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Assessment of Pattern of Sport Injuries in Selected Ballgames during a Season of the Kenyan National Leagues

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Abstract The purpose of this study was to investigate the pattern and specific anatomical location of injuries on male and female players in one season of the Kenyan national division one leagues of basketball, handball and volleyball. It was prospective cohort design with 768 participants (478 male and 290 females) who comprised of 138 male and 133 female, 191 male and 95 female and 149 male and 62 females in basketball, handball and volleyball, respectively. Data was collected during training and competitions and recorded on a sport injury observation schedule. An injury was recorded if it caused a player to stop playing in that or subsequent games during training or competition. Chi-square set at 0.05 level of significance was used to test hypotheses of the study. Findings showed that 2098 injuries occurred during the season with 1362(64.9%) and 736(39.1%) affecting male and females, respectively. Cumulatively, the number of injuries per player was slightly higher in proportion to males (2.8) than females (2.5). Significant differences were found between and within sport and gender on the pattern and also the site of injury. However, within gender, a significance difference in the pattern of injuries was only found in females of basketball, male players of handball and both genders of volleyball. On the specific location of the injury, results showed significant difference was found in all except females of handball. It was concluded that pattern and anatomical location of injuries is influenced by gender, nature and characteristics of a sport.

Keywords Ballgames, Injuries, Kenya, League

1. Introduction

The concept of preventing sports injury was first muted in 1905, when the then president of United States(U.S), Robert Theodore Roosevelt challenged the American colleges to "adjust the rules in the American football to eliminate risks" [1]. Many years later, not so much was achieved towards this area with much attention being focused on the process of treating and rehabilitating injured athletes [2]. In the recent past, there has been growing enthusiasm for a paradigm shift from curative to preventive management of sport injuries. These developments have had resultant effects on the rules, facilities/equipment and standards of officiating in different sports [3]. Anecdote evidence indicate that sport injuries are alarmingly increasing, possibly due to the rigors of training, entry of many participants in sport for health benefits or the fact that sport is currently a major source of employment. The process of preventing sport injuries requires knowledge of their patterns in order to unearth information that to guide formulation of strategies for their prevention [4].

The model of causation of sport injuries and their risk during sport participation contend that sport injuries should be delineated from different sources- intrinsic, extrinsic or the inciting events(actual playing actions) [5]. They should also be approached from a mechanical, social, and psychological and tissue adaptations point of view [6, 7]. Furthermore, it is recommended that methodology of studying sport injuries need to engage proactive approach to produce current and real time empirical data [8, 9]. Studies on the pattern of sport injuries indicate that nature of the sport whether contact, non-contact, individual or team sport and characteristics of its skill influence pattern and location of the injury [10-13]. There is however a dearth of literature about cohort prospective studies of injuries in different sports collectively; with most of the studies being retrospective and focusing on a specific sport during a day or two days tournament [14, 15].

With the current influx of many people into sport for both competitive and recreational needs, documentary evidence of the pattern and anatomical site of the injury is necessary to give insight on the risk of participating in a particular sport.

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This would facilitate development of strategies for injury prevention as well as determine approaches of training [16-18]. A study of the pattern and anatomical site of injuries in different sports would also form a framework for comparative purpose and guide and encourage synergism in harnessing capacities for developing collaborative programs of injury prevention among federations. Injury studies need to be conducted to determine injury profile of players in order to answer questions on whether there are differences in the spread of injuries and anatomical location between males and females in different sports. Therefore, a study of the pattern and site of injuries represents unparalleled opportunity of reducing morbidity and mortality of athletes [19].

2. Methods and Materials

2.1. Research Design

Cohort prospective design was used for this study. Cohort prospective designs have become popular in the recent past as it helps generate real time knowledge about aspects of development at different stages of life compared with retrospective design which is affected by recall errors. Prospective designs offer a reasonable alternative of identifying real time information for this study, without unethically interfering with the privacy of respondents unlike other designs like randomized experimental research design [10]. This design was applicable because real time information of sport injuries was observed and recorded from cohorts in basketball, handball and volleyball during practice and competitions.

