



Sex-Related Injury Patterns among Iranian Professional Handball Players

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ABSTRACT

Background: Information of sex related injury pattern in handball players is very limited. Although several authors have analyzed the incidence of Handball injuries in male and female, but the results are difficult to expand because of heterogeneous in study design, injury definition, observation periods and level of play. Thus, a survey study to assess the injuries in men and women Iranian professional handball players was necessary.

Objective: To investigate the incidence, circumstances and characteristics of injuries in men and women Iranian professional handball players.

Participants: Eight of ten 15 clubs for professional male players (n=154; 80%) and all six clubs for professional female players (n=125; 100%) from the eight Province of the Iran Handball Associations participated in this study.

Setting: During one season, the physicians or physiotherapist of 14 club(279 players) playing in the Iran professional handball super league reported exposure time and injuries on a standardized injury report form.

Results: In total 169 injuries were reported from 118 matches and 1262 hours team training in women and 2152 hours team training in men. Incidence of injury was 2.83 per 1000 hour player exposure risk. In Iranian men professional Handball players, incidence of match and training injuries were respectively 28.76 and 1.18 injuries per 1000 hour player and in women they were 42.85 and 1.86 injuries per 1000 hour player. Women had acute injuries 1.66 times more than men. But there is no significant difference in mechanism of injuries between men and women. Time-loss injuries in women professional handball players were 1.66 times more than men. In men's Handball from 29 match injuries, 14 injuries (48.2%) caused by foul of opponent, as judged by the team physician. But it was 61% (11 of 18 injuries) in women. Women players 2.46 times more than men suffered from knee injury. Incidence of ACL injuries lead to surgery for women was 0.53 per 1000 player hours but it was 0.26 per 1000 player hours for men.

Conclusion: Women Iranian professional handball players more than men are prone to sports injuries, in both matches and trainings and preventive program are necessary for women. Also, severity of injuries in women is more than men. But mechanism, location and type of injuries in men and women are the same.

Keywords: Asia, handball league, professional player, sport injury, sex-related injury pattern.

INTRODUCTION

Handball is a *team contact game* in which players dribble, pass, and throw the ball with their hands, trying to make it end up as many times as possible in the opponents' goal.¹

It is played indoors or outdoors by both sexes and all ages: young children, juniors, and seniors. A dynamic development of Handball along with an increasing interest of the public has resulted, as in other sports, in major professionalization of all top teams, which has directly affected the performance in this sport. The players' speed, strength, and weight have increased. The tempo of the match has increased, throws and shots became more powerful. At trainings a lot of time is devoted to movements and specific exercises, in order to hinder the attacking team. When the concept of "disabling the opponent at any cost" is applied, numerous injuries may result; thus, prevention of sports injuries in Handball is the need of the day.²⁻⁵

The Islamic Republic of **Iran Handball Federation** (IRIHF) is the governing body for Handball in Iran. It was founded in 1975, and has been a member of International Handball Federation since 1978. It is also a member of the Asian Handball Federation. The IRIHF is responsible for organizing the Iran national handball team.

At the 15th Asian Summer Games 2006 in Doha, the four players of the Iran national senior handball team

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could not participate, because of sport injury. Also, several reports from Iran handball professional clubs (specially women clubs) about their harmfulness due to huge numbers of injured players, it was decided, in medical committee of Iran Handball Federation, to establish a comprehensive activity in order to prevent and minimize Handball injuries in Iranian professional Handball players.

To prevent sports injuries in extent as well as in severity, a structured step-by-step approach is required. The first step is to identify and describe the injury problem in terms of its incidence and severity. Second, the risk factors and injury mechanisms must be identified. The third step is to introduce measures to reduce the future risk and/or severity of injuries. The preventive measures should be based on the information identified in steps one and two. The fourth step is to evaluate the effectiveness of the measures by repeating the first step.⁶

Identifying sex related injury pattern in handball players have been studied in several populations (see table 1). Researches show injury rates for women are different from those for men¹⁰, especially for injuries to the knee.^{7,8,9} Among the potential reasons for such differences are femoral notch size variation, cross-sectional diameter of the ACL, the variations in lower extremity strength and flexibility, and hormonal influences on injury risk.¹⁰ Since almost all studies were conducted in Europe or during international competitions also the results are difficult to compare because of heterogeneous in study design, injury definition, observation periods and level of play.¹¹ So, information on sex related injury pattern in men and women handball players in Asian players is limited and a survey study to analysis the injuries in Iranian handball players are necessary.

