

Preventing injuries in handball

Purpose

The purpose of this policy briefing is to highlight the main risks involved in handball and to give an overview of promising measures and implementation strategies for reducing handball injuries in number and severity of their outcome.

It also presents preliminary results of a pilot project in implementing a set of most promising measures adapted to local needs and opportunities. This pilot, which has been part of a EU-sponsored project called 'Safety in Sports', has been carried out in collaboration with the European Handball Federation and two of its member associations, the Norwegian and Czech Handball Federation.

This policy briefing summarises the results of this project as to the prevention of injuries in handball. It has been developed for national handball federations and local associations and is in particular addressing coaches and officials. This with the view to assist them in developing and implementing safety management schemes in clubs and their national federation and to encourage coaches as well as athletes to apply the appropriate safety measures in a consistent and systematic manner. More detailed information as to the methodology, results and literature used can be found in the reports listed on the last page.

Key messages

- Handball is characterized by intense body contact, frequent intermittent running, demanding one-on-one situations, quick direction changes in combination with challenging technique and coordination elements like catching, throwing, passing and dribbling.
- The overall incidence of an injury in handball is around 2 injuries over 1000 hours of training and playing. In competition matches the incidence is at least 10 times higher than in training, depending on age, gender and performance level. It is estimated that in Europe at least 320,000 handball related injuries occur each year at a cost of up to 400 million for medical treatment only.
- Most of the injuries happen during matches, in particular in one on one situations, i.e. by body contact. Lower extremities account for most of the injuries, followed by head injuries and injuries of the upper extremities. Sprains and contusions are the predominantly injury types. Injuries of the lower extremities often result from non-contact situations.
- Knee injuries represent by far the largest share of severe injuries. It has been shown that women are clearly more vulnerable to knee injuries, in particular to ACL-ruptures.
- In general backcourt players seem to be more prone to injuries compared to other player groups.
- For maximum performance and ability to cope with the challenges of the game it is essential that players have an excellent condition of athletic fitness. Proper balance, coordination and technique skills are essential for preventing injuries of the lower extremities. Considering upper body regions core stabilisation, flexibility and basic and advanced coordination and technique skills are essential.
- The use of protective devices is also strongly recommended such as mouth guards, ankle braces and knee orthoses, certainly in case of previously sustained injuries.
- Despite efforts to promote injury prevention in handball, the challenge is to get the appropriate measures being accepted by athletes, coaches and officials and to ensure compliance on the long term.
- As the primary goal of sportsmen and women is to maximise their performance, preventive measures can best be integrated as a standard component in sport-specific performance enhancement programmes. This will increase the chances of successful and sustainable inclusion of injury prevention measures in training and coaching.
- And last but not least, all injury incidents should be reported to trainers and coaches and should be systematically recorded by trainers and coaches, in order to identify individual and situational risk factors, to monitor injury trends at club and national level and to evaluate effects of measures taken.





The game

Handball is a so-called transition game, as players are frequently switching between defensive and offensive play. The game action is characterized by frequent intermittent running and sprinting. There are only a few breaks during the game and players are repeatedly substituted in order to allow regeneration.

Motion-analysis has shown that depending on playing-time and playing position handball players cover a distance of up to 6.5 km per game. The match level of play includes running forwards, backward and sideward, planting, cutting, feints, jumps, landings, turns usually in combination with moderate or intense body contact due to repeated one-on-one situations. Therefore, players need a proper athletic condition with regard to strength, agility, acceleration, deceleration, jumping and throwing power.

It is evident that the physiological requirements in handball are quite high, calling for considerable demands of cardiovascular and metabolic capacities as well as for the musculoskeletal system of players. This implies that players with bad athletic condition have a stronger predisposition for suffering injuries.

Injury characteristics

In general terms we have to make a distinction between acute/traumatic and chronic/overuse injuries. Acute/traumatic injuries result from a specific, identifiable event whereas chronic/overuse injuries are caused by repeated micro-traumas without a unique identifiable event responsible for the injury. Although chronic injuries, in particular shoul-

der pain in field players and elbow injuries among goalkeepers, are not uncommon in handball, minor injuries and overuse injuries are not so well recorded in hospital records, insurance statistics or in national surveys that commonly focus on the more acute injuries which are immediately recognisable by athlete, team partners and coaches.

Therefore the injury characteristics described in this section predominantly relate to acute injuries.

The overall incidence of an injury in handball is around 2 injuries over 1000 hours playing or training time. Professional athletes show notable higher incidence rates than semi-professionals or amateurs.