2.2. Population

The population for this study was drawn from 62 teams that were registered for the 2010 Kenya national leagues of basketball, handball and volleyball. According to gender, there were 24 teams in basketball with 12 male and 12 female, 21 teams in handball with 14 male and 7 female and 17 teams in volleyball with 12 male and 5 female teams. Bio data of players was extracted from registers of the respective sports and a code value was attached to each player. The code was serialized using membership registration number. In each sport, the following numbers of players were registered; 288 in basketball comprised 144 male and 144 females, 294 in handball comprised 196 male and 98 females and 221 in volleyball comprised 156 male and 65 females. In total 803 players were registered in the three sports for that season and comprised of 496 male and 307 females.

An exclusion criterion was developed for the purpose of identifying specific players for the study. Since the aim of the study was to assess new sport injuries within the season, beside other conditions, the exclusion criteria was based on the presence or absence of a sport injury to a player prior to the beginning of the study. Therefore, only a player who was duly registered for the respective sport and was to be regularly fielded and had not suffered a sport related injury during the last four months prior to commencement of this study was selected for the observation. Consequently, 768 players met the conditions of the inclusion criteria with a dropout rate of 4.35%. They comprised of 138 males and 133 females in basketball, 191 males and 95 females in handball and 149 males and 62 females in volleyball hence there was no need for further sampling of the subjects.

2.3. Instrument for Data Collection

A sport injury observation schedule was developed based on the conceptual model for the causation and management of sport injuries [6, 7]. It was designed to allow recording of multiple injuries during training and competition in real time. A focus group discussion consisting of researchers in the field of human performance and sport appraised the items of the tool. The tool was piloted with basketball, handball and volleyball teams of the national league during the last quarter of the 2009 season. Research assistants were drawn from the team analysts of the respective sports. A team analyst is a certified trainer and therefore has basic knowledge of sport medicine and is supposed to accompany their teams during training and competitions. Research assistants were initially guided by the researcher on the process of observation and recording of injuries in the observation schedule. They were allowed to practice the process by informally record characteristics of injuries in their teams independently. Their results were randomly compared for conformity and consistency and disparities were clarified or corrected.

Finally, a group of 12 research assistants and 21 coaches/physicians were selected for the piloting of the tool with selected teams. The teams for the pilot were drawn from the National Division Two Leagues of basketball, handball and volleyball in the last quarter of 2009 season and included two male and two female basketball teams, two male volleyball teams, one male handball team.

The response return rate for the pilot study was 12 (100%) from research assistant and 15(71.4%) by the coaches/ physicians. The lack of 100 percent return rate from the coaches could be attributed to their absence during training sessions or some injuries could have been too minor to warrant their documentation. An inter-ratter reliability test for consistency in the interpretation of the items in the tool was performed on the responses between research assistants and coach/physicians yielding a reliability of 0.79. A split-half method was used to correlate responses of the items in the observation schedule and yielded a correlation-coefficient of 0.79 which was considered adequate for the study. Data for the study was collected by researcher and research assistants assisted by team coach/physician. Returns and summaries were made on weekly basis by the researcher.

2.4. Data Analysis

Data was coded and cleaned through statistical package for social sciences (SPSS). Data generated was nominal and

was therefore expressed in frequencies and percentages and presented in tables. Chi-square test of independence at $p_{value} \leq 0.05$ probability of error was used to analyse the data since it is the appropriate non-parametric statistical tool for the analysis of nominal data [20].

3. Results

3.1. Patterns of Injuries

The patterns of injuries in different sport are presented in Table 1.

Table 1. Pattern of injuries (n=768)

Sport	Gender	Axial part	Appendage upper limb	Appendage lower limb	Total
Basketball	Male	110(5.24%)	190(9.06%)	104(4.96%)	404(19.26%)
	Female	155(7.39%)	208(9.91%)	099(4.72%)	462(22.02%)
Subtotal		265(12.63%)	398(18.97%)	203(9.68%)	866(41.28%)
Handball	Male	178(8.48%)	219(10.44%)	186(8.86%)	583(27.79%)
	Female	48(2.29%)	71(3.38%)	61(2.91%)	180(8.58%)
Subtotal		226(10.77%)	290(13.82%)	247(11.77%)	763(36.37%)
Volleyball	Male	79(3.76%)	185(8.82%)	111(5.29%)	375(17.87%)
	Female	18(0.86%)	49(2.33%)	27(1.29%)	94(4.48%)
Subtotal		97(4.62%)	234(11.15%)	138(6.58%)	469(22.35%)
Grand- total		588(28.03%)	922(43.94%)	588(28.03%)	2098(100%)

Numbers in brackets represent percentages.