Table 1 : Studies on incidence of injuries in men and women handball players.

Author and year	Country	No. of players (teams)	Skill level	Study period	Men injuries (per 1000 player hours)	Women injuries (per 1000 player hours)
Olsen <i>et al.</i> , (2005) ¹²	Norway	900 female players (75 teams), 180 male players (15 teams)	youth divisions	7-month season (9/2001-3/02)	8.3±2.49 (acute injuries per1000 hours)	14.5±2.35 (acute injuries per1000 hours)
Langevoort <i>et al.</i> , (2007) ¹³	international	365 matches, equivalent to 5110 player match hours	Senior national players	6 international tournaments 2000 - 2004	110,129,89 (injuries per1000 hours)	84,96,145 (injuries per1000 hours)
Junge <i>et al.</i> , (2006) ¹⁴	international	72 matches	Senior national players	Olympic Games 2004	89 (injuries per1000 hours)	145 (injuries per1000 hours)
Aswambo & Wekasa (1998) ¹⁵	International	406 players (9 male and 5 female team);29 matches	Senior national players	9 days	0.9 (injuries per player)	0.5 (injuries per player)
Lindblad <i>et al.</i> , (1992) ¹⁶	Denmark	381 women and 189 men	No report	1-year period	31 (injuries/1000 people)	61 (injuries/1000 people)

METHODS

In 2008, the Iranian professional Handball Super League comprised 10 men teams and 6 women teams with a total of 312 players. All 16 clubs were invited to participate in this study.

Official letters signed by president of the IRIHF were sent to the 16 professional Handball clubs from the eight Province of the Iran Handball Federation (centre, north, south, east, south east, and northwest of Iran). Two clubs refused to participate in this study, therefore, eight (80%) professional men clubs with 154 players and six (100%) professional women clubs with 125 players participated in this study. Player's age ranged from 16-36 years. Based on the federation rules, players could change their club in the half season. The 14 official physicians or physiotherapists of the clubs were educated to collect the injury and exposure data for the present study by Medical Committee of Iran handball federation and were research members in this study.

Incidence and circumstances of injuries in players of 16 teams were observed during one season (in the men league from September 2008 to February 2009 and in the women league from November 2008 to February 2009). An injury was defined as "any physical complaint sustained by a player those results from a handball match or handball training, irrespective of the need for medical attention or time-loss from handball activities". An injury that results in a player being unable to take a full part in future handball training or match was known as a "time-loss" injury. Injury severity was defined as "The number of days that have elapsed from the date of injury to the date of the player's return to full participation in team training and availability for match selection."⁸ Before beginning the season, all information about age and previous injuries of players were recorded. At the end of every training

session or matches its duration and number of participating players were recorded. When an injury occurred, all information of that injury were recorded in a standardised injury report form published by Junge *et al.*, (2006).¹⁷

Injury incidence was expressed as number of injuries per 1000 hours of player exposure.¹⁸ Confidence intervals were calculated as the incidence ± 1.96 times the incidence divided by the square root of the number of injuries. The statistical methods applied, were frequencies, cross-tabulations, descriptive statistics, χ^2 test and Fisher's Exact Test. Significance was accepted at the 5% level.

RESULTS

Incidence of injuries

In total 169 injuries were reported from 118 matches and 1262 hours team training in women and 2152 hours team training in men. Fewer injuries occurred during matches (63; 37.3%) than during training sessions (106; 62.7%).

Incidence of injury was 2.83 per 1000 hour player exposure risk. Incidence of match injuries was 32.9 injuries per 1000 hour player match exposure to risk. And with 3414 hours training, the incidence of training injuries was 1.35 injuries per 1000 hours players training exposure to risk. Iranian professional Handball players were 24.37 times more likely to be injured in games than in practice sessions.

In Iranian men professional Handball players, in 88 matches (1008 player hours during matches) 29 injuries were recorded (28.76 injuries per 1000 hour player match exposure to risk) and in Iranian women professional Handball players, in 30 matches (420 player match hours) 18 injuries were recorded (0.6 injuries per match or 42.85 injuries per 1000 hour player match exposure to risk).

In Iranian men professional Handball players, in 43712 hours training exposure to risk 52 injuries were recorded (1.18 injuries per 1000 hours players training exposure to risk) and in Iranian women professional Handball players, in 14492 hours training exposure to risk, 27 injuries were recorded (1.86 injuries per 1000 hours players training exposure to risk).

