

# Epidemiology of Handball Injuries

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# Epidemiology

- “Injury epidemiology is the study of the distribution and determinants of varying rates of injuries in human populations for the purpose of identifying and implementing measures to prevent their development and spread.”

# Epidemiology

- The study of the distribution of varying rates of injuries (i.e., who, where, when, what) is referred to as **Descriptive Epidemiology**.
- The study of the determinants of an exhibited distribution of varying rates of injuries (i.e., why and how) and the identification and implementation of preventive strategies is referred to as **Analytical Epidemiology** (Duncan, 1988).

# Epidemiology

- The game of Handball is continuously evolving – players speed, strength, and technique, and changes in the rules and tactics to accommodate these evolutions)
- Injury potential - related to its dynamic character and the “less restrictive” rules regarding physical contact compared with basketball, i.e.



# Epidemiology

- Today, Handball is played in 199 countries; there are 19 million players worldwide in over 800,000 teams
- Played year round at the professional level.
- Combining international competitions with club and national team - elite players play between 70 and 100 matches a year.

# Epidemiology

- Aggressive contact is an integral part of the game - often used not only to stop the opponent but also to intimidate opponents from approaching the goal.
- Contact-related injuries represent a large fraction of all handball injuries, as well as non-contact.

# Reporting Inconsistency...

- Most widely used classification of injury severity in the handball literature are:
  - minor injury (1–7 days absence)
  - moderate injury (8–21 days absence)
  - major/severe injury (>21 days)

# Adult Injuries

- Senior/Adult level - incidence of time-loss injuries in prospective studies has been estimated to be 11.2–14.3 per 1,000 exposure hours in matches and 0.6–2.4 in training (Nielsen and Yde 1988; Seil et al. 1998; Wedderkopp et al. 2003).





# Adult Injuries

- Elite level players during major international tournaments (2002 women's European Championship, 2003 women's World Cup, 2001 and 2003 men's World Cup, 2004 Olympics – M and W)
- The competition injury rate was 89–129 injuries per 1,000 match hours for M and 84–145/1,000 match hours for F (Langevoort et al. 2007).
- For comparison, Ekstrand et al. studied highest level of professional football play (the UEFA injury study) and reported that the acute injury incidence was 27.5 injuries/1,000 match hours (Ekstrand et al. 2009).

# Adult Injuries

- Injury incidence per match per player was 1.2 for M and 2.0 for F (Langevoort et al. 2007).
- Time-loss injuries - 31–40 / 1,000 h for M and 13–36 / 1,000 h for F (0.6 and 0.5 injuries per match per player for M and F, respectively).



# Adult Injuries

- 2008 - 58 injuries in 334 players (M & F) (17.4 %). Estimated incidence of time-loss injuries was 13.4 %. (Junge et al. 2009)
- 2012 – 76 injuries in 349 players (M & F) (21.8 %). A total of 32 injuries 139 (9.2 %) caused >1-day time loss and 16 (4.6 %) led to more than 7 days time loss.
- 171 F players - 45 injuries (26.3 %) were recorded of which 10 (5.8 %) were >7 days time-loss injuries.
- 142 M players, 31 injuries were recorded, of which 6 (3.4%) were >7 days time-loss injuries. (Engebretsen et al. 2013).