The results in Table 1 shows that pattern of injuries between male and females in these sports were those affecting the appendage upper limb 43.94%(922), appendage lower limb 28.03% (588) and axial part 28.03% (588). The patterns of sport injures by type of sport and gender is presented in the next session.

3.2. Pattern of Sport Injuries Based on the Type of Sport and Gender

Table 2 shows the association on the pattern of injuries by sport and gender.

Table 2. The association between type of sport, gender and the pattern of sport injuries (n=768)

Sport	Gender	Axial part χ^2	Appendage Upper limb χ^2	Appendage lower limb χ^2	Cumulated χ^2
Basketball	Male	0.09	0.88	0.75	1.72
	Female	5.02	0.12	7.20	12.34
χ^2		5.11	1.00	7.95	14.06
Handball	Male	1.30	5.40	3.10	9.80
	Female	0.11	0.83	2.20	3.14
χ^2		1.41	6.23	5.30	12.94
Volleyball	Male	6.50	2.50	0.33	9.33
	Female	2.62	1.44	0.02	4.08
χ^2		9.12	3.94	0.35	13.41
Cumulated χ^2		15.64	11.17	13.6	40.41

χ^2 40.41≥ p 0.05 10df

It was hypothesized that pattern of injuries between and within sports and gender will not be significantly different, however, results in Table 2 showed a significant difference in the pattern of injuries by sport and gender. It was found that within sports, there was no significant difference among basketball male players on the pattern of injuries. However, injuries on the axial part and appendage lower limb were significantly different on females. In handball, significant difference was

found on the appendage upper limb to only the male players. In volleyball, a significant difference was observed in both genders on only the axial part. The anatomical location of the injuries is presented in the next section.

3.3. The Anatomical Location of Sport Injuries

The anatomical location of the sport injuries are presented in Table 3.

Table 3. Anatomical location of sport injuries (n=768)

Sport	gender	head	chest	lower back	Shoulder	Elbow	Finger	hip	Thigh	Knee	Ankle	Total
Basketball	Male	67	18	13	11	22	157	12	14	21	69	404
	Female	78	31	17	16	21	171	29	12	33	54	462
sub-total		145	49	30	27	43	328	41	26	054	123	866
Handball	Male	92	53	13	43	30	146	20	12	77	97	583
	Female	22	12	6	10	9	52	8	4	31	26	180
sub-total		114	65	19	53	39	198	28	16	108	123	763
volleyball	Male	14	12	23	50	45	90	30	24	52	34	375
	Female	4	3	5	14	10	25	6	4	16	7	94
sub-total		18	15	28	64	55	115	36	28	68	41	469
Grand-Total		277	129	77	144	137	641	105	70	231	287	2098

Results on the anatomical location of injuries show that head, chest, lower back, shoulder, elbow, finger, hip, thigh, knee and ankle were the commonly sites of injuries across these sports. Finger 641(30.55%) account for most injuries followed by ankle 287(13.68%), head 277(13.2%), knee 231(11%), shoulder 144(6.86%), elbow 137(6.53%), chest 129(6.15%), hip 105(5%), lower back 77(3.67%) and thigh 70(3.3%).Within sports, finger 328(15.63%) was the commonest site with head 145(6.91%), ankle 123(5.86%), knee 54(2.57%), chest 49(2.33%), elbow 43(2.05%), hip 41(1.95%), lower back 30 (1.43%) shoulder 27(1.29%) and thigh 26(1.24%)in basketball. It was also the commonest site accounting for 198(9.44%) followed by ankle 123(5.86%), head 114(5.43%), knee 108(5.15%), chest 65(3.1%), shoulder 53(2.53%), elbow 39 (1.86%), hip 28(1.33%), lower back 19(0.9%) and thigh 16 (.76%) in handball. The trend of the anatomical locations differed slightly in volleyball but finger was still the commonest site with 115(5.48%) injuries followed by knee 68(3.29%) shoulder 64(3.05%), elbow 55(2.62%), Ankle 41(1.95%), hip 36(1.72%), lower back 28(1.33%), thigh 28(1.33%), head 18(0.86%) and chest 15(0.71%).