During one season, in men's Handball 27 overuse injuries (0.60 injuries per 1000 player hours) and in women 16 injuries (1.07injuries per 1000 player hours) were recorded. Rate ratio of incidence of overuse injuries in women vs. men was 1.77. The incidence of acute injuries was 1.81 injuries /1000 player hours in women and 3.01 injuries /1000 player hours in men. Women had acute injuries 1.66 times more than men. But there is no significant difference in mechanism of injuries between men and women.

In men professional Handball players, 47 injuries (56.5%) were expected to result in absence from handball (1.05 time-loss injuries per 1000 player hours) and in women professional handball players, 27 injuries (55.7%) were expected to results in absence from handball (3.02 time-loss injuries per 1000 player hours). Time-loss injuries in women professional handball players were 1.66 times more than men.

Table 2: Severity of injuries in men and women

	Non time-loss	Time-loss	Total
Men handball	61 (56.5%)	47 (43.5%)	108
Women handball	34 (55.7%)	27 (44.3%)	61
Total	95	74	169

$\chi^2 = 0.009$, Asymp. Sig. (2-sides)=0.925, Significant at 0.05 level.

In men's Handball from 29 match injuries, 14 injuries (48.2%) caused by foul of opponent, as judged by the team physician. In women's Handball of 18 injuries, 11 injuries (61%) caused by foul of opponent as judged by the team physician. In men's Handball, of 14 foul actions lead to injury, in 8 cases there were sanctions by referee (57.1%). In women's Handball, of 11 foul actions lead to injury, in 6 cases (54.5%) there were sanctions by referee.

Table 3: Injuries that caused by foul action in men and women

	Men	Women
Action leading to injury was not a violation of handball laws	2 12.5%	1 8.3%
Action leading to injury was a violation of laws, without sanction	5 31.3%	5 41.7%
Action leading to injury was a violation of laws, with sanction against injured player	1 6.3%	0 0%
Action leading to injury was a violation of laws, with yellow cart to opponent	8 50%	4 33.3%
Action leading to injury was a violation of laws, with red cart to opponent	0 0%	1 8.3%
Action leading to injury was a violation of laws, with free kick to opponent team	0 0%	1 8.3%

The location and type of injuries did not vary significantly between men and women. In both men and women professional Handball players, Joint and Ligament injuries was the most frequent type followed by Muscle and tendon injuries. In both sex Knee injuries were the most frequent location of injury followed by "Back/Pelvic/Rib area" in both sex also "Lower leg Achilles tendon in women.

Table 4: Types of injuries

Type of injury	All N (%)	Men's Handball	Women's Handball
Concussion	3 (1.8%)	3 (2.8%)	0 (0.0%)
Fracture and other bone injuries	6 (3.6%)	4 (3.7%)	2 (3.3%)
Skin damage	8 (4.7%)	5 (4.6%)	3 (4.9%)
Joint and ligament injuries	75 (44.4%)	45 (41.7%)	30 (49.2%)
Contusion	20 (11.8%)	15 (13.9%)	30 (49.2%)
Muscle and tendon injuries	50 (29.6%)	30 (27.8%)	20 (32.8%)
Other injuries	7 (4.1%)	6 (5.6%)	1 (1.6%)
Total	169 (100%)	108 (100%)	61 (100%)
			Fisher's Exact Test=2.336* Exact Sig.(2-side)= 0.953

*Significant at 0.05 level.

Table 3: Locations of injuries

Location of injury	All N (%)	Men's handball	Women's handball
Head/ Face	9 (5.3%)	7 (6.5%)	2 (3.3%)
Neck/ Cervical spine	2 (1.2%)	2 (1.9%)	0 (0.0%)
Abdomen	7 (4.1%)	6 (5.6%)	1 (1.6%)
Back/Pelvic/ Ribs area	25 (14.8%)	16 (14.8%)	9 (14.8%)
Shoulder/ Clavicle	10 (5.9%)	6 (5.6%)	4 (6.6%)
Upper arm	5 (3.0%)	4 (3.7%)	1 (1.6%)
Elbow	7 (4.1%)	4 (3.7%)	3 (4.9%)
Forearm	3 (1.8%)	2 (1.9%)	1 (1.6%)
Wrist	1 (0.6%)	1 (0.9%)	0 (0.0%)
Hand/ Finger/Thumb	17 (10.1%)	11 (10.2%)	6 (9.8%)
Thigh/ Hip/ Groin	17 (10.1%)	12 (11.1%)	5 (8.2%)
Knee	29 (17.2%)	10 (9.3%)	12 (19.7%)
Lower leg/ Achilles tendon	17 (10.1%)	8 (7.4%)	9 (14.9%)
Ankle	17 (10.1%)	10 (9.3%)	7 (11.5%)
Foot/ Toe	3 (1.8%)	2 (1.9%)	1 (1.6%)
			Fisher's Exact Test=4.466* Exact Sig.(2-side)=0.652

*Significant at 0.05 level.