**Table 2** Injury rates from men's elite-level international competitions

Location	Male						Female					
	WC 2001 (men)	WC 2003 (men)	Olympics 2004 (men)	Euro 2008 (men)	Euro 2010 (men)	Avg. (%)	Euro 2002 (women)	WC 2003 (women)	Olympics 2004 (women)	Euro 2008 (women)	Euro 2010 (women)	Avg. (%)
Head and neck	11 (11.0 %)	30 (28.0 %)	15 (32.0 %)	3 (6.4 %)	11 (24.4 %)	20.4 %	15 (29.0 %)	30 (29.0 %)	23 (35.0 %)	13 (24.6 %)	19 (22.3 %)	28.2 %
Shoulder, arm, and elbow	21 (22.0 %)	21 (19.0 %)	10 (21.0 %)	5 (10.6 %)	5 (11.1 %)	16.7 %	8 (16.0 %)	18 (17.0 %)	7 (11.0 %)	6 (11.3 %)	10 (11.7 %)	13.4 %
Hand and finger	8 (8.0 %)	10 (9.0 %)	4 (9.0 %)	11 (23.4 %)	8 (17.8 %)	13.4 %	3 (6.0 %)	13 (12.0 %)	2 (3.0 %)	9 (17.0 %)	6 (7.3 %)	9.1 %
Trunk	16 (17.0 %)	14 (13.0 %)	5 (11.0 %)	3 (6.4 %)	2 (4.4 %)	10.4 %	4 (8 %)	20 (19.0 %)	12 (18 %)	6 (11.3 %)	19 (22.3 %)	15.7 %
Leg	13 (14.0 %)	1 (1.0 %)	3 (6.0 %)	10 (21.3 %)	14 (31.1 %)	14.7 %	3 (6.0 %)	3 (6.0 %)	3 (5.0 %)	11 (20.8 %)	15 (17.5 %)	11.1 %
Knee	15 (16.0 %)	15 (14.0 %)	5 (11.0 %)	6 (12.8 %)	2 (4.4 %)	11.6 %	5 (10 %)	12 (11.0 %)	10 (15.0 %)	4 (7.5 %)	6 (7.0 %)	10.1 %
Foot and ankle	9 (9.0 %)	17 (16.0 %)	8 (17.0 %)	6 (12.8 %)	3 (6.8 %)	12.3 %	7 (14.0 %)	15 (14.0 %)	5 (8.0 %)	4 (7.5 %)	10 (12 %)	11.1 %
<b>Total</b>	<b>92 (100 %)</b>	<b>106 (100 %)</b>	<b>48 (100 %)</b>	<b>47 (100 %)</b>	<b>45 (100 %)</b>		<b>50 (100 %)</b>	<b>98 (100 %)</b>	<b>63 (100 %)</b>	<b>53 (100 %)</b>	<b>85 (100 %)</b>	

Data based on Langevoort<sup>14</sup> and Holdhaus<sup>54–57</sup>

WC World Championships, EC European Championships

## Injury and illness surveillance during the 24th Men's Handball World Championship 2015 in Qatar

Tone Bere,<sup>1,2</sup> Juan-Manuel Alonso,<sup>1</sup> Arnlaug Wangensteen,<sup>1,2</sup> Arnhild Bakken,<sup>1,2</sup> Cristiano Eirale,<sup>1</sup> H Paul Dijkstra,<sup>1</sup> Hosny Ahmed,<sup>3</sup> Roald Bahr,<sup>1,2</sup> Nebojsa Popovic<sup>1</sup>

- 2015 Men's WC (Qatar): 24 teams, 384 players (325 compliance = 96.7%)
- 132 injuries, 27.1%.
- Most – match injuries (n=122)
- Match injuries per 1000h = 104.5, 1.4 per match
- 50.5/1000h time-loss injuries, 0.7 per match

