted from Augustsson 2006, and it is used for data collection in the present study. The tool was piloted to two volleyball teams of the Zones which zone? Of Amhara Regional State in June 2015, 20 nurses who were recruited from government and private health centers of the region were participated in collecting the data.

These research assistants, who participated in collecting the data, were initially guided by the researcher. In addition to the nurses, two orthopedic medical doctors and two physiotherapists were involved in the process of observation and recording of injuries during the observation schedule.

In the current study, injury was defined as" any musculoskeletal complaint newly incurred during the competition and/or training season that was given medical attention, and which causes for absence from competition or training". The total injuries which took place during competition or training were classified into three grades of severity: minor (absence from training or competition for less than one week), moderate (absence from training or competition from one week to one month) and major (absence from training or competition for more than one month) (Beneka, 2009).

Injury surveillance data

Sport injury incidences should preferably be expressed as the number of sport injuries per exposure time. Hence, in this study, exposure related injury was calculated and expressed in this way: injuries per 1000 player-hours (i.e. number of injuries as a numerator and number of player-hours as denominator multiplied by 1000.

Measurements

The baseline investigation had included physical assessment and volleyball specific functional tests. Likewise, the physical assessment had also incorporated anthropometric measurement and quadriceps angle (Q-angle) measurement. The volleyball specific functional tests of flexibility, balance and vertical jump were used. The objective of doing these was to determine whether or not a significant relationship existed among the intrinsic factors and musculoskeletal injury.

Statistical analysis

Data were statistically analyzed using x^2 analysis of the SPSS statistical package to determine whether or not any of the factors were related to the incidence of injury.Independent Sample t-test was used to compare means. In all cases, the null hypothesis was rejected when $p \leq 0.05$.For match compared with training, and for men compared with women, relative injury risk (RR) and corresponding 95% confidence interval (CI) were calculated. Where possible, odds ratios (OR) and the corresponding 95% CI were calculated for the factors associated with injuries.

Results

Injury rate

During the period of the study (10 months), the total sample (n=323) reported were 188 injuries. Of this, 32.98 % (62/188) of injury cases were registered from elite players while the other 67.02 % (126/188) cases occurred on young players. It is notable that according to the records, 131 players (40.56% of the total players) were injured. Of these, 25.19 % (n=33) were elite (m =18, f = 15), but 74.81 % (n=98) players were young (m = 45, f = 53). The injury rate in elite players was statistically lower than the injury rate in the other age groups (young) players (x^2 = 15.88, p≤0.05). (Table-1).

Table 1.Percentage of injuries sustained by gender and team type.

			Injury		
Team Type	**Sex**	**Injury Cases (%)**	**Injured (%)**	**Noninjured (%)**	X^2
	Female	68 (36.17%)	53 (40.46%)	91(47.39%)	
Young	Male	58 (30.85%)	45 (34.35%	84 (43.75%)	0.11, p = 0.74
	Total	**126 (67.02%)**	**98 (74.81%)**	**175 (91.15%)**	
	Female	23 (12.23%)	15 (11.45%)	9 (4.69%)	
Elite	Male	39 (20.75%)	18 (13.74)	8 (4.17%)	0.25, p = 0.62
	Total	**62 (32.98%)**	**33 (25.19%)**	**17 (8.86%)**	
Young vs Elite		X^2=15.88,p≤0.0001 OR=0.2885,Cl:0.1528-0.5445,p≤0.0001 RR=0.5439,Cl:0.4217-0.7014,p≤0.0001			

Key: X^2=chi square; OR = odds ratio; RR = relative risk

In order to study the different injury rates in relation to age, the 323 players were divided into four groups (team categories according to the Ethiopian Volleyball Federation's training and competition manual as under-13, under-15, under 17 and Club. Under-13 players were not included in the present study). Of the 188 recorded injuries on players, 118 injuries were took place on 91 players whose age ranged from 14-16 years (62.77 %), 65 injury cases were happened on 37 players who were at the age range of 17-25 years (34.57%) and 3 players who covered 5 injuries were on the age range of 26 and above years (2.66%).(Table-2)

Table 2.The rate of injured and non-injured players in terms of age category.

