7 Summary

Over the last decade, the two top German handball leagues have established themselves as reference classes in international men’s team handball due to their high degree of professionalization and their uniform performance levels compared to other European leagues. The dynamics and physicality of the game have increased remarkably in the course of increasing competitiveness and in the wake of incising rule changes. The game schedule, already tight due the close-knit, international competition calendar, has become even tighter with the introduction of new and reforms of existing competitions. This inevitably increases the burden on athletes, which in turn raises the risk of injury.

The statutory accident insurer of German professional sports, the Verwaltungsberufsgenossenschaft (VBG) [Employers' Liability Insurance], had to react to the rising number of accidents and the associated additional costs for rehabilitation benefits in paid sports by significantly increasing its insurance premiums. By 2016, the premium is expected to rise by another 16% or so. This development has the potential to jeopardize the financial situation of professional clubs, especially that of the less wealthy clubs. Potential consequences under consideration, such as reducing the size of the squads and lowering players’ salaries, can threaten the status of the two German professional leagues outlined above.

There are not enough recent studies on the epidemiology and etiology of injuries in men’s professional handball which necessarily focus on the first two steps in the sequence of systematic sports injury prevention described by van Mechelen et al. (1992), especially with a view to the specificity of regular league play. The aim of this study was therefore to make up for this research deficit and to generate a database that allows the risk and frequency of injuries and the most common injuries and their causes in this special population to be identified, without which it is impossible to derive targeted prevention measures in the first place.

All first and second division handball players who had been entered in at least one competitive match in the official game sheet were therefore prospectively entered in the study and observed over a period of three seasons (2010 - 2013). To this end, the study prospectively surveyed all injuries of these players that were registered with the VBG as part of the occupational accident reporting and that either led to the player’s short-term disability or to medical treatment costs, regardless of whether they led to insurance claims or not. In order to make any statement about the cause of the injury, a systematic, semi-quantitative video analysis of a subgroup of selected acute injuries sustained in competition was also conducted, for which an observation form had been developed earlier that had been evaluated in terms of its intra and inter-examiner reliability.
On the basis of known monitoring tools (Olsen et al, 2004; Andersen et al, 2004; Henke et al, 2005; Henke et al, 2009; Hutchison et al, 2013c.) this video observation form for expert raters was developed in two evaluation phases. Using Cohens- und Fleiss-Kappa (κ) measures for bi- and multi-rater analyses, the concordance analysis with regard to inter- as well as intra-examiner reliability resulted in a very good concordance (κ> 0.8) with the final observation form for 93% of the variables and a good concordance (κ = 0.61 to 0.8) for 7% of the variables. In total the observation form contained 27 variables in five item groups.

During the observation period, 930 of the 1,194 observed players were injured. A total of 5,456 injuries were recorded, of which 56% resulted exclusively in medical expenses and 44% in short-term disability. The prevalence rate is at 77.9%, the overall incidences determined amount to 2.4 injuries per player per season (95% CI: 2.4 to 2.5) or 4.3 injuries per 1,000 hours (95% CI: 4.2 to 4.4). Considering only the injuries that lead to the player’s short-term disability, the so-called time-loss injuries, an overall incidence rate of 1.1 injuries per season and player (95% CI: 1.0 to 1.1) or 1.9 injuries per 1,000 hours (95% CI: 1.8 to 2.0) can be reported.

57.1% of injuries resulted from training, 42.9% from competitive games. The training incidence rate was 2.5 injuries per 1,000 hours (95% CI: 2.5 to 2.6). In contrast, the rate of game incidences is 65.2 injuries per 1,000 hours (95% CI: 62.6 to 67.8). In terms of time-loss injuries, this means a training incidence of 1.3 injuries per 1,000 hours (95% CI: 1.3 to 1.4) and a game incidence of 27.7 injuries per 1,000 hours (95% CI: 25.9 to 29.4).