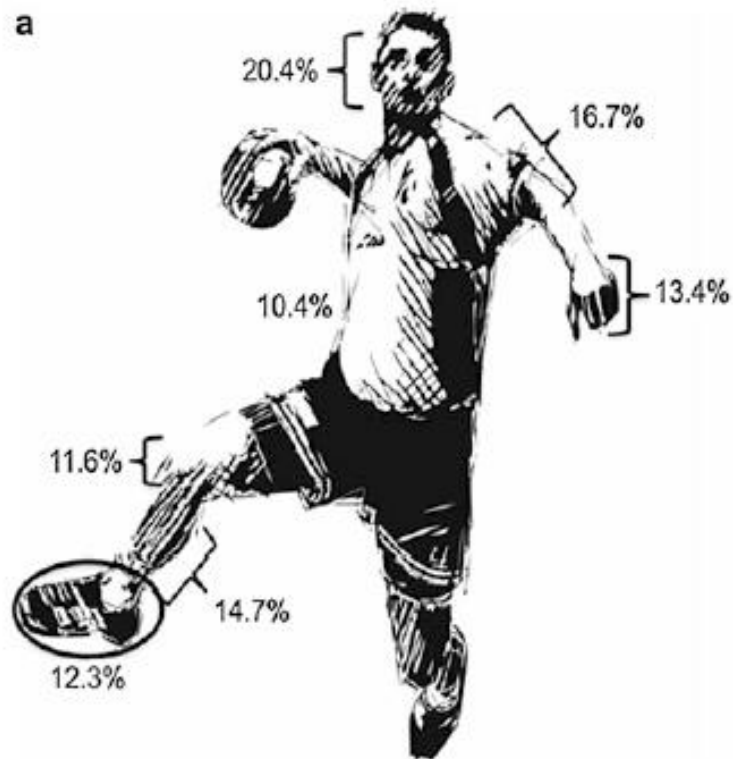
# Youth Injuries

- Injury rates in youth team handball seem to be similar - estimated between 8.9 - 14 injuries/1,000 match hours and 1.7–4.3 injuries/1,000 training (Nielsen and Yde 1988; Backx et al. 1991).
- A prospective study in Norway - 428 players (aged 15–18 years) in 25 F and 9 M teams Recording all injuries (not only time-loss ones).
- Match injury rates - 8.3 injuries/1,000 h in M and 10.4 injuries/1,000 h in F;
- Training injury rates - 0.6 injuries/1,000 h and 1.0 injuries/1,000 h, respectively (Olsen et al. 2006).

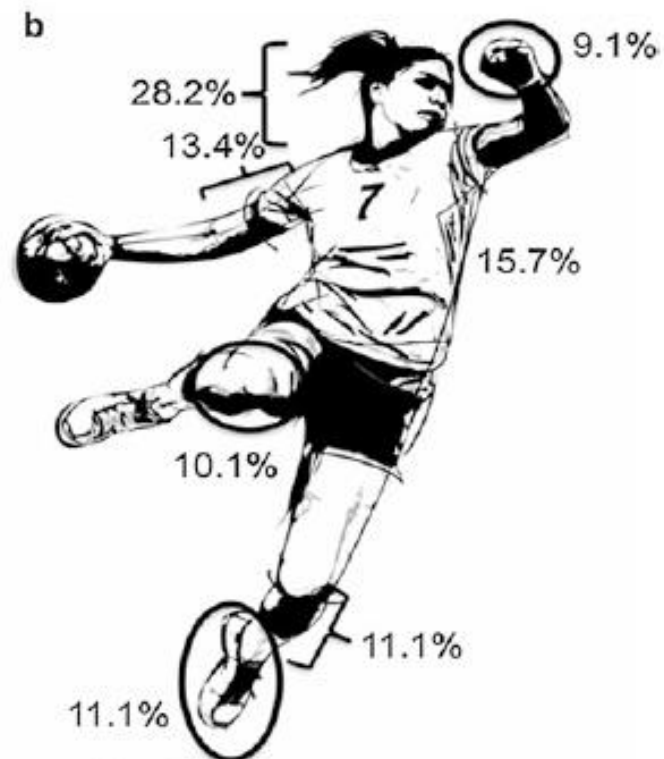
# Gender Differences

- Analyzing only time-loss injuries data – significant gender based differences are found only at the national team level (Langevoort et al. 2007, Holdhaus – 2008,2010)
- When focusing on ACL injuries – women have been found to have an incidence 3-5 times higher than men (Lindenfeld et al. 1994, Bjordal et al. 1997, Myklebust et al 1997, 1998)

a



b



Injury frequency in males (a) and females (b) based on data from elite-level international competitions



# Factors

- Smaller size of ACL
- Smaller intercondylar notch
- Larger Q-angle ?
- Weaker hamstrings
  - Ratio of 10 (quadriceps) to 7 (hamstrings)
- Hormones
  - Estrogen – reduces collagen strength
  - Relaxin

