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The Burden of Sport Injuries in the European Union

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Editorial note

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1 Executive summary

As in all other spheres of life, also in sport the possible risks of accidents resulting into injuries of even death should be well anticipated and controlled, which is to some extend also a responsibility of the European Union. In the Treaty of Lisbon, Member States agreed to coordinate their policies and programmes in order to improve public health, prevent physical illness, and obviate sources of danger to physical health. The Treaty also provides that the Union shall strengthen the European dimension of sport by amongst others protecting the physical and moral integrity of sportsman and women.

Any prevention action needs knowledge about frequency, severity and circumstances of sport related injuries. Mortality and hospitalisation statistics often lack information on the type of activity that caused the injury (like sporting) or on the place of occurrence (like sporting ground). Factually only rough indications of the size and nature of fatal sport injuries can be derived from usual health statistics.

Fortunately, the European hospital based injury surveillance system IDB (European Injury Database) provides more information, in particular on the circumstances of the injury event, the activity involved, the place of occurrence and products involved. The IDB register on treatments in hospital emergency departments has been introduced in order to guide targeted prevention and it is intended to have it being expanded to all member states by 2015. Although, in 2008, only 11 countries were collecting IDB data, the sample is sufficiently large to extrapolate figures on sport injuries for the European Community as a whole. Regarding other forms of medical treatment, e.g. in doctor's offices, rough estimates can be made through national health interview surveys.

Based on the Eurostat and WHO mortality databases, the number of fatal sport injuries can be estimated at 7.000 fatalities per year. Based on IDB it is estimated that annually almost 6 million persons need treatment in a hospital due to an accident related to sportive activity, of whom 10% require hospitalisation for one day or more.

'Team ball sport' account for about 40% of all hospital treated sport injuries. By specific type of ball sport the ranking order in team ball sport is: football (74%), basketball (8%), volleyball (7%), and handball (3%). Due to its typical one-on-one situations the injury risk in team ball sports is relatively high, compared to other types of sport. Nevertheless, the majority of sport injuries result from participation in so called non-organized, i.e. individually organized sport according to the EU IDB records.

Regarding the economic costs of sport injuries, there are no comprehensive and comparable estimates available at EU-level. In practice only the number of days of in-hospital treatments is available as cost indicator and so, on the average costs of a day in hospital, one can produce an estimate for the economic burden taking into account the relative severity of the injuries. Such calculation (as developed by the EURO-COST project) leads to lower bound for the direct medical costs in the European Community of at least 2.4 billion Euro.

For long-term consequences of sport injuries (disabilities), there are also no comprehensive and comparable estimates available at EU-level. An approximation is possible based on the diagnoses available in the IDB records. The various diagnoses represent a different probability for long-term disabilities. Such calculation (as developed by the INTEGRIS project) leads to an estimate of about 30.000 life-long disabilities as consequence of a sport injury.

The advantage of the methodology chosen is that the set of indicators proposed by this study provides a comprehensive picture of the burden of injury. Once the IDB monitoring system is well implemented in all EU member States it will be possible to derive it with little effort for all member states, every year, even for subgroups of sport injuries, and to compare the burden of sport injury with the burden of injury in other spheres of life as road transport or work place. The disadvantage is that these indicators can differ quite substantially from focused studies of sport injuries, which frequently are based on other definitions of injuries as being prevented from practicing sport ("time-loss-injury") including chronic injuries.

Although the burden of sport injury is substantial, from a public health point of view, refraining from sport is no desired option for preventing injuries. It is widely acknowledged that physical activity (and sport as prominent part of it) contributes to health and well-being, and in particular to the prevention of obesity, diabetes and cardio-vascular diseases. Sport brings also a great array of other societal and economic benefits to society. However, a substantial amount of these health benefits gets lost due to sport related injuries and more health gains can be obtained by a wider application of proven effective measures to increase safety in sport and thus preventing sport related injuries. The two public health strategies of promoting physical activities and promoting safety need to become more strongly interconnected in order to provide maximum health gains.

2 Objectives of this report

2.1 To inform about decrementing effects of sport injuries

Sport is one of the most widespread leisure activities of European citizens, a common cultural element of modern societies, and an important social and economic phenomenon. It plays a significant role in education and socialisation, patriotism and community-spirit, recreation and health enhancement, well-being and tourism, entertainment and advertising. Beside the great numbers of active sportsperson and their families, spectators and supporters, various professional groups and business sectors earn money with sport or are in another way concerned. Sport is in probably in all European countries a distinct policy sector and usually represented in national governments by ministers or state secretaries for sport. Sport accounts for an estimated 3.65% of the GNP of the European Community (European Parliament 2012). The count of medallists or the organization of events like Olympic Games is a matter of national governments and national pride.

On the other hand, sport accounts for a considerable number of injuries: Estimated 14% of all medically treated injuries are related to sport (Bauer & Steiner 2009). Eventually there is no other human activity where the risk of failing and getting injured is as present as in sport. Nevertheless, injuries mean human suffering, a considerable burden for the health and the welfare system, and a noteworthy loss of societal productivity. Sport injuries reduce considerably the health gains which can be expected from this physical activity, and narrow the opportunities of promoting sport as health enhancing physical activity. According to first preliminary estimates, 40-50% of health gains due to sport get lost due to injuries (BASPO 2001, Weiß 2000).

Moreover, sport injuries damage directly the interests of the sport sector itself as they curtail the benefit of training, diminish the prospect of success in competitions, devaluate investments of sport clubs in the development of promising players. Many successful athletes terminate their activity, not because they want but because they have due to injuries. The perceived risk can keep people away from sport, and frequently a serious injury prompt people to terminate practicing sport. All these aspects are good reasons for considering how sport can be made safer, in order to increase its productivity in terms of sportive success, health, as well as in economic terms.

Considering the manifold positive aspects of sports, refraining from sport is no desired option for reducing the burden of sport injuries. Fortunately, there is a wealth of knowledge indicating that there are many effective measures for reducing specific injury risks as: better targeted training methods, improvements of sport facilities and sports equipment, use of personal protective equipment, adaptation and improved enforcement of rules. For many sports the characteristic of risks as well as of factors increasing or decreasing the risk are well described, which is necessary but not sufficient for developing and implementing comprehensive policies and programmes. Although some of these measures might already be implemented to a large extend, there is always room for doing better without challenging purpose and yield of sport activities. As it is with prevention measures and methods of treatment for other health problems too, the implementation of effective measures as a matter of routine is a challenge in terms of organization, management, and policing.

2.2 To make policy makers aware of their responsibility

The main responsibilities for sport policy and public health policy are vested within the Member States, but there are also clear responsibilities of Community institutions:

- Since the Treaty of Lisbon (Treaty on the Functioning of the European Union 2008) there are actions of the Union in the area of sport explicitly foreseen. According to Article 165 of the Treaty the Union shall contribute to the promotion of European sporting issues, and Union action shall be aimed at *developing the European dimension of sport*, by promoting fairness and openness in sporting competitions and cooperation between bodies responsible for sport, and *by protecting the physical and moral integrity of sportsman and women*.
- According to Article 168 of the European Treaty (Treaty on the Functioning of the European Union 2008) the Union shall complement national health policies in order to improve public health, prevent physical illness, and obviate source of danger to physical health. Member States agree to coordinate their policies and programmes, and the Commission may take any useful initiative to promote such coordination, *in particular initiatives aiming at* guidelines and *indicators*, the organization of exchange of good practices *and the preparation of periodic monitoring and evaluation*.

The Communication from the Commission on "actions for a safer Europe" (European Commission 2006) and the Council Recommendation "on the prevention of injury and the promotion of safety" (Council 2007) clearly earmark sport injuries as a priority for more action and identify the a need for better information of decision and policy makers in the area of sport on the burden of sport injury as well as of the oppor-

tunities to reduce these risks effectively. It is well established that physical activity (at least within a wide range of intensity) contributes to health and well-being and its promotion can be an effective strategy for fighting obesity, diabetes, diseases of the cardio-vascular system etc. From a public health point of view, it is desired that all people practice physical exercise with appropriate intensity and that simultaneously the risks of unwanted side effect of injuries is reduced to a minimum. The two public health strategies of promotion physical activities and promoting safety are not well interconnected yet, and frequently the respective policies do not refer well to each other.

In spite of the mandate of the treaty for "protecting the physical integrity of sports-persons" it seems as if policy makers, in particular in the area of sport are not fully aware of the decrementing effect of injury as well as of the opportunities to meet this challenge. In fact, in European sport policy documents and decisions "injuries" are hardly mentioned as a challenge. The European Commission's White Paper on Sport (Commission 2007a), which actually serves as a strategic document for setting up a European sport programme, does not mention sport injury at all, while e.g. violence and doping are well recognized as unwanted side-effects and detrimental phenomena which need to be tackled. Only in the accompanying Commission's working document (Commission 2007b) sport-related injuries are mentioned but only as "potentially negative health effects of sport" which "have to be avoided through proper education and information". It has to be questioned how injury can be considered as a just "potentially" negative phenomenon. Per definition, injury is a bodily damage creating a loss in terms of well-being and productivity e.g. due to sick-leave and medical costs for treatment and rehabilitation. Only very minor injuries like sore muscles could be considered as positive as necessary for achieving training effects. In principle, it is only the sporting activity itself which can produce positive effects, e.g. in terms of sportive success, entertainment or health, but never an injury. When exercising, injuries may be unavoidable to a certain extent, but this does not transform them into a positive phenomenon.