This study showed 0.38 knee injuries per 1000 player hours in men and 0.93 knee injuries per 1000 player hours in women and IDR of knee injuries (number of knee injuries in women per 1000 player hours divided by men's) was 2.46. Therefore women professional handball players are more than men prone to knee injuries.

In Iranian men professional handball players during one season, totally 12 ACL injuries lead to knee surgery happened which was 0.26 ACL injuries lead to surgery. But in women professional handball players 8 ACL injuries (0.53 ACL injuries per 1000 player hours) lead to surgery. IDR of ACL injuries lead to surgery was 1.99. Thus, Women professional handball player were near twofold prone to serious ACL injuries than men.

DISCUSSION

The present study reported the sex related injury pattern in men and women Iranian professional Handball players and provided a unique database for comparing the injury patterns of men and women handball players.

Results of this study revealed that women professional handball players are 2.03 time more prone to be injured than men. Over the past several years there has been a strong focus on the idea that girls participating in sports are at a higher risk of injury¹⁰, especially knee injury, than boys.^{7,8,9} But Whieldon and Cerny (1990)¹⁹ reported in contact sports (baseball, softball, basketball, soccer, and field hockey) men had significantly higher injury than women. In handball, except Asembo & Wekasa, (1998)¹⁵ who found more injury rate for women and Longwoort *et al.*, (2007)¹³ who indicates there is no significant difference, in other studies (Olsen *et al.*, (2005)¹², Lindblad *et al.*, (1992)¹⁶ and Junge *et al.*, (2006)¹⁴) incidence of injuries in women were reported more than men. So risk factors which predispose women handball players to be injured more than men must be known clearly and preventive policy from sports injuries in women handball players must be employed seriously.

Result of this study in consonance with Nielson & Jyde (1988)²⁰, Seil *et al.*, (1998)²¹, Tsigili *et al.*, (2005)²², Wederkoop *et al.*, (1997)²³, Longwoort *et al.*, (2006)¹³ and Olsen *et al.*, (2003)¹² showed in professional handball players the injury rate was significantly higher during the matches than trainings, whereas results in consonance with Longwoort *et al.*, (2006)¹³ and Olsen *et al.*, (2003)¹² showed there is no gender different in rate ration of incidence of matches and trainings injuries. Also, the ratio of incidence of match and practice injuries in Iranian Professional Handball players almost is higher than all other populations which have been studied. This indicates Iranian professional Handball players more than other populations are prone to match injuries. Difference between content of a training session and a match, like difference in psychological factors and motivation levels, may cause players to be injured in match more than training. So, all risk factors in match situation must be indentified and protective measures for avoiding them must be assessed and seriously must be employed in match situations.

Results of this study unlike Jung *et al.*, (2006)¹⁴ and Longwoort *et al.*, (2007)¹³ showed in Iranian professional Handball players significantly more injuries of women than of men were expected to result in absence from handball. It means injuries in Iranian women handball players were not only more than men but also more severe than men. The same intrinsic and extrinsic risk factors that predispose players to more injuries may predispose them to more severe injuries. Age, range of motion, strength of muscles, power of muscles, cardio-respiratory capacity, previous injuries, Quality of trainings by coaches (i.e. intensity of exercises, rest period between two training sessions, accuracy of training), floor type, weather, using protective equipment, level of competition, psychological factors (i.e. anxiety and stress response, excessive muscle tension, impaired ability to attend to the play the game) and many other risk factors, may predispose players to more injuries and more severe injuries.

Results of this study in consonance with Jung *et al.*, (2006)¹⁴ showed injuries caused by foul action in women handball players were more than men. But Asembo and Wekesa (1998)¹⁵ reported in handball match situation 66.67% of men injuries were caused by another person whereas only 19.37% of women injuries were caused by another person. Loss of fair play spirit, and high degrees of psychological pressures on players, force he/she disables the opponent at any cost and cause many injuries due to foul play of opponent.