Figure: Mary Albury-Noyes

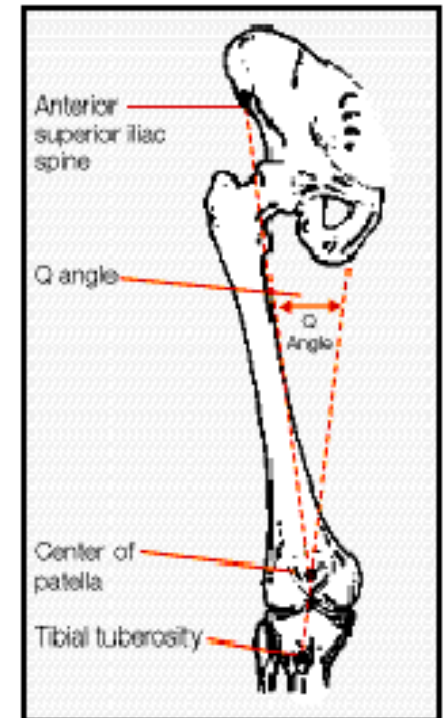


Figure 2. Anatomic landmarks for establishing the quadriceps angle (Q angle). There is no apparent relationship between Q-angle and ACL injury.

# Match vs. Training Injuries

- Match injury incidence is significantly higher than training injury incidence (Yde and Nielsen 1990; Backx et al. 1991)
- **Why?** Play and contact intensity
- This is accentuated in the highest level competitions like Olympic tournaments and European and World Championships (Langevoort et al. 2007).

# Injuries According to Player Position

- Most injuries occur on offense, with reports ranging from 52%
  - 86% (Leidinger et al. 1990; Seil et al. 1997; Asembo and Wekesa 1998; Oehlert et al. 2004).
- Seil et al, looked at 186 players (male) in 16 senior German teams over a year:
  - Wing players sustained 36 %, 33 % of all injuries to backcourt players, 19 % happened to line players, and goalkeepers sustained 12 % of the injuries.



# Injuries According to Player Position

- Other studies, however, have noticed that backcourt players were more at risk for injury (Jorgensen 1984; Frobose et al. 1996).



# Injuries According to Player Position

- high incidence of injuries among back players was also reported earlier by Fagerli et al. (1990).
- Piry et al. (2008 Asian Handball Championships) found 60.3 % of injuries occurred to back players, whereas only 12.7 % occurred to the wing players and 11.1 % to the line players (pivot) (Piry et al. 2011).
- Back players injuries seem to be even higher in studies involving elite players (Myklebust et al. 1998).
- **Why?** the majority of ball movements in the offense is done by back players who perform a substantial amount of planting and cutting movements and jump shots.

In addition, they are involved in more aggressive contact than players at other positions, normally facing the biggest and strongest defenders in the opposing team.

# Injury and illness surveillance during the 24th Men's Handball World Championship 2015 in Qatar

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**Table 1** The total number of injuries reported (n=132), as well as match injuries only (n=122), match exposure (number of player-hours), and match injury incidence (injuries per 1000 player-hours) for each of the player positions

Player position	All injuries		Match injuries		Exposure Player-hours	Match injury incidence (CI)	
	Total	Time-loss	Total	Time-loss		Total	Time-loss
Wing	32	21	31	20	334	93.0 (60.2 to 125.7)	60.0 (33.7 to 86.3)
Back	48	23	44	22	500	88.0 (62.0 to 114.0)	44.0 (25.6 to 62.4)
Line	36	12	31	11	167	185.6 (120.3 to 251.0)*	65.9 (26.9 to 104.8)
Goalkeeper	9	3	9	3	167	53.9 (18.7 to 89.1)	18.0 (-2.4 to 38.3)
NA	7	3	7	3	–	–	–
Total	132	62	122	59	1168	104.5 (85.9 to 123.0)	50.5 (37.6 to 63.4)

\*Relative risk line versus goalkeeper: 3.44 (1.64–7.24).

NA, not available.