There is another superficiality in the quoted sentence: Education and information (the so called "active strategies" of prevention) play an important role in injury prevention, but in general, there are other, and in most cases even more effective prevention strategies available like proper training, safe sporting grounds or the use of protective equipment (the so called "passive strategies"). The quoted reference to "education and information" seems to illustrate a shortcoming of the current understanding of the origin of sport injuries: The proclivity to attribute the responsibility for safety to sportswomen and sportsmen, who just need to be informed about how to behave, or to institutions which are seen as responsible for education and information as schools and health promotion agencies. This focus, although justified in many respects, ignores the importance of "passive" safety strategies and underesti-

mates the responsibility of the sport sector itself. In other sectors like road transport or labour it is well established and recognized that the main responsibility for safety is vested in the concerned policy areas, authorities and businesses, as only the institutions managing the settings and their risks have the capacities for making a real difference. Generally, the situation is the same in sport as in other productive systems like road transport or industry, where accidents and injuries occur as unwanted side effects, which need to be reduced in order to increase the productivity of these systems. Erroneous public beliefs as that injuries are inevitable or that they are only preventable by refraining from sport lead to "sport safety issues being downgraded in importance in favour of other health problems that are perceived to be more important or preventable" (Timpka et al. 2008, p 803).

Also in statements of the European parliament on sport (European parliament 2008, 2012) injury is not mentioned at all. This reveals a strong need for better information about the size of the problem, its decrementing effects on the benefits of sport for health & society, and about the opportunities for tackling it efficiently. Comprehensive reports about both sides of the coin (the burden of injuries on one side and the opportunities for prevention on the other) are needed. There is a wealth of knowledge about opportunities for improving the safety of sportsperson, which probably is also not fully recognized by stakeholders. Just exemplary are mentioned here the position statement of the European College of Sport Science (Steffen et al. 2009) and the reports on the German speaking conferences "Safety in Sport" (Alt et al. 2000, Baumgartner 2002, Brügger 2004, Henke et al. 2006, Brügger 2009).

Tackling the sport injury risk is mainly the responsibility of the sport policy sector, providers of sport related services, and sport good manufacturers and traders. Most sports depend on specific services, provided either by not-for-profit clubs (e.g. in team sports) or by commercial service providers (e.g. in athletics or skiing). It is clear that institutions providing facilities, equipment, and instruction have an important responsibility also for the safety of the members or costumers. In most cases, sport industry and service providers have the best knowledge and the best opportunities for reducing the injury risk, by guiding their costumers, by offering safe facilities and equipment, by obeying the rules, by offering appropriate training. This responsibility has clearly been acknowledged by the International Olympic Committee IOC (Ljungqvist 2008, Bahr 2011), which organizes since 2008 bi-annual international conferences in order to spread the available knowledge on reducing the injury risk without refraining from sport.

2.3 To assess the health burden of sport injuries

Main objective of the present report is to assess the magnitude of sport injuries and their health and economic burden in the European Union of currently 27 countries. It addresses policy and decision makers in the areas of public health and sport, at Community as well as national level, with the intention of providing them with estimates about frequency, severity, and cost of sport injuries as well as about its distribution over the different sports and population groups. Also key persons in the areas of sport and public health should be well aware of the decrementing effect of sport injuries on health and the economic dimension of these unwanted side-effects of an inherently healthy and productive sector. The report is to illustrate the fact, that not only physical inactivity but also physical activity implies health risks, and that both risks needs to be tackled in order to maximize the health enhancing effect of sport. Key figures shall facilitate the understanding for the benefits of enhanced injury prevention.

2.4 To develop a methodology for routine application

Pre-requisite to such calculations is the development of a methodology for monitoring sport injuries which is based on widely available health statistics, as mortality statistics, hospital discharge statistics, and surveys in emergency departments. Such a methodology makes it possible to compare the health burden to various countries, types of sports, and population groups, as well as the development of this burden of the time. Also, the injury risks of the sport sector shall get comparable with other main sectors as school, home, road, or workplace. The intention of this approach is to make best use of available data sources and to demonstrate the usability of existing surveillance systems. As it is based on cost units like hospital days and ambulatory treatments, also a comparison with the estimated health gains due to physical activity will be facilitated. In principle, the methodology can be applied at EU level as well as in an increasing number of EU Member States, promising comparable figures and indicators in the future. Comparisons between countries and various types of sport can be powerful motivators for enhancing injury prevention.

Figures describing sport injury risks shall be also comparable with those describing other health problems like cancer or cardio-vascular diseases. Much is known about characteristics, circumstances, and consequences of sport injury risks, but most studies focus on specific types of sport or are confined to one country, but a challenge is to make risks comparable. Health and cost indicators shall be comparable over countries. Comparing vital performance indicators (benchmarking) is one of the success strategies of the European Union, as differences are a highly effective motives for doing better, no matter if budget deficit or unemployment rate, health care costs or

injury rates are concerned. And figures shall be also comparable over the time in order to monitor their development, in particular as a result of active policy making. Yet few studies try to assess the injury risks of various types of sport in a comprehensive way at the same time on the level of the European Union.

So far, within the public health policy domain a few projects have been carried out under the Injury Prevention Programme 1999-2003 and the Public Health Programme 2003-2008. A first explorative study on the European epidemiology and available practices was provided in 2002 by the project "Sport injuries in the EU countries in the view of the 2004 Olympics", led by the Centre for Research and Prevention of Injuries among the Young "CEREPRI" in Athens (Petridou 2001, 2002). Another initiative was aimed at building up know-how about skiing injuries and the effective prevention measures for skiing and snowboarding: "Best practices in prevention of skiing accidents in Europe 'BEPRASA'", led by the International Department of the Board for Health and Welfare of the Veneto region (Azienda ULSS20 et al. 2006, Azienda ULSS20 2010). Other projects like "Maintenance, Development and Promotion of the ISS Hospital Survey in the current and enlarged EU", led by the Austrian Road Safety Board and concluded in 2006, focused on the development of a European monitoring system for external causes of injuries (European Injury Database IDB) with a view to provide comparable data for all types of injuries including sport injuries (Zimmermann & Bauer 2007). Currently, a follow up project targets on the roll out and sustained implementation of the IDB injury monitoring system: Joint Action on Monitoring Injuries in Europe "JAMIE" (Eurosafe 2012).

The work plan 2007 of the EU Public Health Programme 2003-2008 made a call for a project on the prevention of high risk sports, to which a consortium of the Ruhr University Bochum (RUB), the Austrian Road Safety Board (KfV), the Dutch Consumer Safety Institute (CSI) and the European Association for Injury Prevention (EuroSafe) submitted a proposal. In 2008 EC-funding was granted for the project "Safety Management for High Risk Sports in Collaboration with European Sports Federations 'Safety in Sports'" (Safety in Sports 2012). One objective of this project is to compile the current status of knowledge concerning the burden of sports injuries, existing effective and practicable prevention measures, and implementation strategies, in particular regarding "high risk sports" which are team sports with their typical one-on-one situations. In order to summarize the various opportunities of prevention for high risk team sports, the project "Safety in Sports" has produced seven inventories of preventive measures for five high risk sports: football, handball, basketball, volleyball, rugby, field and ice hockey. The present report is the main deliverable related to the project objective of compiling the current status of knowledge regarding the burden of sport injuries.

2.5 Who is addressed by this report

This study shall serve the information needs of stakeholders at European level: Concerned administrators in the relevant Commission departments, in particular in DG Health and Consumers as well as DG Education and Culture, decision makers and experts in European sports federations, Members of the European Parliament who are in particular concerned with sport and public health issues, key persons of the concerned business sectors as sport good manufacturers. At national level the report should be recognized by policy makers and administrators in the sport as well as in the public health sector, decision makers and experts in national top sport federations, researchers in the area of sport science and sport medicine, public health institutions and agencies for injury prevention and safety promotion. For more details see table/figure 1.