3.4. Association between Anatomical Location of the Injuries, Gender and Type of Sport

It was hypothesized that there will be no significant difference in the anatomical location of sport injuries between and within sports and gender. The anatomical location of the injuries and its relationship with type of sport and gender is presented in Table 4.

Table 4. Association on the anatomical location of sport injuries by type of sport and gender (n=768)

Sport	Gender	Head	Chest	Lower back	Shoulder	Elbow	Finger	Hip	Thigh	Knee	Ankle	Cumulated
		χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2
Basketball	Male	3.6	1.7	0.3	10.3	0.8	8.5	3.4	0.3	12.6	3.2	44.7
	Female	5.0	0.3	0.0	7.8	2.9	5.8	1.4	0.2	6.5	1.5	31.4
χ^2		**8. 6**	**2.0**	**0.3**	**18.1**	**3.7**	**14.3**	**4.8**	**0.5**	**19.1**	**4.7**	**76.1**
Handball	Male	3.2	8.9	3.4	0.2	1.8	6.2	3.0	1.6	2.3	3.4	34.0
	Female	0.0	0.2	0.0	-	0.5	0.0	0.0	-	6.9	0.2	7.8
χ^2		**3.2**	**9.1**	**3.4**	**0.2**	**2.3**	**6.2**	**3.0**	**1.6**	**9.2**	**3.6**	**41.8**
Volleyball	Male	25.5	5.0	6.0	22.7	16.7	5.6	6.5	14.6	2.6	6.0	111.2
	Female	-	-	1.2	13.1	3.7	0.0	0.7	-	5.0	1.7	25.4
χ^2		**25.5**	**5.0**	**7.2**	**35.8**	**20.4**	**5.6**	**7.2**	**14.6**	**7.6**	**7.7**	**136.0**
Cumulated χ^2		**37.3**	**16.1**	**10.9**	**54.1**	**26.4**	**26.1**	**15**	**16.7**	**35.9**	**16**	**254.5**

χ^2 254.5 ≥ p 0.05, 55df

The results showed that cumulatively, specific site of a sport injury was significantly different ($p > 0.05$) within and between sports and gender. The results further indicated that between sports, there was significant difference on females in basketball and males in volleyball on injuries to the head, males in handball and volleyball on injuries to the chest, males in volleyball on injuries the lower back, male and females in basketball and volleyball on injuries to shoulder, males in volleyball on injuries to elbow, both genders in basketball and males in handball and volleyball on injuries to the finger, males in volleyball on injuries to the hip, males in volleyball on injuries thigh, both genders in basketball and females in handball and volleyball on injuries to the knee and males in volleyball on injuries to the ankle.

4. Discussion

The results (table 1) seem to contradict other findings that sport injuries in most sports occur to the ankle and knee than in other parts of the body [12,21-23]. This difference may be attributed to either the method of classifying body parts, the purpose or the sport used between the studies. It was found in this study that in the three sports, appendage upper limb was the most affected with finger as the most commonly injured part. The fact that equipment/facility specifically the ball has been reported to be a main cause of injury in other studies [24,25] indicate that finger on the appendage of the upper limb which is mainly used in these sport is more prone to injuries. It is therefore apparent that nature of the sport and its demands determine the pattern of injuries. Furthermore, injuries on the finger, arm and shoulder are justifiable by the nature of play of these sports. The patterns of injuries in the three sports seem to be similar for both male and female athletes.

In regard specific sport, the pattern of injuries showed that playing basketball increases risk of injuries on the appendage upper limb than on either the axial part or appendage lower limb to players. A similar picture is replicated on the handball and volleyball but with a difference on the number of injuries between the axial part and the appendage lower part across these sports. The implication of the results is that most injuries in basketball affect appendage upper limb caused by the ball, the rim and or backboard [26-28]. It is therefore necessary to develop strength training, flexibility and train on the mechanics of handling play equipment. Tapping/strapping of the fingers is also necessary. Coaches should ensure that protective devices are used by players. Furthermore, the skill of dunking in basketball should be discouraged especially among shorter players as it has been reported to be a risk factor in basketball especially on finger or on spinal column.