Results of this study unlike Jung *et al.*, (2006)¹⁴ showed in Iranian professional handball players there is no significant different between men's and women's handball referees in sanction against foul actions lead to injuries. Knowledge of handball rules, decision making skills, judgment skills are factors that affect referee's performances.

In consonance with Jung *et al.*, (2006)¹⁴ and Longwoort *et al.*, (2007)¹³ location and type of injuries in this study did not vary significantly between men and women. But Asembo and Wekesa (1998)¹⁵ reported 43.27% of injuries in male affected head area while 13.43% of female players injuries affected head area. Also Lindblad *et al.*, (1992)¹⁶ and Nielson and Yde (1988)²⁰ recorded finger injuries are most often seen in women.

Iranian women handball players 2.46 times more than men are prone to knee injuries. Jung *et al.*, (2006) revealed rate ratio of knee injuries in women than men was 2.48. Longwoort *et al.*, (2006)¹³ reported, during six men and women handball Olympics and world cups, rate ratio of knee injuries in women than men were up to 2.47. Also

Myklebust G. *et al.*, (1998)⁷, Arendt E. *et al.*, (1995)⁸, Zelisko J.K. *et al.*, (1982)⁹ reported that female athlete incur substantially more knee injuries than male athlete.

Iranian women professional handball players had two fold increased risk of sustaining ACL injuries compared with men. Myklebust *et al.*, (1998)⁷, found that Norwegian women handball players had a fivefold increased risk of sustaining ACL injuries compared with men. Gwinn *et al.*, (2000)³² reported within military training, women had a relative risk of 9.74 compared with men and soccer players were nearly 7 times more likely to sustain an ACL tear than male soccer players, but there were no significant differences in the relative risk between male and female basketball players.¹⁰ But Malone *et al.*, (1993)²⁴ revealed incidence of ACL injuries in women collegiate basketball players approximately six fold more than men. Chandy T.A. *et al.*, (1985)²⁵, Ferrenti A. *et al.*, (1992)²⁶, Gerberich S.G. *et al.*, (1987)²⁷, Gray. G. *et al.*, (1985)²⁸, Hewett T.E. *et al.*, (1996)²⁹, Huston J.L. *et al.*, (1996)³⁰, Whiteside (1980)³¹, Zelisko J.A. *et al.*, (1982)⁹ have reported in jumping and pivoting sports women players are prone to a knee ligament injury, like ACL, four to six fold more than men.

There are three theories to explain the difference in female and male injury rates which reviewed by Hewett T.E. *et al.*, (2001)¹⁰:" 1-Anatomical differences; Due to a wider pelvis, females have an increased angle between the long axis of the femur and the tibia (Q angle), and this increased angle may account for increased female injury rates. Also females have smaller femoral notches than males. A narrow femoral notch may predispose the female knee to ACL injury, perhaps because a narrower notch leads to a smaller, weaker ACL. 2-Hormonal influences on ligamentous integrity and neural function; Decreased ligament strength or altered neuromuscular control mechanisms due to cyclic changes in female hormones may be possible contributors to the increased knee injury rates in female athletes. 3-Neuromuscular imbalances; some athlete allows the knee ligaments, rather than the lower extremity musculature, to absorb a significant portion of the ground reaction force during sports maneuvers. This results in high valgus knee moments and high ground-reaction forces. Typically during single leg landing, pivoting, or deceleration, as often occurs during knee ligament injury, the female athlete allows the ground-reaction force to control the direction of motion of the lower extremity joints, especially the knee joint. This lack of dynamic muscular control of the joint leads to high forces on the knee ligaments. In the other hand female athletes tend to activate their knee extensors preferentially over their knee flexors to control knee stability when performing high-torque force movements. This over-reliance on the quadriceps muscles leads to imbalances in strength and coordination between the quadriceps and the knee flexor musculature. Female athletes reacted to a forward translation of the tibia primarily with a muscular activation of the quadriceps muscles, whereas male athletes relied on their hamstring muscles to counteract the anterior tibial displacement. At last, female athletes have been reported to generate lower hamstrings torques on the nondominant than in the dominant leg. Side-to-side imbalances in neuromuscular strength, flexibility, and coordination have been shown to be important predictors of increased injury risk".

Conclusion

Iranian women professional handball players more than men are prone to sports injuries, in both matches and trainings and preventive program are necessary for women. Also, severity of injuries in women are more than men. But mechanism, location and type of injuries in men and women are the same.

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