		Injury				
		Injury Cases	Injured	Noninjured	X^2 (*chi square)*	p-Value
Age	14-16	118 (62.77%)	91 (69.47%)	154 (80.21%)	5.89	0.05
	17-25	65 (34.57%)	37 (28.24%)	37 (19.27%)		
	<26	5 (2.66%)	3 (2.29%)	1 (0.52%)		
	Total	**188 (100%)**	**131 (100%)**	**192 (100%)**		

Incidence

In terms of volleyball participation for more than 40 weeks, the coaches and data recorders reported a total of 188 injuries during 50 379 played-hours, and the overall injury incidence was estimated to be 3.7 per 1000 played hours.

Of the 155 male volleyball players, 97 reported injuries had over a total exposure time of 22 523hours per year which covered an overall incidence of 4.30 injuries. In the same way, from 168 female volleyball players, 91 recorded injuries had also a total exposure time of 27 856 hours per year that took an overall incidence of 3.26 injuries per player per year.

From the total number of injuries (n=188), 107 (56.91%) injuries were happened during match time in an exposure time of 6 813 hours per year with an injury incidence of 15.7. Of these, 53 (28.19%) of recorded injuries happened on females within 3 749 hours, and it covered an incidence of 14.13 injuries, but 54 (28.72%) of them were on male players which took place in 3 064 hours per year with an incidence of 17.62 injuries. With similar statistical data during the study period, players were sustained 81 (43.09%) injuries during 43 566 hours while they were participating in training which had 1.86 incidences. From this number, 43 (22.87%) injuries were on males within a total of 19 459 hours exposure time, and with an injury incidence of 2.21, but 38 (20.21%) injuries which happened in 24 107 hours and which had an incidence of 1.57 were on females. (Table-3)

In addition, the elite or club volleyball players were reported to host 62 injuries during a total exposure time of 8 720 hours per year taking an overall incidence of 7.1 injuries. In the cases of young players, 126 injuries were reported in a total exposure time of 41 659.5 hours per year, and it had an overall incidence of 3.0 per player per year.

Table 3. Injury frequency and incidence rate related to training and match by gender.

Gender	Activity	Injury				Expo Player-Hours	Incidence Rate
		Injury Cases (%)	Injured (%)	Non-injured (%)	Row Total (%)		
Female	Match	53 (28.19)	49 (37.4)	64 (33.33)	113 (67.26)	3 749	14.13
	Training	38 (20.21)	19 (14.5)	36 (18.75)	55 (32.74)	24 107	1.57
	Total	91 (48.40)	68 (51.9)	100 (52.08)	168 (100)	27 856	3.26
$X^2 = 1.19$, p = 0.27 RR=1.25, 95% Cl:,0.82-1.91 OR=1.45, 95% Cl:,0.74-2.83							
Male	Match	54 (28.72)	37 (28.2)	53 (27.6)	90 (58.06)	3 064	17.62
	Training	43 (22.87)	26 (19.8)	39 (20.31)	65 (41.94)	19 459	2.21
	Total	97 (51.60)	63 (48.1)	92 (47.92)	155 (100)	22 523	4.30
$X^2 = 0.02$, p= 0.88 RR=1.02, 95% Cl:,0.69-1.51 OR=1.04, 95% Cl:,0.54-2.01							
Total Values	Match	107 (56.91)	86 (65.65)	117 (60.94)	203 (62.85)	6 813	15.70
	Training	81 (43.09)	45 (34.34)	75 (39.06)	120 (37.15)	43 566	1.86
	Total	188 (100)	131 (100)	192 (100)	323 (100)	50 379	3.73
$X^2 = 0.74$, p = 0.39 RR=1.12, 95% Cl:, 0.85-1.49 OR =1.22,95% Cl: 0.77-1.94							

Key: X^2 =chi square; OR = odds ratio; RR = relative risk

There were 167 (88.83%) acute injuries with an incidence of 3.3 per 1000 playing hours, and there were 21 (11.17%) overuse syndromes which had an incidence of 0.4 per 1000 playing hours. For the total samples, injuries were distributed throughout the body.