Stakeholder	**Stakeholder's benefit**	**Potential impact**	**What can stakeholder do?**
European Commission (DG Sanco and DG Youth)	- Political interest in promoting health enhancing physical activities (HEPA) - Ensure physical integrity of sport participants - Implementation of the Council Recommendation on Injury Prevention 2008 - Reduce the negative effect of injuries on the promotion of physical activities	- EC is important for initiating EU-wide discussion on safety in sport - Strong impact on sport and youth organisations	- Increase awareness of preventability of injuries in sport in the MSs by benchmarking - Continue to provide statistical information on health and economic burden of sport injuries - Stimulate sport organisations in taking up safety management programmes as part of good governance - Exchange of good practices (e.g. the inclusion of safety management in the overall policy of associations)
WHO-Europe	- Reduce the negative effect of injuries on the promotion of physical activities - Strong interest in injury prevention and HEPA promotion	- Authority in Europe for national governments - Capable in forging EU wide exchange and actions	- Identifying good practices - Dissemination of technical guidelines and tools - Networking with practitioners and policy makers

Stakeholder	Stakeholder's benefit	Potential impact	What can stakeholder do?
National Governmental Departments for Public Health and Sport	- The health sector has a limited interest in sport but growing interest in promoting 'sports for all' - Most sport departments have prime focus on top sport instead of amateur sports	Ministries have a limited influence on sports organizations (who profile themselves often as 'trade unions') - Ministries may well energize the medical field in profiling need for sport injury control	- Initiating national collaboration and exchange on sport safety - Stimulate initiatives from sport organisations to include safety management as part of good governance in sport - Use current financing and licensing systems for making safety requirements mandatory
Regional Sport Councils	Focused on promotion of physical activities, less active in injury prevention	Advisory role, but in some counties/ regions also have an important financial stake in sport	Assistance in raising awareness among local clubs and associations - Use licensing and/or financing schemes for mandatory safety requirements for clubs

Table/figure 1: Non-exhaustive list of stakeholders and their role in the promotion of safety in sport (Eurosafe 2012b, p8-9)

3 Why sport injury matters

While the societal benefits of sport, as gain of fitness, reducing risk of diseases, recreation, educational effects, or integration of marginalized groups are well aware among policy makers, relatively little attention is paid to the unwanted side-effects of injuries. Injuries are not only damages to health, but also restrain the chances of getting more people physically active and benefitting from the positive effects of sport. Table/figure 2 illustrates the benefits for the main stakeholder groups as well as their losses due to injuries.

	Benefits	**Drawbacks due to injuries**
Health	Improvement of health, reduced risk for certain diseases, gain of healthy life years, reduction of costs for health care and welfare, reduction of sick-leaves, increased sense of well-being	Health problems due to acute and chronic injuries, loss of healthy life years, additional costs for health care and welfare, and lost productivity. Perceived injury risk deters people from considering to take a more active lifestyle
Community	Positive educational effects (e.g. teamwork, community spirit, self-discipline), integration of marginalized groups	Perceived injury risk deters people from considering to participate in sports
Sport clubs	Income from members and sponsors, increase in jobs in sport clubs, scale of economy	Losses by drop-outs, reduction of chances for success in competition, increased insurance fees. Perceived injury risk deters people to participate in sports
Business	Income and jobs in commercial sport service providers, sport good industry and trade, media, advertisement, tourisms	Limitations due to drop-outs and reduced willingness to get active

Table/figure 2: Benefits from sport and drawbacks due to injuries

3.1 Sport

Sport injuries have not only a decrementing effect on health but are also damaging interests of the sport sector itself:

- Injuries cause people to stop practicing sport
- Investments of sport clubs in young players get lost when youngsters drop out
- The omnipresence of sport injury (of professionals in the media as well a daily experience in the personal environment) damages the image of sport as healthy activity
- The (perceived) risk of sport injury may prevent persons from starting (or re-starting) with sporting
- The perspectives of promotion of sport as health activity is confined as any increase of activity may lead to more injuries
- Enhancement of all related businesses is hampered by reduced willingness to practice
- Investments into key players are jeopardized when they get injured
- The chances of sportive (and commercial) success of professional clubs are reduced when their active players are more frequently injured than players of concurrent clubs

Injuries are a significant burden for clubs in competition. In particular in high risk sports, i.e. team sports with typical one-to-one situations a considerable number of active sportspersons are not able to participate in competitions due to acute injuries. This lowers considerable the perspectives of success for clubs, which need success in order to secure and enhance their financial situation. Drop out of one or a few of key players can put lead to the loss of huge amounts of income.

Sport injuries are a common reason for stopping sportive activities. This is not only true for top performers, but also for players at lower levels. Investments into youth squads are partly lost, when youngsters decide to give up; in many cases an injury and the consequent absence from training and the backlash in performance ability trigger giving-up. This might be associated with other factors like adolescence, upcoming other priorities, but injuries contribute. In a number of cases the injuries are also severe enough to make continuation objectively impossible.

The image of sport (in general as well as of specific types of sport) can be assumed as an important factor for preventing people to start or to revive activities, although the relation between perceived injury risk and physical activity is not well studied. "Sport is Murder" is a common saying, frequently used as joke but obviously with a relevant core. Serious injuries of top performers, often spectacularly staged by television, certainly influence the perceived injury risk of sports and give some specific types of sports the image of being "dangerous". General dislike of physical exercise, lack of time, or lack of discipline seem to be important motives for staying inactive, but a perceived high injury risk may contribute. The image of sports as "risky" is an inhibiting factor – although probably the most decisive one – for more success in promoting health enhancing physical activity (Telford et al 2012).

3.2 Health

In past decades, the scientific knowledge of the health consequences of physical activity and inactivity has increased substantially. There is wealth of evidence that physical activity, in particular appropriate sport, can have positive effects on health. E.g. Felderer et al (2006) report estimations that regular sportive activity reduces the risk of suffering from cardiovascular diseases by about 50%, the risk of suffering from diabetes type II and obesity by 30-50%. Cardiovascular diseases are the number one cause of mortality in Europe, and the number of citizens of the European Union who suffer from diabetes and obesity is rising. Also the risk of cancer of the colon can be reduced by about 40-50%. Moreover, sport plays an important role in preventing from osteoporosis, dorsalgia and arthritis. Moreover regular sportive activity also decreases the risk of mental illnesses like depression. Doing sport enhances well-being, stabilizes mood states, reduces perceived stress, enhances self-worth especially in women and meliorates sleep. Regular sport participation also reduces the risk of Alzheimer disease and enhances some brain functions like planning, decision making, short time memory and the ability to concentrate.

Physical exercise, and sport as part thereof, is a "salutogenetic factor". Regular physical activity, active play and sports can be a practical means to achieving numerous health gains, either directly or indirectly through its positive impact on other major risks, in particular high blood pressure, high cholesterol, obesity, tobacco use and stress. These benefits are mediated through a number of mechanisms: in general, it improves glucose metabolism, reduces body fat and lowers blood pressure. Physical activity may reduce the risk of colon cancer by effects of prostaglandins, reduced intestinal transit time, and higher antioxidant levels. Physical activity is also associated with lower risk of breast cancer, which may be the result of effects on hormonal metabolism. Participation in physical activity can improve musculoskeletal health, control body eight, and reduce symptoms of depression (WHO 2003).

Powell et al (2011) made the statement that any kind of physical activity is enhancing health. Nevertheless, a certain level of activity is necessary to achieve significant effects. A noticeable improvement of the health status requires exercise of at least 150-300 minutes per week with moderate intensity. In general, at least up to a certain level, more work out seems to have better effects. With doing various sportive activity, various health goals can be reached. While endurance training has a positive effect on cardiovascular function, weight training helps against obesity and loss of bone density. The "EU physical activity guidelines" (EU-Working group "Sport and Health" 2008) also underlined the effect of regular physical activity for reducing of cardiovascular diseases, preventing of high blood pressure, maintaining of metabolic functions, increasing fat utilisation, lowering the risk of breast, prostate and colon cancer, preventing of osteoporosis, improving digestion, improving of muscular strength and endurance, maintaining motor functions including strength and balance, maintaining cognitive functions, lowering stress levels, improving sleep quality, lowering the risk of falling of older people, improving self-image and self-esteem, increasing enthusiasm and optimism and decreasing sick leave from work.

It has been highlighted that due to the evolution the human body is optimized for a certain level of regular physical exercise. Too much but also too less exertion increases the risk of health damages. While in the long history of mankind, overexertion due to heavy labour and injury were main health threads, in modern, industrialized societies, the lack of activity has become a major source of illness. Physical inactivity is an independent risk factor for chronic diseases, and overall is estimated to cause 3.2 million deaths globally" (WHO 2010a). Physical activity can take place at work, during home-work, gardening, simple walking, various leisure time activities, but sport plays a particularly important role. Based on profound evidence, the promotion of physical exercise in everyday live has been identified as an effective strategy to reduce the risk of heart diseases, stroke, obesity etc. Although physical activity shall be intensified in all areas of life in order to achieve the wanted positive health effects, the sport sector has a particular important role to play (Cavill et al. 2006; EU-Working group "Sport and Health", 2008).

Felderer et al (2006) prospected the economy of inactivity in Austria, Finland, United Kingdom, Netherlands, Norway and Switzerland. Through increase of the physical activity of the Austrian population € 566 million Euro could be saved. 30% of this amount is caused by death, 25% by in-patient-treatment, 29% by outpatient treatment, 9% by workdays lost due to illness and 7% by pensions due to disabilities. For the United Kingdom the inactivity costs are estimated to € 3 billion (€ 520 million for health system, 1260 million for lost workdays and 1250 million for evaded wage. In the Netherlands € 725 million could be saves through more physical activity. A new calculation for the Netherlands in 2008 led to an increase to € 907 million (Breedveld et al. 2008).