Injury frequencies, injury incidences and injury risk were higher in the in the first Bundesliga (HBL) than in the second Bundesliga (HBL2). Both prevalence (HBL: 82.7%, HBL2: 73.4%), overall incidences (HBL: 2.7 injuries per player per season [95% CI: 2.6 to 2.8], HBL2: 2.2 injuries per player per season [95% CI: 2.1 to 2.2] and HBL: 4.9 injuries per 1,000 h [95% CI: 4.7 to 5.1 injuries per 1,000 h], HBL2: 3.9 injuries per 1,000 h [95% CI: 3.7 to 4.9]) as well as training incidences (HBL: 2.8 injuries per 1,000 h [95% CI: 2.7 to 2.9], HBL2: 2.3 injuries per 1,000 h [95% CI: 2.2 to 2.5]) and competition incidences (HBL: 73.6 injuries per 1,000 h [95% CI: 69.5 to 77.8], HBL2: 58.1 injury per 1,000 h [95% CI: 54.8 to 61.5]) showed significant differences.

Overall, a slight increase in injury incidence was observed in the last two seasons compared to the first season. In cross-comparison with the two subsequent seasons, the season 2010/2011 showed a lower overall incidence (2010/11: 4.0 injuries/1,000 h [95% CI: 3.8 to 4.2]; 2011/12: 4.6 injuries/1,000 h [95% CI: 4.4 to 4.8]; 2012/13: 4.5 injuries/1,000 h [95% CI: 4.3 to 4.7]).

Prevalence rates were generally very high. The differentiated analysis identified playing position, age and nationality as risk factors in addition to the level of professionalism (league) and the season. Thus, back court players (RR: 1.2 [95%
CI: 1.1 to 1.3]) and pivots (RR: 1.2 [95% CI: 1.1 to 1.3]) had a greater relative risk (RR) of injury than goalkeepers (RR: 1.0). Back court players (RR: 1.1 [95% CI: 1.0 to 1.2]) also faced a greater risk than wing players (RR: 1.0). In U21-players (RR: 1.0), the relative risk of injury was lower than that in players aged 21-25 (RR: 1.3 [95% CI: 1.2 to 1.4]), aged 26-30 (RR: 1.4 [95% CI: 1.2 to 1.5]) and aged 31-35 (RR: 1.3 [95% CI: 1.2 to 1.5]). There was also a greater risk of injury for foreign players (RR: 1.1 [95% CI 1.0 to 1.2]) than for German players (RR: 1.0).

The knee (13.8%), ankle (12.8%) and shoulder (9.8%), followed by the thigh (8.7%), head (8.4%) and hand (8.3%), were the body parts most commonly affected. When using mean short-term disability (STD) as the main, and mean treatment costs (TC) as a secondary criterion, it was striking that knee (STD: 50.1 ± 84.3d, TC: € 2,898 ± 9,076), hand (STD: 37.8 ± 55,8d, TC: € 1,087 ± 5,487) and shoulder injuries (STD: 37.3 ± 60.1d, TC: € 1,519 ± 4,524) on average showed the greatest degrees of severity.

88.8% of injuries were acute injuries, only 11.2% had a chronic onset. The overall incidence of chronic injuries was 0.5 injuries per 1,000 h (95% CI: 0.4 to 0.5) compared to 3.8 acute injuries per 1,000 h (95% CI: 3.7 to 4.0). Within the subgroup of chronic injuries, the shoulder (24.3%) was most commonly affected, before the knee (19.2%) and the back (18.2%).

Overall, contusions (27.1%) and sprains (26.5%) were the most common types of injury, followed by ruptures with 12.2%. Based on the degree of severity, dislocations (STD: 70.7 ± 81.1d, TC: € 3,288 ± 7,461), ruptures (STD: 45.7± 71,8d, TC:€ 3,224 ± 9,091) and fractures (STD: 43.6 ± 52.7d, TC: € 2,461 ± 7,649) had the most severe consequences.

A total of 243 injury situations in league, European Cup, DHB German Cup and German international games were identified and analyzed for the video analysis of the causes of injury. The identification rate was 43.4% of the selected acute, moderate and severe injuries sustained in competition (n=560, STD> 7d, TC> € 1,000).