# Injury Mechanisms: Contact vs. Non-contact

- Most injuries in elite handball - player-to-player contact.
- Top competition level - contact injuries represent 80 % - 92 % (Asembo and Wekesa 1998; Oehlert et al. 2004; Langevoort et al. 2007).
- Noncontact injuries mostly are related to the lower extremities and in general are more severe (i.e., ACL injuries).
- ACL injuries - noncontact mechanism in the majority of cases when the player is performing a plant and cut maneuver or landing after a jump shot (Myklebust et al. 1997, 1998, 2003).



# Time of Injury During Matches

- A higher injury incidence was found during the 2nd half with increasing player's fatigue and intensity of close matches (Dirx et al. 1992, Asembo and Wekesa 1998).
- Langevoort et al. reported 45 % of the injuries occurred in the middle 10 min of each half and decreased toward the end (Langevoort et al. 2007).
- The majority of match injuries were shown to occur during offensive plays (Leidinger et al. 1990; Frobose et al. 1996; Seil et al. 1998).
- 77 % to 92 % of injuries occurring during the offensive phase of play (Wedderkopp et al. 1997, 1999; Olsen et al. 2003; Wedderkopp et al. 2003).



# Injury Type - Acute Injuries

- The majority of injuries reported in handball, both in adults and adolescents, are acute injuries.
- International championships - contusions are the most common injury type (44 % and 60 %) followed by muscle strains and ligament sprains (7–27 %)
- Some studies show sprains are the most common injury type (46–68 % of all injuries) (Nielsen and Yde 1988; Seil et al. 1998)
- Fractures and dislocations are usually less common – but exist...

# Overuse Injuries

- Insufficient data regarding overuse injuries in handball
- However, we know the truth...
- Incidence of overuse injury to the shoulder of German players was reported to be 40 % (von Gohlke et al. 1993).

# Overuse Injuries

- Common locations - knee (26.9 %) and ankle (20.3 %), but also handball-specific injuries as “throwing shoulder” and “throwing elbow” accounted for 17.1 % and 11.9 % of the overuse injuries (Leidinger et al. 1990).
- Tyrdal and Bahr stated that 41 % of 729 (male and female) goalkeepers reported current elbow injuries (Tyrdal and Bahr 1996) - termed “handball goalie’s elbow” resulting from repeated elbow hyperextension trauma.
- “Jumper’s knee” among elite athletes from different sports - prevalence among male handball players was 30 % and 10 % among females (Lian et al. 2005).



Moller et al. Distribution of overuse injuries among 517 male and female youth and senior elite handball players.

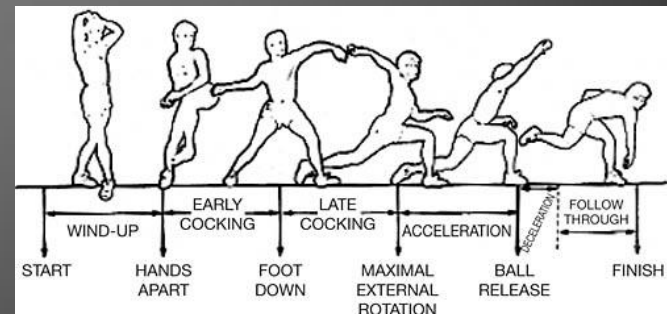
# Anatomic Location - Head and Neck

- A high number of injuries to the head and neck (minority are concussions; most are contusions; Tooth fractures – mouthguards?)
- 34% - 43 % of injuries among males involving the head and neck (Asembo and Wekesa 1998 - African championship, Oehlert et al. 2004)
- Similar numbers from the 2003 WC and the Olympics in 2004 (28 % and 32 %) (Langevoort et al. 2007)
- Women's Euro 2008 – 24.3%, 2010 – 22.3%
- Men's Euro 2010 – 24.4%



# Shoulder Injuries

- Handball players perform up to 48,000 throws per year (Langevoort 1996).
- Most severe acute shoulder injury in handball is Gleno-humeral dislocation - not encountered often.
- The throwing arm is frequently and unexpectedly opposed or blocked by an opponent, causing repetitive microtrauma to the capsulolabral structures of the shoulder.
- The forces encountered by a player's shoulder affect the joint, especially during the cocking phase of the throw





# Shoulder Injuries

- Unsurprisingly most acute shoulder injuries occur to players who throw most (backcourt and wing players).
- The incidence of acute or chronic shoulder pain in handball players has been reported to range between 30 % and 57 %  
(Konig et al. 1996; Pieper 1996; Myklebust et al. 2013).