Therefore, physical exercise is seen as a promising strategy for improving public health (Cavill et al. 2006). As sport in particular is associated with regular training and targeted exertion, it plays an important role in the strategy of promoting health enhancing physical activities. Also the "White Paper on Sport" (Commission of the European Communities 2007) highlights that sport is a valuable tool for enhancing health, in particular for reducing the risk of overweight, cardio-vascular diseases, and diabetes. Diseases due to lack of activity are a severe burden on the health system and economy, as well as a source of diminishment of quality of life.

The need for physical exercise as a condition for health is obviously already well known and understood by the general public. Zunft et al. (1999) report, that improving health is the most important reason for people over the age of 55 for doing sport. There are various motives for active people for engaging in sport or other physical activity as to improve fitness, to enhance personal appearance, to develop physical performance, to relax, to have fun, to be with friends and the enjoyment of doing sport, but the leading motive is improving health. Zunft et al. report that 42% of the participants of their survey reported that their main reason to do sport is to maintain good health, 30% to release tension and 30% to improve fitness. The recent Eurobarometer study on sport (2010) confirms these findings: 61% of respondent mention improving health as motive. But there are significant interstate differences in the intended personal benefits of sport. While 55% of the Spanish people do sport to maintain good health, only 21% of Portuguese people do so; 41% of Italian citizens get active for releasing tension but only 16% of the Swedish citizens mention this as motive; 36% of the Swedish people do sport to improve fitness and only 8 % of the Portuguese do so.

Weight control is another motive. In general, citizens of the European Union have the opinion that continuous sportive activity is good for preventing obesity. Goldberg and King (2007) ascertained that physical activity is an important component of effective personal weight management. For achieving a measurable impact a person needs to be active at least for half an hour a day with at least modest intensity. Although for only 13% of the active Europeans weight control is a leading motive (Zunft et al 1999), obese women report regularly to use sport for weight management.

These motives reflect assumptions or knowledge about the general benefits of sport. On the other hand the factual participation of a person depends also on assumptions about how far the generally achievable benefits can be factually realized by this concrete person.

3.3 Community

Sport can also satisfy social needs. In particular, young people have a strong need to join each other. But also for older people, meeting others is a reason to do sport (Umberson et al., 2010).

Participating in sport is aligned with developing special values. The Eurobarometer survey (2010) shows that European citizens think that doing sport helps people to develop special skills: team spirit 52%, discipline 46%, friendship 38%, effort 36%, self-control 33%, fair play 32% and sticking to rules 31%. Despite this strong belief in the character building effect of sport, there is a lack of evidence for such beliefs. Sport only has a weak influence on the development of moral, team orientation and effort. This weak influence could also be described through selection processes before sticking to a special sport club. In this term children who have already these skills go to a fitness club with the same ethic orientation (Frey & Eitzen 1991).

Sport is a field in which people can learn to contribute to a community interest. Especially young people can involve themselves into society and become an active citizen. This may have beneficial effects on providing delinquency. For the European Commission strengthening of volunteers and providing access to non-formal education is a main issue, since a decline in volunteers in the field of sport has been noticed (Commission of the European Communities 2007a). Sport is the biggest provider for voluntary, especially for people aged from 15-24 in the European Union. According to the European Commission (2005) the decrease in voluntary can be stopped through changing from an old to a new approach on voluntary work. New voluntary work is temporary, taking place in different organisations and fields, fits to a volunteers´ biography, is a medium for self-realisation, offers the opportunity to develop skills and is semi-professional.

Sport is also seen as an instrument for integrating people, in particular immigrants. According to the Eurobarometer (2004), 73% of the European citizens think so. There are significant differences between nations, several education levels and personal sport involvement. Central European nations show lower belief in integration through sport, higher frequency of sport attendance and higher education level are positively correlated with that belief. 64% of the European citizens think that sport provides the fight against discrimination. This approach is higher in Belgium, Finland and the United Kingdom and lower in Luxembourg, Greece and Austria. The majority (59%) of the European Unions´ citizens say that the promotion of ethical and social values in sport should be enhanced. Also for the European Commission (Commission of the European Communities 2007a) sport participation is an oppor-

tunity for immigrants and the host society to interact together in a positive way, because "sport promotes a shared sense of belonging and participation".

3.4 Economy

There are various economic aspects of sports, direct expenditures (or income) where money flows can be observed at least in principle, as well as indirect economic effects as societal costs, which cannot be assessed by observing money flows but can only be estimated with the help of theoretical constructs. Direct expenditures are e.g. public spending for facilities and events, expenditures of sport clubs and federations, expenditures of facility providers, expenditures of consumers (e.g. for sport equipment, clothing, services, travelling, and tickets for events, expenditures of business for sport sponsoring and sport related advertising, expenditures of media for reporting – including the costs of treating sport injuries. This complements to the income of sport club and their federations, the providers of sport facilities and event organizers, sport good industry, sports good traders, service providers in tourism, salaries of sport teachers, trainers and other related professionals - including health professionals treating sport injuries.

Societal costs are indirect expenditures as e.g. the loss of productivity as consequence of sport injuries. Societal savings are related to the other immaterial benefits as savings of health expenditures due to the enhancement of health, savings of welfare costs due to educative effects on adolescents or integration of marginalized groups.

Referring to the White Paper (Commission of the European Communities 2007a) "sport is a fast growing sector with an underestimated macro-economic impact…It can serve as a tool for local and regional development." For example the infrastructure can be improved through sport events. Sport and sport related tourism create new jobs. For assessing the share of sport satellite accounts have been developed. "A satellite account of sport can gather – when other data are missing – all available information about costs, expenditures, financing, the factors of production, and about who exactly uses sports goods and services. All gathered data are classified within the national account framework, although some magnitudes are registered in non-monetary units" (Andreff & Szymanski 2006, p15).

Any use of this technique depends highly on the definition of sport and sport related businesses. Initiated by the White Paper (quote) the EU working group "sport and economics" of the European Commission has developed the "Vilnius definition of sport" which is based on the NACE classification ("Nomenclature statistique des ac-

tivités économiques dans la Communauté européenne ») and provides a basic tool for assessing and monitoring the direct economic effects, and The NACE- system is a classification of trade branches, which was created by the European Union in 1970 and was developed continuously since then. NACE 92.6 is described as "sporting activities" and belongs to the subgroup "recreational, cultural and other sporting activities". There are two sub-codes 92.61 "Operation of sports arenas and stadiums" and 92.62 "Other sporting activities". There are three definitions for sport related economic activities.

- The so called "Statistical definition": Covers the only sport related economic activity which has its own NACE category (NACE 92.6 Rev.1.1: "sporting activities");
- The so called "Narrow Definition": All activities which deliver inputs to sport (i.e. all goods and services which are necessary for doing sport) plus the "Statistical Definition".
- The so called "Broad Definition": All activities which require sport as an input (i.e. all goods and services which are related to a sport activity but without being necessary for doing sport) plus the Narrow Definition (SportsEconAustria 2007).

For a pilot application data were collected from Austria, Cyprus, Poland and the United Kingdom with sport satellite accounts. The employed people in the field of sport are 6.35% (AT), 2.2% (CY), 1.54% (PL) and 2.5% (UK) of all employed citizens of a country. Consumer expenditure is calculated with 3.62% (AT), 3.7% (CY), 2.1% (PL) and 2.9% (UK). The gross value added in market prices is 4.89% (AT), 2.4% (CY), 1.96% (PL) and 2,3% (UK). The relatively high figures for Austria obviously represent the high importance of winter tourisms in this Alpine country (SportsEconAustria 2011)

Obviously based on these first results the European Parliament estimated that sport counts for estimated 3.6% of the Community GNP in EU countries (European Parliament 2012).

3.5 Balance of benefits and losses

Isolated monetary calculations of benefits – e.g. saved health care costs due to physical activity or the health care costs due to the lack of physical activity – have a fundamental shortcoming: They do not take into account the losses due injuries related to physical activity. If the costs for treating injuries would be higher than the savings,

the promotion of physical activity could not be justified, at least not from the standpoint of health economy (Engbretsen & Bahr 2009).

Therefore it is surprising how little scientific attention was paid up till now to the question: What is the balance between the benefits of sport (e.g. in terms of saved health costs) and the losses due to the unwanted side-effects (e.g. in the terms of additional health costs due to injuries). Sometimes, the health costs of injuries were estimated, in order to justify sport safety measures, sometimes the health costs of lack of physical activity were estimated, in order to justify the promotion of sport. Both these one-sided approaches do not answer the fundamental question: Is the health cost balance of sport (or all physical activities) positive or not?

Beside phenomena like doping, violence related to sport events, or the misuse of young sportspersons, the most obvious negative side-effect are acute and chronic injuries as well as long-term damages to health due to prolonged overloading. Although most sport injuries can be cured without a reasonable time, also long-term damages are quite frequent. Fatalities are relatively rare compared to other areas of live as road transport. Accidental deaths are exceptional events in usual team sports or gymnastics, and only a few sporting activities produce most of the fatal sport injuries: water sport, aviation sport, motor sport, bicycling and mountaineering.

In principle, all negative effects can be calculated in monetary terms as loss of investments, additional promotion costs, loss of income expectation, or additional direct expenditures. Usually it is distinguished between direct and indirect costs: Direct costs are expenditures, where a transfer of money takes place, which in principle can be observed. Indirect or societal costs are losses of productivity which can be estimated but hardly observed. A comprehensive balance of benefits and losses in sports might be desired, but is not available yet.