Type, anatomic location and diagnosis of injury

When we consider the whole injuries, the most common anatomic location of injury for the athletes was finger (55 cases, 29.25%) with an incidence of 1.09 per 1000 hours of play followed by ankle (35 cases, 18.62%) and knee (33 cases, 17.55%) which had an incidence of 0.69 and 0.65 per 1000 hours of play respectively.

In comparison with team type (young and elite), frequent finger injuries were accounted on young players (n=43/55), or 78.18% whereas on elite athletes, the most anatomic location for injuries was ankle (n=22/35), or 62.86%.The majority of injuries were sustained on players' upper extremities, 62.77% (118/188), followed by the lower limbs 37.23% (70/188).

The odds ratio (OR) of injuries in the upper extremities in the season compared with lower extremities was OR=1.68 (95% Cl: 1.07 to 2.64) p=0.02≤0.05. Significant difference was observed. The probability of upper extremity for injury is 36.53%. Similarly, for lower extremities, the probability is 21.67% with a relative risk of 1.36 (95%Cl: 1.04 to 1.78) p=0.02≤0.0003, and it is statistically significant.

In the current study, according to medical diagnosis, the most common diagnosed injuries were: sprain, laceration and dislocation. From the total number of injuries sustained (n=188), sprain was 31.38 % (59/188) of which 54.24 % (32/59) were took place on fingers followed by ankle (25.42%, 15/59).

In similar statistical data, laceration was 21.28% (40/188). From these, the majority, 65 % (26/40) of laceration sustained was on knees followed by elbow (25%, n=10). Regarding dislocation, from the total number of injuries, it covered 21.28 % (n=40). Of these, 42.5 % (n=17) happened on ankle followed by fingers (35%, n=14). The other 20 % (n=8) of injuries were sustained on thumbs, and one injury was on hand.

In the present study, 27.66% (52/188) of injuries were recorded during the execution of blocking, but 28.19 % (53/188) of injuries were documented during setting. Likewise, 7.98 % (15/188) of injuries were took place when spiking was performed while 4.26 % (8/188) of injuries were happened during serving. Finally, 20.74 % (39/188) of injuries were documented during other situations like serve receiving.

Injury mechanism and risk factors

The current study revealed that 27.66% (52/188) of injuries were recorded during the execution of blocking, but 28.19 % (53/188) injuries were taken during setting. And 9.04 % (17/188) of the injuries took place while spiking was performed. In terms of sex, 32.99% (32/97) of males and 21.98% (20/91) of females hosted injuries during the execution of blocking, but 11.34% (11/97) males, and 6.59% (6/91) of females were injured during spiking. In a similar way, 22.68% (22/97) males, and 34.06% (31/91) females were injured during setting the ball to the hitters. In relation to other technical performances like receiving the first ball, 28.87% (28/97) males, and 32.97 % (30/91) females were injured.

Severity of injury

The severity of injuries was expressed in terms of absence from competition or training after the time of injury. The rate of mild injuries was 53.19% (100 cases), but the rate of moderate injuries was 36.70% (69 cases) while the rate of major injuries was 10.11% (19 cases). Pertinent to the degree of severity in terms of team type was as follow: 13.83% (26/188 cases) were male elites while 8.51 %(16/188 cases) were female elites. Similarly, 12.77 % (24/188 cases) young males and 18.08 % (34/188 cases) young females injured players missed their training and match for less than a week. The rate of moderate injuries occurred was 3.72 % (n = 7cases) out of which 14.36 % (n = 27 cases), and 5.85 % (n = 11 cases) on female and on male elites respectively while 12.77 % (n = 24cases) were on young male players. Likewise, the frequency of major injuries was 1.06 % (n = 2case) on elites, and 4.25

% (n = 8 cases) were on young male players, but 4.79 % (n=9cases) were also registered on young female players. In relation to sex, there were no statistical differences among severities of injury. This paragraph is very disorganized statistically. If you agree with this edition, it is okay. If you don't agree with this edition, please look your statistical data again about pertinent, the rate of injuries and frequency of injuries and rewrite again.