Taking into account the number of 2.4 – 4.8 million regular players in Europe and assuming an overall incidence of 1-2 injuries per 1000 hours exposure and an average 90-100 hours participation a year for each athlete, the total number of handball injuries can be estimated at least 320,000 a year. The total medical costs of these injuries are estimated at 400 million euro a year, half of these costs being related to knee injuries.

About two third of all injuries occur in competition and one third during training exercises. Injuries in competition gain more significance with advanced age and performance level, even though more time is being spent in training compared to time spent in competition. With respect to specific injuries it is striking, that in particular knee injuries seem to have a significant higher incidence rate in match play.

Although there is no significant difference between men and women in the overall injury incidence rates, women are clearly more vulnerable to specific injuries than men. Women have a significant higher risk to ACL injury than men.



Body parts injured in males (left) and females (right)



Most injuries affect knees or ankles of handball players, followed by hands and heads. Younger athletes seem to be more prone to injuries of the upper body regions, especially finger injuries, whereas with advancing age there is an increase in injuries of the lower extremities, in particular in knee injuries. Almost half of all injuries in the group of players under 14 years of age relate to hand/wrist or head. In contrast almost one third of all injuries in adults are knee injuries.

The most common acute injuries are sprains, with knee, ankle and fingers being the most affected body parts followed by contusions and strains. In elite tournaments contusions are more common than in play at amateur level. Fractures and dislocations are quite rare. However, younger athletes are typically more vulnerable to fractures than older athletes, in particular to finger, wrist and forearm fractures.

Chronic injuries usually result from repetitive stress on biological tissues such as capsules, ligaments or tendons, leading to instabilities of the affected joints. In handball, the most common overuse injuries are lower back pain -probably due to muscular imbalances-, periostitis, shoulder pain and elbow pain. In particular goalkeepers frequently experience elbow pain caused by repetitive hyperextension traumas resulting from frequent ball blocking.

Circumstances

Most players get injured in *contact situations*. In general players in offensive actions are more at risk than defence players. Half of all injuries in matches are due to contact with opponents whilst in training only one out of five injuries occur in contact situations. The share of contact injuries is even higher during major international tournaments. In the majority of cases injuries occurring in contact situations affect the upper body, in particular head and fingers.

Non-contact injuries mostly are related to the lower extremities and in general those injuries are more severe. Jumping, landing and cutting manoeuvres while running are the predominant situations leading to non-contact injuries.

Several studies have indicated that female, particularly young female athletes are at greater risk of ACL ruptures, possibly due to

deficits in neuromuscular control as well as a greater joint laxity and less muscular stiffness. However, there are no hard facts as to differences in athletic condition, e.g. in terms of muscle strength, between female and male athletes in relation to injury risks. As artificial floors have a higher friction factor they may also increase the ACL injury risk.

Injury incidence rates vary for the players position. For instance, attacking backcourt players seem to be more frequently affected by injuries, followed by pivot players and central defenders. Pivot players, playing at a position with a high risk of forceful physical contact, have a high share in head injuries.

Considering these risk factors, it would be appropriate to educate players in successfully managing contact and non-contact situations, to improve typical basic motor patterns such as jumping, landing and cutting – also in combination with body contact control –, to improve their general fitness level and to ensure that time is taken for sufficient regeneration and rehabilitation from injury.

Prevention approaches

In general, measures aiming at preventing sport injuries can be roughly divided into four more or less distinct categories, namely into measures focusing on ‘training and physical preparation of handball players’, ‘technical and political approaches’, ‘adaptation of equipment and facilities’, and ‘medical and non-medical measures’. In practice, most programmes rely on a mixture of approaches, so-called ‘multifaceted approaches’.

A literature search identified over one hundred preventive recommendations in 75 publications related to preventing injuries in handball. Most of these journal articles and publications originate from Germany, Denmark, Norway and Sweden, i.e. countries where handball enjoys great popularity and hands-on experience in coaching and in managing this branch of sports.

Almost half of the published recommendations were based on strong scientific evidence, all others were at least based on expert opinion.

In order to better assess the value of the conclusions and recommendations from the literature survey, a selected group of experts in



the field was invited to review each of the publications on three criteria:

- potential effectiveness of recommended measure or programme in terms of expected contribution to the reduction of injuries in number and/or severity;
- potential applicability of measure in term of required efforts for implementation (e.g. time, money, infrastructures, competencies); and
- potential acceptance by athletes, coaches and associations and expected level of compliance on the longer term.