56.8% of the video analyzed injuries were contact injuries, another 25.1% were indirect contact injuries and 18.1% were non-contact injuries. A foul was observed in 35.8% of cases. 63.8% of injuries were the result of attacking play, 36.2% of defensive play. In 56.4% of cases, the player in possession of the ball injured himself while in 28.8% of cases his direct opponent was affected.

With field players, the throw (33.6%) and tackle (30.9%) were the handball-specific movement techniques that most frequently led to injuries, while with goalkeepers it was the save (90%). Looking at the general motion characteristics, running (33.2%) and landing (27.8%) in field players and landing (50%) in goalkeepers were the main actions leading to injury. As a combined mechanism, one-on-one tackles...
while running (19.3%) and the landing (18.7 %) and airborne phase (6.3%) of jump throws in field players as well as the landing of saves (50%) in goalkeepers were the typical actions causing injury.

While pivots most often injured themselves in a defensive position and through contact, injuries in backcourt players were more often the result of indirect contact and in an attacking position. Injuries to goalkeepers were over-represented in the defensive game. They also suffered non-contact injuries more frequently than field players (chi² [6, 243]=24.75, p≤0.01).

Field players injured themselves during the final thirds of each half in 43.0% of cases, which is disproportionately often. Overall, with 22.4%, most injuries occurred within the last ten minutes of the game (chi² [5, 223]=11.32, p≤0.05).

Two typical accident situations could be identified for knee injuries. First, there are indirect contact situations due to a body check by the opponent, which led to an insufficient, single-leg landing of jumps and subsequently to a twisting of the knee. The second typical injury situation was a non-contact side-cutting movement with ball during body feints, especially if the attacking player is moving faster.

Ankle injuries, however, typically resulted from collisions with the foot of an opponent or teammate when landing a jump, which then leads to supination or eversion trauma.

Acute shoulder injuries were commonly observed as the result of shoulder-to-shoulder and body-to-shoulder collisions, especially during fast phases of the game (Exact Fisher test [45, 243]=53.13, p≤0.05) or after falls on the abducted arm that were preceded by a body check of the opponent.

While injuries to the head and hand were almost exclusively caused by contact during collisions with the upper extremities and torso of the opponent, thigh and lower leg injuries were disproportionately often non-contact injuries without clearly identifiable extrinsic factors. One can therefore assume that these injuries are caused by excessive intrinsic loads on the injured structures.

In General this study shows that men's professional handball is also associated with a high risk of injury in regular league play. In terms of injury incidence and injury risk, the level of play, the tournament, age, nationality and especially the playing position and competition in comparison to training must be considered significant risk factors. In terms of frequency and severity, knee, shoulder, hand and ankle injuries were the most common injuries, which should be given special attention and priority from a preventive perspective. Moreover, the video analysis of injuries sustained in competition made it clear that not only sport-specific, but also position- and injury-specific aspects must be taken into account in order to derive targeted, multidisciplinary preventive measures, which is the third and next step in
the sequence of sports injury prevention as described by van Mechelen et al. (1992). In this context, it is in particular the identified typical injury patterns, which varied as a function of injured body region and playing position, which can provide valuable clues.

In addition to more consequent implementation of preventive interventions with general athletic, sensorimotor and core stabilizing training elements, the undoubtedly performance-determining techniques of throwing and tackling, though at the same time fraught with high injury risk, should therefore be trained according position-specific injury risks. The teaching of adequate jumping and landing techniques, especially under at times difficult conditions involving intense physical contact that are typical for handball, should be a central component of technical training, in particular in the development of young professional players. In the meantime, the consistent use of external ankle stabilization like tape or orthoses appears to be useful as an adjunct in the primary and secondary prevention of ankle sprains. Furthermore, the introduction of a systematic and holistic stress and regeneration management scheme for individual control of stress and load experienced in training and games is recommended to reduce injuries as a result of acute or cumulative fatigue and to identify individual players with increased risk of injury in advance.

The continuous monitoring of injuries and causes of injury, in particular the collection of longitudinal data, is of overriding importance and an essential prerequisite for gaining detailed knowledge of injury circumstances and for deriving targeted prevention measures in handball as well as controlling any interventions initiated.