Nevertheless, there are first results available regarding the balance of health gains and losses, as here the same indicators like medical treatments, days of hospital care, life years or healthy life years can be used. Such attempts have been made by Weiß (2000) and BASPO (2002). Both studies make use of the wealth of studies on health gains due to physical activity and applied the reported findings e.g. on reduced incidences on average treatment costs. Biggest savings are to reductions of cardiovascular diseases, dorsopathies and discopathies, as well as general mortality. These two studies indicate that sport injuries do not entirely annihilate the positive health effects of sport, but reduce the health benefit significantly (table/figure 3).

Study	Weiß (2000): AUSTRIA			BASPO (2002): SWITZERLAND		
	Currency/year	1,000.000		Currency/year	1,000.000	
Savings of health costs	ATS (2000) EURO (2000) EURO (2012)	7790 566 736	100%	CHF (2000) EURO (2000) EURO (2012)	2677 1785 2320	100%
Health costs due to injuries	ATS (2000) EURO (2000) EURO (2012)	4147 301 391	53%		1123 749 974	41%
Balance = actual savings	ATS (2000) EURO (2000) EURO (2012)	3643 265 345	46%		1554 1036 1347	58%

Table/figure 3: Balance of savings of direct health costs due to sport and costs due to sport injuries (estimates for 2012: assumed 30% inflation 2000 – 2012).

From a health point of view two objectives need to be pursuit simultaneously: to increase sport participation and to reduce the injury risk involved. It seems to be important to discourage the naive promotion of all physical activities as health enhancing without controlling eventually unwanted side-effects as on the risk of fatal and non-fatal injuries.

4 Key terms and methodological remarks

As this study is to deliver estimates the burden of sport injuries, definitions of the key terms "sport", "injury" and "burden" are needed. It is obvious that "sport" is a physical activity, but not all physical activities are sport, like physical work or walking. A closer look quickly reveals that a definition of "sport" needs more demarcations, in particular regarding leisure activities which are not necessarily sport like swimming, bicycling, or hiking. Also the term "injury" needs to be specified, in particular regarding severity. There is a great number of minor injuries, which do not lead to noteworthy constraints of day-to-day business of individuals, but severe injuries are far less frequent. In sport also chronic (overuse) injuries play an important role. Any estimate of the number of sport injuries will highly depend on the inclusion or exclusion of certain types of physical activity, and on the inclusion or exclusion of less severe injuries.

The current study intended to make best use of what kind of data is available in member states of the European Union. It was not intended to collect specific data, and therefore the definitions of "injury" could be chosen but must be – at least to a large extend – depicted by existing data in European injury registers and health statistics. If there would have been freedom to choose the most appropriate definitions and the according subjects to be studied, specific data collection would have been necessary in order to get measurable and countable observations. The following discussion will show that it was necessary to find approximations to the academic definitions by items, which are factually counted in the available health statistics. The gaps will be discussed and should be well understood by the reader.

4.1 Physical activity

"Physical activity is defined as any bodily movement, produced by skeletal muscles, that requires energy expenditure" (WHO 2010a). While every sport is a physical activity, there are many other physical activities which are not "sport" like industrial work, housekeeping, gardening, or simple locomotion by walking. Some of these activities – if carried out with a certain minimum of duration and endeavour - may have a positive effect on health and are of particular interest of public health policy. They are addressed e.g. by the question: "How often do you engage in a physical activity outside sport such as cycling or walking, dancing, gardening etc.?" of the recent "Euro-Barometer" survey (Eurobarometer 2010). The term "health enhancing physical activities" comprises such activities and sport, and the promotion of such activities is an important public health strategy.

4.2 Sport

Quite broad is the definition by the Council of Europe: "Sport means all forms of physical activity which, through casual participation, aim at expressing or improving physical fitness and mental well-being, forming social relationships or obtaining results in competition at all levels" (Council of Europe: European Sports Charter, 1993). A constituent element is exercise. Doing sport and is planned for maintaining or improving fitness, to getting recreation, or to winning a completion, and takes place during training or during competitions. Exercise can be characterized as "planned, structured and repetitive bodily movement done to improve or maintain one or more components of physical fitness," whereas "physical fitness is a set of attributes that people have or achieve that relates to the ability to perform physical activity". The relationship between exercise and the physical fitness is well examined. Trained people have a higher level of physical fitness, depending on the intensity, duration and frequency of the training (Blair et al. 1992). Narrower definitions point out, that sport follows specific rules and contains special bodily movements. "Sport is any highly structured, goal directed physical activity governed by rules, which has a high level of commitment, takes the form of a struggle with oneself or involves competition with others, but which also has some of the characteristics of play. Sport involves either vigorous physical exertion or the use of relatively complex physical skills by individuals whose participation is motivated by a combination of the intrinsic satisfaction associated with the activity itself and the external rewards earned through participation" (Kent 2006). According to this definition, specific rules, specific intentions, and a high level of exertion are key elements.

Accordingly, movement games of children are not "sport", as they hardly follow the standardized rules of a sport. Also activities of persons with chronic health problems, who exercise with a view to strengthen or recover the normal functions of a healthy person, and where therapeutic indications are dominating, are not "sport". Leisure time activities with the pure purpose of recreation and with a low physical strain, like walking, swimming or biking are also not covered by the usual definitions of "sport".

Sport can be systematized in manifold ways, but the most apparent classification is according to the specificities of the required movements, which constituent the various sports and their subgroups or disciplines. Although there is a fluent transition from other forms of exercise to sport, commonly practiced sports have names, their rules are laid down in writing, and committed participants are frequently organized in sport clubs, and the clubs belong to greater federations. Sports can be grouped ac-

cording to many characteristics, e.g. team sport vs. individual athletic activity, organized vs. unorganized, indoor vs. outdoor, winter vs. summer, competitive vs. non-competitive activity, or according to the used sport equipment (ball, racket, vehicle, horse, water, snow, etc.). The most popular sports are contested during the Olympic Games – the so called "Olympic sports": Currently, 28 sports with 36 disciplines are acknowledged as "Olympic" for the 2012 summer games and seven more with 15 disciplines for the winter games. Sports (or types of sport) within the international Olympic framework have international governing bodies named International Federations. For example, Gymnastics, represented at the Olympic level by the Federation International of Gymnastics, is a sport that includes trampoline, artistic gymnastics and rhythmic gymnastics as disciplines.

Many other sports are recognized by the International Olympic Committee (IOC) as "Potential Olympic sports" (interestingly also chess and bridge). Main criteria for being recognized by the IOC are that a sport is widely practiced around the world, and that there is an international federation ensuring its practice according to the Olympic charter. Many more sports do have names and rules, but most of them have only a limited geographic range. "To make it onto the Olympic programme, a sport first has to be recognised: it must be administered by an International Federation which ensures that the sport's activities follow the Olympic Charter. If it is widely practised around the world and meets a number of criteria established by the IOC, a recognised sport may be added to the Olympic programme on the recommendation of the IOC's Olympic Programme Commission" (IOC 2012).

Sportive activities can be also grouped by the organizational setting, which roughly delineates the main political responsibility for safety. This approach leads to three relatively distinct worlds of sport:

- Sport in the framework of educational institutions, in particular during class hours of the teaching subject physical education at schools. Within this "world" the educational sector bears the main political responsibility for safety;
- Organized sport, which follows specific rules, and where competitions play an important role. Dominantly such sports are done within the framework of hierarchically structured sport clubs (e.g. football, handball, basketball, ice hockey). There are about 700.000 registered sport clubs throughout Europe which provide the necessary services as regular training by coaches, organization of regular competitions, and provision of sport facilities. Professional sport (what type of sport ever) could be considered as a separate "sport world" due to its dense organizational framework and high intensity of practice. For professionals sport is their main occupation, and they earn money through extraordinary high performance. Professional sport gets the highest

level of public attention and plays an important role in the advertising and the entertainment business. Within this "world" the sport sector bears the main political responsibility for safety;

- Self-directed, individually organized leisure sport, which is not bound to sport clubs or competitions (e.g. jogging, mountain hiking, bicycling, skiing, swimming, gymnastics). The facilities are mainly provided by the nature or the public (roads, foot paths, hiking trails) or by commercial providers (ski slopes, swimming baths, fitness clubs, etc.). For some activities, there is no clear demarcation between sport and leisure or recreation. Sometimes, such activities are called "informal sports". In this "world" sports persons are mainly in the position of "customers", and the consumer safety sector bears the main political responsibility for safety.

For determining if an "informal sport" should be considered as "sport" in the narrow sense, it would be necessary to assess the intention, the level of commitment and physical strain (is it a "struggle with oneself or involving competition with others"?). Unfortunately, in health statistics, which provide the basis for this study, such details are not ascertained. When a patient seeks medical treatment in an accident and emergency-department, he/she is hardly been interviewed about intention, commitment and intensity of the activity which was carried out when the injury was caused. Factually, the study is bound to what activity the patient declares as "sport". Bodily movements are not included if declared as "play" (e.g. movement games), "travelling" (e.g. bicycling with the prime motive of locomotion), or leisure (e.g. taking a walk). It has to be assumed that the common understanding of "sport" is close to the definition of sport (exercise, specific movements, specific rules, and specific intentions).