These findings confirms that pattern of injuries within the sports is determined by gender of the participant hence measures of prevention should be based on gender characteristics. Results between sports showed that only axial part and appendage lower limb among basketball females, appendage upper limb among handball males and axial part among volleyball males were significantly different. It attests that pattern of sport injuries is influenced by the sport. The conclusion derived from the above analysis is that pattern of sport injuries is influenced by the nature and characteristics of a particular sport together with gender of the participant. These conclusions are in tandem with other studies. For example, Piry *et al.*, [29] results showed that the incidence of injuries in elite Asian handball players is quite high and prevention should focus on ankle and knee injuries. In soccer, sport injuries mainly affect head and the lower extremity [30]. The upper and the lower extremity were found to be the most sites of sport injuries in volleyball [18] with equipment/facility as the main cause of injury [25, 31].

Most injuries in basketball, handball and volleyball affect fingers, head and leg with finger in the upper extremity and ankle in the lower extremity as the main sites [32, 2]. According to Dietch *et al*, [33] and Njororai *et al.,*[34] pattern of sport injuries is specific to a sport. Indeed ankle injuries are the most common areas affected in Basketball, Handball and Volleyball [35].McKay et al.,[36] found that ankle injuries occurred at the rate of 3.85 per participation and the three identified risk factors and landing should be considered when preventative strategies for ankle injuries in Basketball are being formulated.

The results (Table 2) support previous findings in basketball [19], basketball and volleyball [37], handball [38] and volleyball [15]. It was found that injuries of the head and chest were more common in basketball and handball while injuries of the lower back were mostly common in basketball and volleyball. Injuries to the shoulder were more common in handball and volleyball while those of finger and elbow were more common across the three sports and the genders. Verhagen *et al.,* [9] ankle sprain is the most common injury in Volleyball accounting for 41% of all volleyball related injuries. Previous injury seems to be an important risk factor for ankle sprain. Injury prevention programme should focus on ankle sprains and concentrate on players with previous ankle sprains. Sport injuries on the hip and thigh were more common in basketball and volleyball and those of the knee and ankle were common across the three sports and also genders. The findings agree with the results of [39] that nature of sport influence anatomical location of injuries. Therefore prevention strategies should address characteristics of a sport and take cognizance of the participating gender. The findings show that the site of injuries is sensitive to specific to needs and demands of a particular sport. Gender orientation also influences the anatomical location of a sport injury [19].

The analysis of the site of injuries (Table 3) within the sport showed there was a significant difference on injuries to the head, shoulder, finger and the knee for both genders in basketball. In handball, a significant difference was found on injuries to the head, chest, lower back, finger, hip and ankle in males and on the knee in females while in volleyball it was found to injuries on the head, shoulder, elbow and thigh in male and on the shoulder in female players. The findings support previous assertions that the site of a sport injury is

specific to the characteristics a sport and gender [31,40]. In handball Dirk, Bouter and Geus, [41] reported that injuries are frequently located at lower extremities (54%) especially the ankle and the majority of injuries involve distortations (35%) and strains (26%). The injuries are located mostly at upper extremities with finger injuries and distortations of ankle joint reported most frequently. Therefore while the authors recommended the expediency of the principle of cross-transfer between these sports, it can only be used on the skills and techniques that cut across the sports if benefits are to be gained. However, common preventive strategies like use of prophylactic equipment and development of muscular strength and joint flexibility are recommended in all the sports.

5. Conclusions

Based on the findings of this study it was concluded that pattern and site of injuries in these sports are similar with subtle differences that can be attributed to characteristics of each sport and gender. The differences could also be explained by the differences in training and the amount of effort and intensity portrayed by the athletes. However, coaches and players are cautioned that the pattern and sites of sport injuries cannot be generalized since every sport has its own characteristics that form a basis for its training. Consequently, studies are needed to determine the training regimen of athletes in Basketball, Handball and Volleyball as this may shed more light on whether there is a relationship between strength training, frequency of training and competition on the occurrence of injuries. Therefore, it is recommended that studies be delineated on the determinants of the pattern of injury for specific sport and gender .There is need to establish factors that determine injuries on the particular part of the body, the role and position of a player in the team. It is necessary to establish the effects of training on the pattern of sport injuries that are important in developing effective injury prevention programs.

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