# Shoulder Injuries

- Prevalence and consequences of shoulder pain among Norwegian female elite handball players (179 players from all 12 teams of the Norwegian elite league) (Myklebust et al. 2013):
  - 57% of all players reported previous or current shoulder pain at the time of evaluation
  - Positive apprehension and relocation tests were recorded by 29% (n = 51) of all players and among 60 % of players with pain at the time of evaluation.
- Seil et al. identified the shoulder as the most common site for overuse symptoms (Seil et al. 1998).



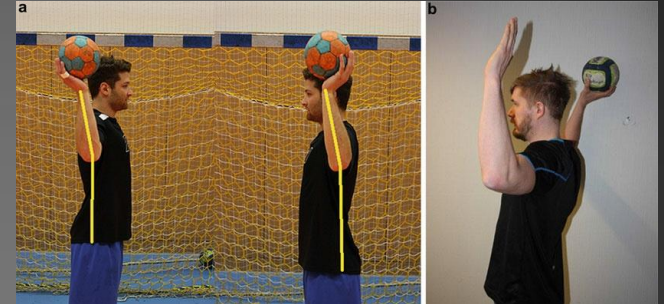
# Shoulder Injuries

- Jost et al. evaluated the shoulders of 30 professional handball players and 20 randomly selected volunteers using MRI and correlated imaging and clinical findings.
- Abnormal MRI findings were found in 93 % of the throwing shoulders, but only 37 % were symptomatic.
- Typical asymptomatic MRI findings included: tendinopathies, partial RC tears, postero-superior glenoid impingement, and impressive supero-lateral osteochondral defects of the humeral head; 71 % of the throwing shoulders with osteochondral defects were asymptomatic (Jost et al. 2005).



# Shoulder Injuries

- An increase in max. external shoulder rotation of about 10–15° in the throwing arm can be found in the majority of players, compared to the non-dominant side (Pieper 1994).
- a considerable reduction of maximal internal rotation of the dominant arm was also observed (GIRD)
- ER/IR ratios were found to be lower for dominant vs. non-dominant side.
- A higher injury risk was associated with imbalanced muscular strength profile.



# Elbow Injuries

- Goalkeepers suffer a much higher incidence of elbow injuries compared to other positions
- “Handball goalie’s elbow” – caused by repeated elbow hyperextension trauma
- Elbow problems were found in 41 % of 729 goalkeepers in the top four divisions (both genders) (Tyrdal and Bahr 1996).
- 1 out of 3 goalkeepers suffered from overuse symptoms at the elbow (Seil et al. 1998).
- Consistent with other sports as: Tennis, golf, baseball.



# Elbow Injuries

- Popovic and Lemaire evaluated 30 elite goalkeepers compared to a control group of 30 age-matched subjects from the normal population (Popovic et al. 2001).
- Radiographes: Osteophyte formation in 67%, loose bodies in 5.5 %, and peri-articular calcification in 5.5 %.
- Significantly greater differences in medial joint space opening between stressed and unstressed elbows (in both elbows) compared to the controls.
- US findings - thickening of the medial collateral ligament in 50 %, thickening of the triceps tendon in 11 %, and ulnar neuritis in 22 %.
- Intra-articular effusion was found in 66 % and small loose bodies in 33 %.