4.3 Injury

The current report follows the most common definition of injury as a bodily lesion resulting from acute exposure to energy in amounts or rates that exceed the threshold of physiological tolerance, or an impairment of function resulting from a lack of one or more vital elements (i.e. air, water, warmth), as in drowning, strangulation, or freezing. The time between exposure to the energy and the appearance of an injury is short (Krug 1999). Whereas the definition includes drowning (lack of oxygen), hypothermia (lack of heat), strangulation (lack of oxygen), decompression sickness or "the bends" (excess nitrogen compounds) and poisonings (by toxic substances), it does not include conditions that result from continual stress, such as carpal tunnel syndrome, chronic back pain and poisoning due to infections. In other words, injuries are the acute, physical conditions listed in Chapter XIX (Injury, poisoning, and cer-

tain other consequences of external causes) and Chapter XX (External causes of morbidity and mortality) in the International Statistical Classification of Diseases and Related Health Problems, Tenth revision ICD-10 (WHO 1990). In principle, the energy causing an injury may be of mechanical, radiant, thermal, electrical, or chemical nature, but for sport injuries mechanical energy plays an overwhelming role.

Mental disorders and chronic disability, although these may be eventual consequences of physical injury, are also excluded by the above definition. In sports the use of performance enhancing substances ("doping") is an issue. Although, certain intoxications can be injuries, doping is no subject of this study. The project does also not deal with injuries as consequences of medical treatment. Frequently, injuries are divided into unintentional ("accidental") or intentional (due to interpersonal violence or self-harm). The current project deals primly with unintentional injuries, whereas injuries due to fouls in team sports are included.

In sports also chronic injuries (cumulative trauma or overuse injuries) like tendonitis, tennis elbow, runner's knee, etc. play an important role. Nevertheless, chronic injuries are no explicit subject of this study as such injuries are hardly treated in emergency rooms, which treatments provide the basis for estimating the general burden in this study.

Non-fatal injuries need the definition of a minimum severity. Minor ("bagatelle") injuries are much more frequent then severe ones, and a lack of clarity in this respect may lead to incomparable figures. The severity of injury can be defined in many ways, in terms of threat to life, immediate effects (e.g. loss of consciousness, compound fracture, multiple injuries); time to recover (e.g. days of sick-leave); the long term outcome for the patient (e.g. full recovery, permanent disability or disfigurement); resources required for treatment (e.g. surgery, days of hospital care) – see Berger & Mohan (1996). Nevertheless, this study depend on existing health statistics, deals with severity in a very pragmatic way, and cover "medical attention injuries" only if treated in hospitals, either as ambulatory treatment in an Emergency Department or as inpatient treatment. Other medical treatments (as in doctor's surgeries) are not covered, as there are no EU-wide figures (statistics) available.

4.4 Sport injury

Any injury, as defined above, which occurs while carrying out a sporting activity, as defined above, is taken as "sport injury".

In sport science – in particular for studies in sport clubs – the use of "time-loss injuries" is frequently used. These are injuries causing a player to staying away from training and/or matches (Fuller et al. 2006). Time-loss injuries do not necessarily require medical treatment, and in many cases even a sick leave from the job might not be necessary. Nevertheless, the eventual abstention from sport as consequence of an injury is hardly recorded in medical settings, and therefore could not be applied in this study. Therefore, the injury frequencies reported in this study are generally lower than targeted studies recording the absence from sport, and including chronic injuries. On the other hand, the advantage is that general health statistics allow for a comparison of sport injuries with other injuries or diseases using the same criterion "medical treatment in hospitals".

4.5 Injury risk and incidence rate

Generally, risk is defined as the likelihood of a hazard causing harm in an exposed population in a specified time frame, multiplied by the magnitude ("severity") of that harm. In public health, separate quantifications of the risks for fatal and non-fatal injuries for certain populations, within one calendar year, are used for many purposes as for the comparison of impact of diseases. Usual measurements are prevalence rates (share of affected persons at a certain date) or incidence rates (share of new cases in a certain period of time). This study predominantly reports along these lines, trying to establish "incidence rates for sport injuries", in analogy to the injury indicators of the European Community Health Indicators Project (Network of Competent Authorities 2004, ECHIM 2010a), in particular the indicator for home, leisure, and school injuries (ECHIM 2010b).

For the comparison of the injury risk of different sports, measures of exposure (e.g. the number of sports persons and/or the intensity of the practice) are desired in order to eliminate its influence. Unfortunately there are no comparable EU-wide estimates available for all sports. Nevertheless, the report will quote publications using this approach.

4.6 Health burden

The Burden of Disease framework of the World Health Organization aims at integrating fragmentary information about population's health, in order to assess the impact of specific health problems in terms of mortality and morbidity. Particular attention is paid to the development of indicators which combines the burden of deaths, morbidity and disability in order to facilitate political decisions on the alloca-

tion of health resources and the provision of health services. Various groups of diseases, according to major diagnostic categories, should be made comparable, while integrating data on fatal and nonfatal health outcomes, and putting this information in relation to general (e.g. socioeconomic) determinants and proximal risk factors. Desired are measures for the gap between the population's current health status and an ideal situation in which everyone lives free of disease or injury, disability and premature death (Lopez et al. 2006).

An appealing measure for this concept is disability-adjusted life years (DALYs), which extends the concept of potential years of life lost (YLL) due to premature death by including equivalent years of healthy life lost by poor health or disability (Murray 1996). In the current study it was not possible to derive this measure for sports injuries, as information about duration and severity of disabilities could not be established. As pragmatic alternative, estimates for fatalities, hospital admissions, not admitted emergency treatments, and other medically treated injuries will be derived. Based on all hospital treatments (admissions and ambulatory treatments) rough estimates for long-term disabilities will be made.

4.7 Economic burden

Generally, the economic burden of a group of health disorders like injuries comprises all direct or indirect costs. Direct costs are all financial flows, which are triggered by the incidences under study and which in principle can be directly observed, that is the value of all goods, services, and other resources that are consumed with respect to diagnosis and treatment of sports injury, including restoration of function, as well as with respect to the provision of other interventions, including costs related to its side effects or other current and future consequences. In injury cost analysis, direct costs may comprise both costs related to the injury (e.g. medical treatment) as well as to the event (e.g. material damage). Indirect (socioeconomic) costs include also other economic losses, mainly the loss of productivity due to sick-leaves, impairments and years of live lost (Gold et al. 1996).

For sport injuries, there are no comprehensive and comparable estimates at European level available. In practice, only the estimated number of days of indoor treatments can be used as cost indicator. If information about the average costs of a day in hospital is available, an estimate for the economic burden based on this information is given.

5 Mortality

5.1 Methodology

For reporting general figures of injuries frequently the form of a pyramid is chosen (see e.g. WHO 2010b, Bauer & Steiner 2009): Figures shall be given for main levels of consequences of injuries, which also reflect the severity of the lesion: Death, hospitalization, treatment in accident & emergency department, other medical treatments. For assessing the health burden also information about long-term consequences as on permanent impairment is wanted. This information is essential for applying the "health burden" model and for deriving overarching indicators as disability-adjusted life years lost (DALYs). Moreover, long term consequences may be the most costly outcome of an injury, at least in developed welfare-states. Therefore this study makes an attempt to estimate also long-term disabilities due to sport injuries.

Fatal sport injuries are relatively rare (e.g. compared to about 50.000 fatal road crashes in the EU), and most of them are related to some forms of sports, which contain specific high risks by the nature of these activities, like aviation sport (fall from great high), water sport (drowning), or motor sport (high speed crash). In most other sports, a loss of control hardly releases sufficient energy for fatal injuries as in football, athletics, or gymnastics. Based on several national studies, Petridou (2002) estimated that in the European Union (of 15 countries in 2002) each year more than 700 individuals die from a sports injury.

Within this study the attempt was made to derive estimates based on available international mortality statistics. Unfortunately, the WHO Mortality Database (WHO MDB) and Eurostat Causes of Deaths Register (Eurostat COD) do not reveal "sport injuries" explicitly. The underlying classification system (in most countries ICD-10; WHO 2010) provides codes for the "place of occurrence", whereas "3" indicates different sports and athletics area, and codes for "activities", whereas "1" indicates sports activities. Unfortunately, in reality the mortality statistics apply only the "place of occurrence" codes, whereas moreover in the majority of cases this digit is "9" (not specified).