The feedback from the consulted experts has led to a reduced list of recommended practices that seem to be promising as to their actual contribution to injury reduction and the potential of being accepted and applied in a sustainable manner in day to day practices and training of handball players.

Experts opinion

In general it is advised that training sessions should be tailored towards the players desire to enhance performance and at the same time address the known high risk injury situations, in particular contact situations with opponents, and injury mechanisms. Athletic training and coordination, e.g. strengthening, stabilization and proprioception, contributes to performance enhancement as well as injury prevention. The correct technique should be trained in handball movement patterns that frequently lead to injuries, e.g. jumping, landing and feints.

More specifically the following (mixtures of) approaches are to be considered while developing training and handball practicing programmes:

- Exercises to improve landing, jumping, cutting and planting technique. In addition, balancing and strengthening exercises are advised. Proper technique and discipline is essential and exercises should be supervised by the coaches.
- Structured warm-up programmes including agility, balance, strength and playing technique exercises, designed to improve knee and ankle control during landing and pivoting movements. It is suggested to start

programmes focusing on technique (cutting and landing movements) and balance training (on wobble boards, mats or similar equipments) in players aged 10-12 years and to continue in adolescents and adults.

- Structured warming-up and mobilisation before training and matches, improving the flexibility, core stability and handball specific coordination, and with due care for appropriate shoes and flooring.
- Regular application of balance, coordination, jump and strength exercises as part of warm-up routine in handball training (pre-seasonal, season-attending) to prevent knee and ankle injuries in particular among female athletes: “Knee over toe” technique.
- Prevention of ACL injuries through neuromuscular training in female elite team handball players. Success depends on full compliance of players with training schedule.
- Training programme of basic exercises dealing with stabilisation of the core and shoulder girdle, balancing and coordination practices and proper jumping and landing technique. It is recommended to pick up 5-6 exercises per session covering knee and shoulder stabilisation and coordination elements as integral part of the warm-up routine. During pre-season the programme should be included in each session, during regular season twice a week.
- Neuromuscular training may assist in the reduction of ACL injuries in females athletes if (a) plyometrics, balance, and strengthening exercises are incorporated into a comprehensive training protocol; (b) the training sessions are performed more than 1 time per week; (c) the duration of the training programme is a minimum of 6 weeks in length.
- Preventive training programmes should include strength and power exercises, neuromuscular training, plyometrics and agility exercises: They should be integrated into warm-up routine of the regular training.
- Neuromuscular training increases EMG activity for the medial hamstring muscles, thereby decreasing the risk of dynamic valgus. This observed neuromuscular adaptation during side-cutting maneuvers can potentially reduce the risk for non-contact ACL injury.
- Education of correct knee joint position,



exercises from respective exercise groups (balancing, strengthening and technique training) is advised to be applied during each session of the first eight weeks of training. Followed by once a week in the course of the season.

- An appropriate warm-up including activation, mobilisation/stretching and preventive exercises (e.g. proprioception, balancing) should be part of each training session. In addition, a regular structured prevention programme containing (a) basic strengthening (b) advanced strengthening with integral technical, coordinative and cognitive handball elements (c) an individual / position-specific preparation for typical injury mechanisms should be applied. Frequency, intensity and contents depend on season phase and individual status of athlete.

Sustainability and compliance (e.g. acceptance among athletes and coaches) are essential criteria for a successful programme. Ideally, these prevention programmes should be introduced as early as possible in the training career, starting at the age of 6–10 years.

How to get the right mix of interventions?

In team sports, coaches play a decisive role in translating the prevention evidence into practice as they are the most promising mediators in promoting training and physical preparation programmes and for integrating safety aspects within current training and practices.

In order to successfully enhance training and coaching schemes in view of injury prevention, it is essential to understand the perception and knowledge of these practitioners as to the injury problem itself as well as their perspectives of handling the problem within existing organisational structures and capacities.

In the framework of the Safety in Sports-project (see acknowledgement section), collaborations could be established with the Norwegian and Czech Handball Federation. Both federations one could already build on certain structures in the field of coaches' education and injury prevention. In Norway, the Oslo Sport Trauma Research Centre and the Norwegian Handball Federation are collabo-

rating in designing injury prevention programmes which are promoted through a website for clubs, coaches and athletes. In the Czech Republic the education of handball coaches is being organized by the Faculty of Physical Education and Sport at the Charles University Prague, which is strongly linked to the Coaches' and Methods Commission of the Czech Handball Federation. In both federations injury prevention has not yet been integrated as a core component in the curriculum for coaches and trainers.