# Lower Extremity Injuries

- Most studies show that most acute injuries in handball involve the lower extremities, regardless of age and gender (Nielsen and Yde 1988; Fagerli et al. 1990; Dirx et al. 1992; Wedderkopp et al. 1997, 1999, 2003; Seil et al. 1998; Reckling et al. 2003).
- The most frequent injuries reported in handball are to the ankle (8–45 %), while the most severe injuries are to the knee (7-27%)

# Lower Extremity Injuries

- In major competitions the incidence of lower extremity injuries in men was 42 %: 13% Knee injuries of all injuries, while 11 % were ankle (Langevoort et al. 2007).
- Seil et al. reported an incidence of 54 % of all injuries to the lower extremity with knee injuries being more frequent than ankle injuries (Seil et al. 1998).
- Knee injuries typically are severe causing the longest absence from sport (Nielsen and Yde 1988; Seil et al. 1998).



# Anterior Cruciate Ligament (ACL) Injuries

- One of the most severe injuries in handball
- A study in top-level players in Norway over 10 seasons (1979 to 1989) - incidence of ACL injury was found to be highest among women (0.82 ACL injuries/1,000 match hours versus 0.31 injuries per 1,000 match hours (Strand et al. 1990).
- Myklebust et al. recorded ACL injuries during two seasons (1989/1990 and 1990/1991) in Norwegian elite handball players: (Myklebust et al. 1997)
  - They found the match injury rate for men to be 0.54 injuries/1,000 match hours and 1.62/1,000 h for women (3 x the rate for men).
  - At the second division, the rate for men was found to be 0.84 injuries/1,000 match hours and 1.82/1,000 h for women (2.2 the rate for men).
  - At the third division, 0.27/1,000 h for men and 0.72/1,000 h for women (2.7 the rate for men)



# ACL Injuries

- Another study in 24 Norwegian elite teams over three seasons (seasons 1993/1994 through 1995/1996) - recorded a total of 5 ACL injuries in men and 23 in women (Myklebust et al. 1998).
- The overall rate of ACL injury was calculated to be 0.06 0.03 injuries/1,000 activity hours for men and 0.31/1,000 h for women.
- A fivefold higher overall risk for ACL injury among women compared to men and a nearly sevenfold higher risk of match injury in women.
- Reasons? intrinsic (e.g., anatomic, strength, coordination, hormonal, level of skill, and conditioning) and extrinsic (e.g., shoe and surface type)



# ACL Injuries

- Practically - an international elite team: Avg. 6–10 h of pure handball training weekly + Other physical conditioning and training and approx. 2 matches a week adds to this.
- About 300 h of handball training and 80 matches a year.
- 80-90 matches = approx. 560 h of exposure per team.
- With the incidence of 0.54 ACL injuries/1,000 match hours found at the highest performance level by Myklebust et al. in 1997 - this translates to 0.3 ACL injuries in matches per team over a competitive year





# Ankle Injuries

- The majority of these studies indicate the ankle is the most frequently injured area with incidences ranging from 8% - 45%
- In major elite-level competitions, however, the percentage of foot and ankle injuries was found in the lower end of that range



# Ankle Injuries

## Why?

- Amount of jumping involved in the game is significant at both ends of the court
- The most common jumping technique in handball is a single leg jump with most players landing on a single leg = high propulsive and impact loads on one leg
- Contact often initiated in the air where even slight contact might tilt the player off balance - increasing the risk of an off-balance landing



# Summary

- Important to note - these reports (and most other studies) do not take into account the minutes played by the injured player in that specific match, the same week, or even up until that phase of the season and therefore should be looked at carefully.

# Summary

- The majority of injuries occur during matches when compared to training
- Higher injury incidences exist at higher performance levels
- Lower extremities account for most of the acute injuries, followed by injuries of the upper extremities and head injuries.
- Sprains and contusions are the predominant injury types.
- Knee injuries represent by far the largest share of severe injuries.

# Summary

- Women are clearly more vulnerable to knee injuries, in particular to ACL ruptures.
- Backcourt players seem to sustain more injuries compared to other player positions.
- The majority of injuries in handball are contact induced

# Summary

- The game of handball is constantly growing in popularity
- The natural evolution of the game of handball has resulted in more intense competition at the top levels.
- Greater intensity and frequent matches played in multiple competitions (with less recovery time between matches) puts the players at high risk for injuries.
- Finding and implementing strategies to prevent and lower injury rates, as well as a good and continuous medical coverage for handball teams is essential.



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