As approximation the following procedure has been applied:

- ICD-10 codes of chapter XX ("External causes of morbidity and mortality") which most probably depict sport injuries were selected: V100-V189 (non-traffic bicycling), V800 (equestrian activities), V904-909, V914-919, V924-929,

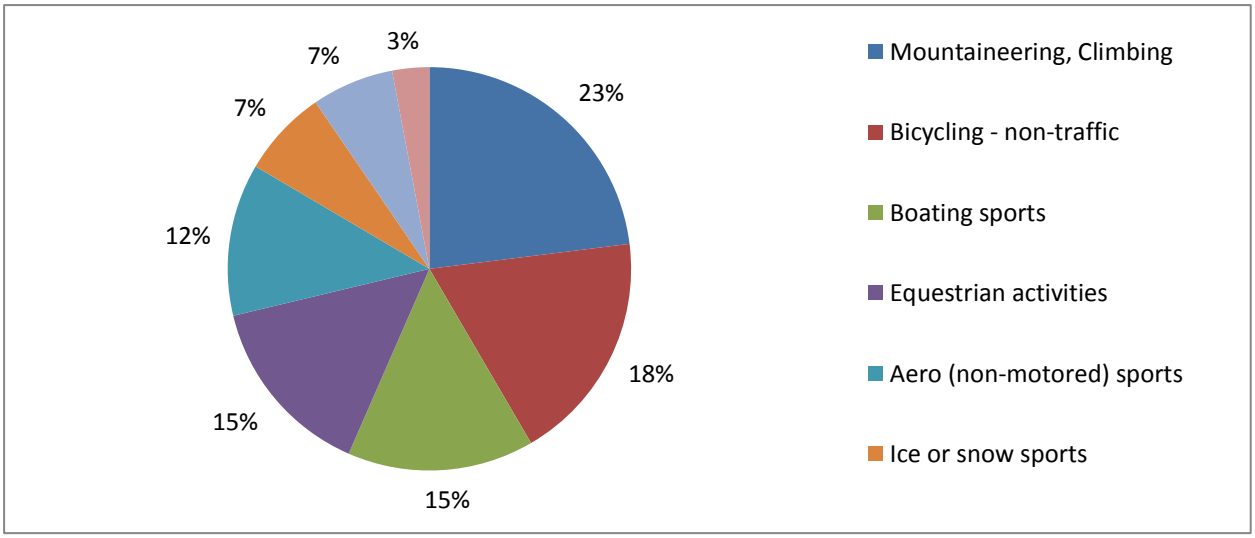
V934-938, V944-949 (boating), W020-029 (ice/snow), W158-159 (mountaineering, climbing), W168-169 (diving), X368-369 (avalanche), V951, V960-969, V972 (aviation). For a wider estimation also ICD-10 categories for swimming were included: W698-699, W708-709, W738-739, W748-749

- The WHO MDB (for 27 EU Member States, years 2005 – 2007) was searched, and all cases with one of the selected codes were taken as "accidental sport deaths" for further analysis of related (risk) factors. ICD-10 data from 18 EU member states were available and could be used: AT, CZ, DK, DE, IE, ES, FR, IT, LT, LU, HU, MT, NL, PL, RO, FI, SE, UK.
- For the projection for the entire Union (EU-27), the proportion of sport deaths within all unintentional fatal injuries was used. Based on ICD-10 coded data of EU member states of the WHO Mortality Database, Bauer & Steiner (2009) estimated that in the years 2005-2007 in the average annually 179.070 unintentional fatal injuries occur.

5.2 Results

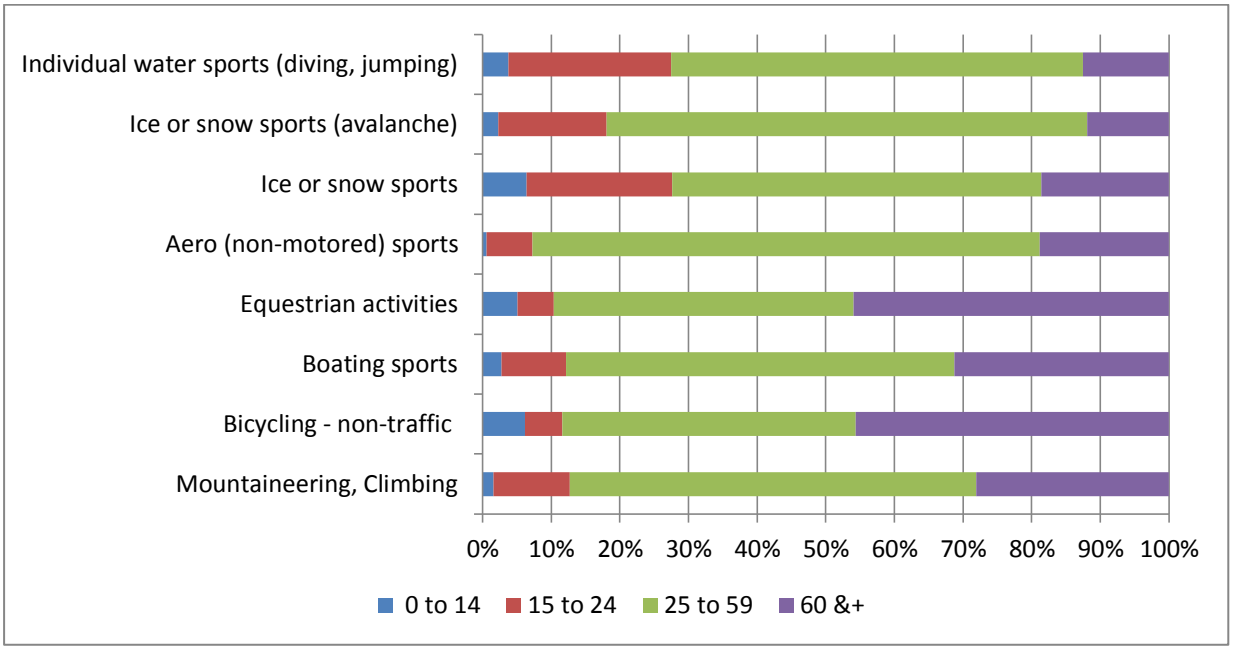
This approximation procedure does not detect casualties in very common sports (e.g. football, athletics, or gymnastics), which leads to an underestimation. The following quotes from the WHO mortality database are meant only as rough estimates about the scope of fatal sports injuries. For a conservative estimate, about 6 in 1 000 unintentional fatal injuries can be related to broad categories of sports, like rock climbing, boating sports, or horse related sports, as shown in table/figure 4. These sports categories are derived from WHO ICD mortality codes like "hang-glider accident" (aero sports), "fall from cliff" (climbing), or "fall involving ice-skates or skis" (ice or snow sports). For details see Bauer & Steiner (2009). The data were extracted in May 2010.

This "lower rate" (179.000 x 0.006) translates into a rough estimate of 1000 sports fatalities per year in the EU-27 (501 million inhabitants). This estimate corresponds relatively well to the estimate of Petridou et al. (2002) of 700 deaths in the EU-15 (399 m. inhabitants), which is based on a similar methodology. For a more general estimate, when certain types of drowning (in natural water and swimming pools) and non-traffic bicycle accidents are included, about 36 in 1000 unintentional injuries can be related to recreational and sports activities. This rate (179.000 x 0.036) translates in to an approximate estimate of 7000 fatalities per year in the EU-27 (with more than 80% of cases related to swimming and drowning). It needs to be noted that non all cases of drowning in natural water and swimming pools are associated with "sport" in the narrow sense.



Table/figure 4: Fatal sport injuries in the EU by type of sports (excluding swimming)

Table/figure 5 illustrates that adolescents and young adults between 15 and 24 years of age are over-represented particularly in "individual water sports" (mainly jumping into water) and "Ice or snow sports", a fact that should be taken into consideration for targeting injury prevention among adolescents and young adults. Senior citizens are disproportionally involved in fatal riding, bicycling, boating and mountaineering accidents.



Table/figure 5: Fatal sport injuries in the EU by type of sports (excluding swimming) and age group

6 Morbidity

6.1 The European Injury Database EU IDB

The analysis of non-fatal sport injuries is based on hospital data gathered and made available through the EU Injury Database (EU IDB), as there is no other suitable source at EU level. Neither Eurostat nor WHO data on hospital discharges reveal sport injuries. National hospital statistics usually are based on simplified ICD-coding which makes it impossible to identify sport injuries, not even for rough estimates as possible for fatal injuries. Segui-Gomez et al. (2008) explored extensively the usability of national hospital statistics for analysing injuries, created a specific database, and demonstrated the usability of hospital discharge data for calculating various general burden indicators, but revealed also, that these data cannot be used for deriving valid figures on non-fatal sport injuries at EU level.

As there is a strong need for better information about injuries, in particular about external circumstances as activities, settings, and involved products, the EU IDB has been set up as complementary injury surveillance system. Information on external causes and circumstances is needed for developing prevention measures, for setting priorities in injury prevention, and for guiding and controlling prevention programmes. For workplace related injuries and road crashes such surveillance systems has been set up already for a long time, but not for other injuries. Considering that home, leisure and sport injuries outnumber work and road accidents by far, it may surprise that the EU IDB data collection is still not implemented in all member states (Kisser et al. 2010). Currently, a new joint action of the Commission and member states has been set up for achieving the roll-out to the remaining countries and for establishing comparable national indicators for home, leisure, sport and school injuries for all member states (Eurosafe 2012a).