These federations were invited to have coaches and officials participating in surveys that aimed to better understand their views and support needs. Many coaches positively responded to that invitation, more than one hundred in each of the two countries. These coaches were also involved in developing tailor made set of promising prevention strategies, measures ('national toolkits') and promotion strategies, and in pilot testing these toolkits within their respective clubs.

Awareness and current practices

These surveys showed that nearly 75% of Norwegian and Czech handball coaches regard injury risks as a major problem for their team. They point at poor physical preparation, lack of regeneration / rehabilitation and insufficient warm-up as main causal factors in injury, and they believe that better athletic preparation and prevention programs will lead to less injuries in handball.

They focus now their prevention measures on warming up, stretching and strengthening, and sometimes coordination and balance exercises, but they are looking forward to support in preventing knee, ankle, shoulder as well as wrist and finger injuries. Also taping and use of orthoses are being promoted, but the main challenge in their view is acceptance and compliance by players themselves.

When informed about the feasibility of implementing the recommended practices, the coaches and officials underline that poor physical condition and insufficient training levels are the predominant intrinsic injury risk factors and therefore training schemes shall be enhanced with proper safety promotion procedures.

Also the education of coaches should be reinforced in view of injury prevention: the integration and improvement of injury prevention



contents into the regular national coaches' education curriculum is seen as urgently needed.

Pilots

Both federations and their volunteers were involved in critically reviewing the evidence based recommended practices and in assessing the applicability and acceptability of these practices within their federation. Based on the results of that review, a draft toolkit of promising injury prevention measures was made for each of the two federations for integration in current programmes offered by the national federations to their coaches and into the training practices of the involved coaches. This process included a couple of consultation meetings with the respective national handball associations, consultations with national experts and the organisation of coaching clinics and training seminars in the respective two countries.

This resulted for both countries into the delivery of a set of 'tailor-made' products and services. In Norway seminars about injury prevention for coaches possessing coaching license 4 were held and a program for young players was developed containing selected exercises for preventing injuries and learning to use the right technique. Information was disseminated through the national handball magazine and the website 'skadefri', including videos with recommended exercises. In the Czech Republic assistance was provided to the existing training courses of trainers and additional print and video materials were developed.

A baseline and follow up survey was carried out to assess the impact of the pilot programme on the attitude of coaches as well as their training practices. The results of these pilot-projects are encouraging:

- Through the pilots, coaches became more aware of the necessity to invest in injury prevention;
- Owing to the pilots, coaches became more willing and able to direct their training practices towards training contents that are more effective in reducing injuries, in particular muscle strengthening and coordination exercises;
- Through the programme, coaches seem to

have found better opportunities to motivate their team members in appreciating and accepting the training practices offered;

- The information provided reached the target audiences very well; and
- Both federations are confident that the pilots will help to anchor injury prevention injury prevention more strongly into their education and training curricula.

What needs to be done?

While taking into consideration the results of the expert consultations as well as the pilot testing of recommended measures, the four components of a comprehensive safety management programme for handball players, to be implemented at national and club level, can be specified as follows:

Training and physical preparation

-Basic physical preparation

Players of all levels and ages need a proper basic athletic condition with regard to endurance, strength, flexibility and speed. On competitive level this is primarily achieved through structured and supervised athletic conditioning programmes that include individually adapted endurance training, functional weight training, dynamic mobilization and agility drills.

- Structured warm-up routines

General cardiovascular activation for 10-20 minutes prior to handball sessions is essential. Beside basic running drills it is strongly recommended to apply neuromuscular, proprioceptive and balance exercises as well as core stabilization and coordination practices. Additionally, plyometrics and agility drills should be included at the end of warming up. Basic handball movement patterns that are linked to increased injury risks can be trained perfectly during warm-ups. This means adding technique exercises that are designed to improve knee and ankle control during jumping, landing and cutting activities.

- Basic and advanced technique training

Proper technique training combines performance enhancement objectives with injury prevention. Good jumping capability is essen-



tial for shooting and blocking. Quick feet are needed for feints, direction changes, turns, starts and stops in defense and offense. Good ball handling helps passing, catching, dribbling and stealing. Proper jumping and landing technique in terms of knee and ankle control help athletes to sustain crucial situations like single-leg landings. Correct ball handling is an important factor to prevent numerous finger sprains and quick and controlled feet assist in coping pivoting movements.