Playing position of the injured volleyball player

Concerning the specialization of players in the present study, from the total number of injuries, back court players hosted the highest injury with 59 (31.38%) followed by Outside hitters (left/right front row) with 49 (26.07%). However, middle hitter and blocker players hosted only 42 (22.34%) injuries.

Based on X^2 statistical analysis, center and left/right front row court players were significantly different, ($x^2 = 7.30$, $p = 0.006 \leq 0.05$ and $x^2 = 8.69$, $p = 0.003 \leq 0.05$) respectively.

Injury Classification (acute or overuse)

In the present study, the acute injuries were significantly higher in comparison to overuse syndromes ($p \leq 0.0001$).

During the season, a total of 167 (88.83%) acute injuries which covered an incidence of 3.3 per 1000 hours were recorded. Of the total acute injuries, 81 (48.50%) were on females and 86 (51.50%) on males.

The odds ratio of the overall acute versus overuse injuries was 9.20 (95% CI, 5.49 to 15.42) p= 0.0001≤0.05, and there was statistically significant difference. The probability of overall acute injury was 88.83%, but for overuse, the probability was 11.17% with a relative risk (RR) of 6.21 (95% CI, 3.92 to 9.83) p=0.0001≤0.05.Like that of the odds ratio, there was significant difference between acute and overuse injuries on players.

Recurrent Injuries

Based on the registered injuries, there were less recurrent episodes (n = 44 cases, 23.4 %) with an incidence of 0.87 per 1000 hours than the cases with new episodes (n=144 cases, 76.6%) which represented an incidence of 2.9 per 1000 hours. Of these, 51.39 % (n = 74) new injuries occurred on females with an incidence of 1.47 per 1000 hours, but 48.61% (n = 70) male players sustained new injuries with 1.39 per 1000 hours injury incidences. Regarding recurrent episodes, 38.64 % (n = 17) of females which represented an incidence of 0.34 per 1000 hours, and 61.36 % (n = 27) of males with an incidence of 0.53 per 1000 hours were exposed. The chi-square statistic is $X^2 = 0.01$, $p = 0.908 > 0.05$ between female and male on recurrent episodes.

This result is not statistically significant. But in terms of the total new and reinjure cases, the value of X^2 is 126.6, p=0.0001in which significant difference was observed.

Discussion

The injury incidence of the current study was estimated 3.7 per 1000 hours whereas the overall incidence for training related injuries was 1.86 per 1000 playing hours, In the same way, there were 15.71 incidences for match related injuries. Differences in study

design, player population, and injury definition between the present study and previous studies complicate the comparison of incidence figures. Nevertheless, incidences found in the present study are similar to those previously found in other studies. The study conducted by Augustsson et al. (2006) reported that an incidence of 3.78 per 1000 played hours is higher than the study conducted by Bahr & Bahr (1997) which had an incidence of 1.7 injuries per played. A similar research finding by Verhagen 2004 got an incidence of 2.6 per 1000 playing hours. In addition to the above studies, Schafle et al.(1990) in a prospective study during 6 days of tournament play (USVBA national tournament) found an injury incidence of 2.3 per 1000 hours in which only injuries causing at least 1 day of missed participation were included. The reason for the greater injury incidence in the present study was the lesser exposure time which was a total of 50,379 played hours compared to the study of Bahr & Bahr (1997) which had a sample size of 272 volleyball players with 51588 played hours. The other reasons for the increment of injury incidence in this study were unavailability of professional care, and uncomfortable playing courts along with inaccessibility of protective equipments for players. Moreover, Bahr &Bahr included only aged athletes (mean age 21.7 years) who hosted only acute injuries in their estimate different from younger athletes and overuse injuries.

In addition to this, Augustsson *et al*. (2006) reported that various factors such as better training, experience of coaches, experience of players, proper facilities, accessibility to injury rehabilitation and proper preventative exercises can be attributed to the decrease of volleyball injuries.