With increasing age and performance level technique training should be adapted to the advanced demands of the athletes. This means for example, progressively adding controlled perturbations (contact) during execution of these movement patterns. Intense physical contact is inherent element of handball and players should get used to it in training to cope with it during competition. Basically, this also helps athletes performing better e.g. better scoring efficiency during contested jump shots (e.g. wing shots, break-through shots).

- Neuromuscular training

Exercises on unstable devices such as wobble boards, slings or mats in combination with core stabilization and plyometrics are effective when conducted regularly (at least 1-2 times per week) during preseason and season. Neuromuscular training contents can be perfectly integrated into warm-up routines, taking into account that this training method has stronger effect in non-fatigued athletes.

Technical and political measures

- Awareness raising

The awareness of prevention as providing a positive contribution to sports performance is a key issue. Individual athletes and coaches should continuously being informed about handball-related risk factors, injury situations and mechanisms as well as about effective, applicable and acceptable countermeasures.

- Adaptation of the education programmes

Athletes and in particular coaches should receive at least a basic education in handball injury prevention. Safety management schemes should be standard element in the current training and education programmes

offered by national handball federations. Integration of 'injury prevention skills' into coaches' certification of all levels and license renewal is desirable.

- Reduction of matches

At professional level, a revision of the competition schedule should be considered in order to reduce the huge number of injuries during and immediately after international competitions.

Next to that, sufficient time for regeneration is key to reduce overuse symptoms and acute injuries due to fatigue or inadequate cured disorders.

Equipment and facilities

- Mouth guards

It is strongly recommended that handball players, in particular pivot and backcourt players wear custom-made mouth guards. Custom-made mouth guards have shown to prevent dental and orofacial fractures.

- External ankle support

It is evident that ankle sprains are at least partially preventable when athletes use ankle braces, orthoses or taping as external protection. Especially, players with a history of ankle injuries should be advised to use external ankle support to prevent recurring injuries.

Medical and non-medical support

- Pre-season screening

At least for professional athletes it is recommended to have regular pre-season screenings to detect potential risk factors for injuries, e.g. cardiovascular problems, muscular imbalances, athletic and neuromuscular deficits. Moreover, performance diagnostics that identify the athletes' individual needs for improvement can assist in increasing physical condition and general performance and thus contribute to reducing acute and chronic injuries.

To conclude

Handball associations and clubs should follow a pro-active strategy as to the risk of injury and communicate with members and the general public openly about risks involved and necessary measures to be taken by clubs and individuals. Players should be provided with



brochures and video productions presenting basic exercises, which should be for instance available for downloading from the EHF's Website and national websites.

Such a pro-active approach will contribute to the positive image of the game and the organisations involved, and will help to attract new members.

It is recommended to have all national associations to include an injury prevention module in their trainer education curriculums and to designate an official staff member as 'safety promotion ambassador' of the federation. And last but not least, all sustained injuries should be reported to trainers and coaches and should be systematically recorded at club and national level, in order to identify individual and situational risk factors, to monitor injury trends and to evaluate effects of measures taken.

References

All information presented in this Policy briefing are based on studies carried out by the Ruhr University in Bochum and published under the titles:

- P. Luig & T. Henke, Inventory of the burden of handball injuries, existing prevention measures and safety promotion strategies, Ruhr University, Bochum, March 2010
- P. Luig & T. Henke, Best injury prevention measures and implementation of strategies in handball, Ruhr University, Bochum, November, 2010
- P. Luig & T. Henke. Luig, Safety management scheme in handball, Implementation and testing, Ruhr University, Bochum, August 2011

For references to sources of information presented in this policy briefing and for further references, readers are advised to consult the above mentioned reports which are accessible through the website:

www.safetyinsports.eu

Acknowledgements

This policy briefing has been produced in the framework of the Safety in Sports project, initiated by the consortium Kuratorium für Verkehrssicherheit (KfV), Ruhr University Bochum (RUB), European Association for Injury Prevention and Safety Promotion (EuroSafe) and Consumer Safety Institute (CSI).



Co-sponsored by the European Commission under the Public Health Programme 2003-2008, and by ARAG Sports Insurance Germany.



The research and piloting activities related to handball have been carried out in close collaboration with the European Handball Federation (EHF) which is the governing body for handball in Europe, the Handball Federation of Norway and the Czech Republic.



Pictures (page 1 and pages on top) by courtesy of the German Handball-Bundesliga (HBL)