In the present study, the overall rate of injuries were higher in match period than training time. Consistent with previous studies we found the injury risk to be significantly higher during match play than during training (Aagaard, 1996; Bahr et al.,1994). This is because of a higher intensity of play and more risks being taken during matches (Bahr et al., 1994; Schafle, 1990).
On the contrary, Tsigganos et al. (2007) found the rate of injuries to be more during training time than match period. With regard to comparing the injuries between acute and chronic in the present study, just 11.2 % (21/188) were chronic injuries and the rest 88.8% (167/188) were acute injuries. This finding is similar to that of (Tsigganose et al., 2007; Zetoua et al., 2006 and Shafle et al., 1987). Studies have reported an increase in the number of overuse injuries because of an increase in the number of training hours (Lian et al., 2003).

As the finding of this research showed, the majority of injuries were of minor severity, but a few were of moderate severity while very few were of major severity. This result was in consistent with those of Augustsson et al., 2006 and of Aagaard and Jorgensen, 1996, who found that the majority of injuries were of minor severity. On the other hand, the result obtained in this study was not the same with those of, Beneka, 2009, Tsigganos et al. 2007 and Zetoua, 2006 in which the majority of injuries were of moderate severity.

Finger injuries accounted for almost one third (55/188) of all injuries recorded in the present study. According to previous studies, finger injuries in volleyball were frequent (Bahr,1997; Bhairo, 1992; Verhagen, 2004) . In order to compare the finding of the current study with previous studies, the registered finger injuries in the present study were exactly similar to

the findings of Schmidt-Olsen and Jorgensen (1987) that were higher than that of Bahr & Bahr (1997) and Bhairo et al. (1992), and lower than Yde, Buhl-Nielsen (1988), and Solgird (1995).

In the largest case series for volleyball published to date, it was found that finger injuries accounted for 24% of 1003 injuries. In most studies, the occurrence of finger injuries is less frequent.

The most situations of volleyball injuries in the literature are usually associated with blocking followed by spiking which are the most frequent skills in volleyball that require jumping, and they are associated with a high incidence of ankle injuries (Beneka et al., 2009; Briner and Benjamin, 1999; Watkins and Green, 1992; Schafle et al., 1990).

Other studies whose results agreed with the results of the present study include: Beneka et al. (2009) found "Incorrect sprawls", "stepping on others' feet" and "fatigue" were the most common injury mechanisms. In other study conducted byAagaard and Jørgensen (1996), Collision with a fellow team player in landing was the reported cause with 41% of all ankle injuries, and collision with an opposing player covered 17% ankle injury.

In addition,Beneka et al. (2007) in their study revealed that "step on others' foot" and "fatigue" are the most common injury causes for elite volleyball players ($X^2 = 423$ $p \leq 0.01$). Also, "incorrect sprawls" and "step on others' foot" are the most common injury mechanisms for local division volleyball players ($X^2 = 150.9$, $p \leq 0.01$).

Conclusion

Overall, the findings of this study revealed that the frequency of injury was high (58.2%) in the 2015/16 season of volleyball played.The total injury incidence in volleyball was 3.7 per 1000 hours whereas the overall incidence for training related injuries was 1.86 per 1000 playing hours, and for match related injuries incidence was 15.71. Finger, ankle and knee injuries were the commonly frequent injuries in each group while sprain was clearly the most common injury in volleyball which accounted nearly about one third of all injuries with an incidence of about one per 1000 played hours. Furthermore, injuries in both groups were much more likely to occur in games than in practice. With regard to injury situation, blocking and overhead finger pass were the factors of injuries for elite players, but conversely, overhead finger pass and setting were the injury factors for young/ project players. On the other hand, sprain, laceration and dislocation were the most commonly diagnosed and reported injuries in volleyball players.Left/right front and back line elite players and back court and center young players are vulnerable to injuries due to wrong technique and incorrect sprawl.

Acknowledgements

I am indebted to Professor Johan van Heerden School Academic Leader: Research (School of Health Sciences) UKZN and the department head of Biokinetics, Exercise and Leisure Science (Sport Science) for his invaluable guidance, encouragement, support in the shaping of this work. To Dr.Mihretie Kokeb, Dr.Habtewold, Mr.Taddese and all Nurses who participated in this study during data collection.

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