The EU IDB was established and funded by the European Commission Directorate General for Health and Consumer Protection in 1999 to host data collected by the Member States on injury hospitalisations and emergency visits for unintentional injuries in the home and leisure environments. The EU IDB was formerly called the European Home and Leisure Accidents Surveillance System (EHLASS), as it originally was restricted to unintentional injuries at home and during leisure time (Danish Institute of Public Health & Psytel 2002). Meanwhile the system has been expanded to all injuries and covers today also road traffic, work related injuries, and injuries due to interpersonal violence and self-harm (Consumer Safety Institute 2005). It comprises treatments in accident and emergency departments (ambulatory treatments as

well as admissions) from a random or exhaustive sample of hospitals in Member States. The EU IDB provides information on external causes and injury circumstances, specifically: age and sex of the victim, injury place of occurrence, activity during injury, sports practiced during injury, type of injury, part of body injured, mechanism of injury, treatment and follow-up of injury, a free text description of the event and products having a role in the injury—a product refers to any object in the environment, ranging from a floor surface to furniture, toys, etc. that causes or is involved in the injury. Currently (for the years 2006-2008) the database includes data from 11 countries. (AT, CY, DK, FR, GE, LV, MT, NL, PT, SE, SI); yearly approximately 400,000 cases are collected from a total of about 70 hospitals. The database can be used for analyses by everyone through the Heidi-Wiki web-gate (European Commission 2012), although only aggregated can be retrieved according to data protection regulations.

Moreover, the EU IDB calculates crude incidence rates based on the aggregated "catchment population" of the hospitals of the participating countries. Two main methods are used to define a "catchment population" and calculate an estimate of national incidence from the IDB sample. One is a population based method (calculation of local or regional incidence rates through identifying and quantifying a catchment area for a given hospital) and the second a patient registry based method (using the sample ratio, percentage of cases in the sample versus all cases, to extrapolate any selection of IDB data to the total number of equivalent cases in all hospitals of the country) (Eurosafe 2012). Austria, the Netherlands and Portugal use the patient registry based method and Denmark, France and Sweden use the population based method. Nevertheless, these incidence rates are not fully comparable as they are based on biased samples in many countries. More sophisticated calculation methods (with correction factors applied for balancing the sample) shall be developed in the course of the mentioned JAMIE-project till 2014.

The project ECHIM (European Health Indicators Monitoring) has recommended to all member states to provide comparable register-based incidence rates on home, leisure, and school injuries (ECHI 29b), has put this indicator on the short list, which shall be implemented through implementation acts based on the EU-Regulation 1338/2008 (European Parliament & Council 2008). More information on ECHIM can be found at the ECHI web-gate (ECHIM 2010b).

EU IDB operates in a – 5–10% – sample of hospitals with a round-the-clock emergency service and can operate at a reasonably low cost – compared to a full coverage of all cases or alternative household surveys. Despite many harmonization efforts undertaken by the respective data centres and data providers in the member states, neither injury statistics nor incidence rates are always completely comparable and the

differentiation in sections of injury surveillance is not always clear-cut. There are many reasons for this ranging from differences in the organization of the national health care systems to cultural differences in the reporting of injury causes. The EU IDB is a selection of cases that come into contact with the hospital accident and emergency department. As a result certain data limitations and biases must be taken into account when comparing data sets; specifically differences in sampling, extrapolation methods and heath care consumption and hospitalisation practices across countries (accessibility, specialisation of the hospitals causing under- or overrepresentation of certain injuries, etc.) (Bauer 2005).

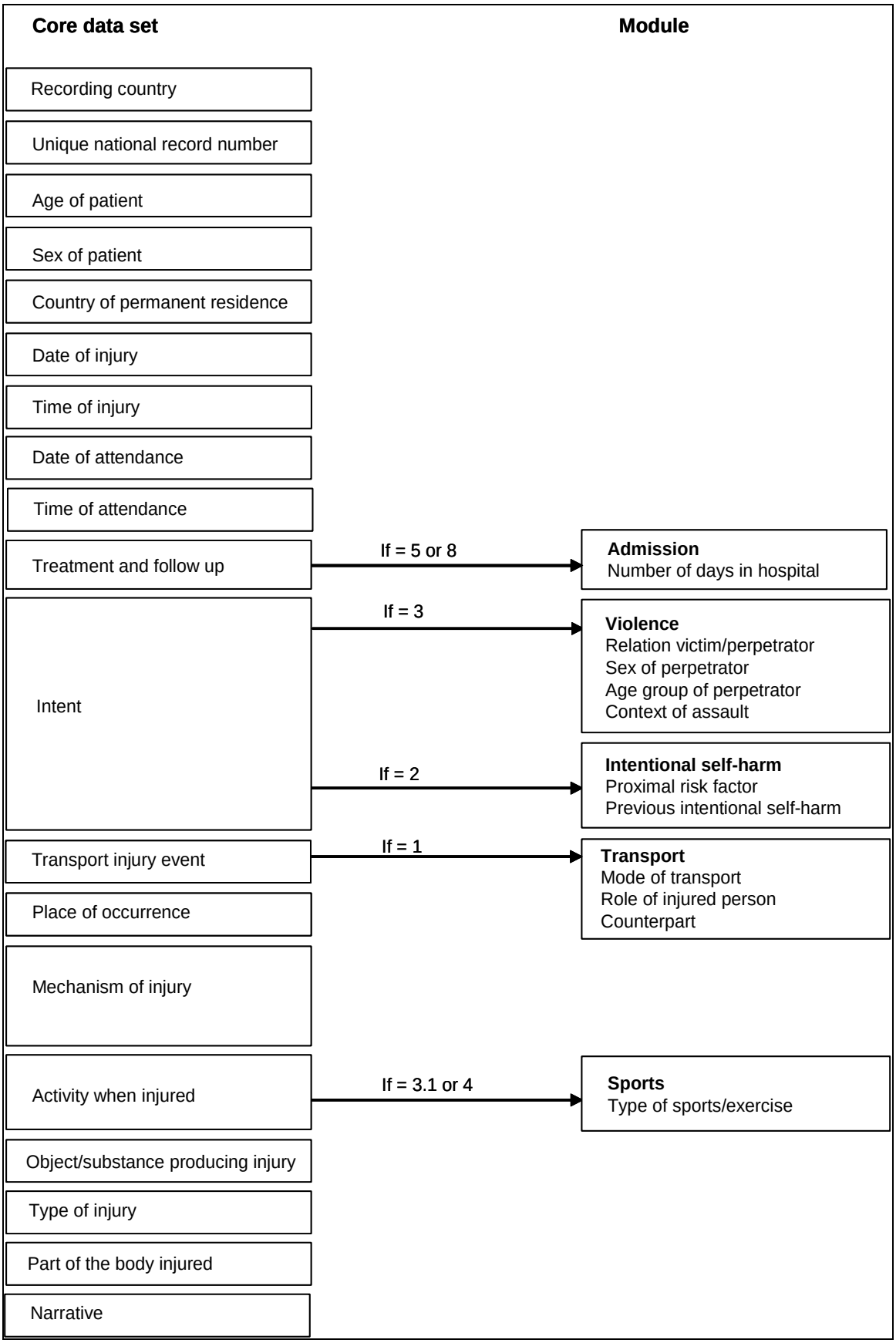
Country differences impacts the validity of the injury incidence calculated in each country. For example, because of the high share of general practitioner treatments in the Netherlands the incidence of hospital treated injuries in this country is overall generally lower than in the other EU IDB countries. The extent to which the results apply to any single or all countries cannot be assessed with the data at hand, in part because the sample of countries may not be representative of the whole of Europe and are biased to the north-western part of Europe, which overall includes countries with higher GDPs than the rest of the European Union countries. In order to be able to make national comparisons, these biases and comparability between IDB data sets must be assessed and improved through the use of indicators (e.g. certain types of fractures that are almost certainly hospital treated in all Member States thus less sensitive to health care system biases) (Lyons et al. 2006a, Polinder et al. 2008), as well as the use of additional data sources such as hospital discharge data. Until these capabilities are achieved it is recommended to use an aggregated incidence as performed in this study.

For the future of emergency department injury surveillance it is essential to link as much as possible with relevant standard classifications in health care. The International Statistical Classification of Diseases and Related Health Problems (ICD) is the standard classification within health care, but does not provide enough detail for injury prevention (Kisser et al. 2010). The International Classification of External Causes of Injuries (ICECI) is related to the External Causes chapter of the ICD and accepted by the World Health Organization (WHO) as a member of the WHO Family of International Classifications (WHO 2003b). Therefore, ICECI was the major guideline for developing the IDB coding manual (Consumer Safety Institute 2005).

The IDB coding manual only includes the data elements for which information will be sent to a central database of the European Commission. The manual includes 18 data elements and a narrative in the core data set and five modules with in total 11 data elements only to be coded for specific types of injuries. Information on all data elements included in this coding manual has to be sent to the European Commission

(in the same sequence as in this coding manual). Table/figure 6 shows the data elements included in the coding manual (core set and modules) and the relationship with the modules. In most of these data elements there is hierarchy. The first part of the code corresponds to the information at the first level, while the second and/or third part specifies the information given at the first and second part, respectively. This hierarchy means that codes on a more detailed level can usually be aggregated to a lesser level of detail. The guiding rules are explicitly mentioned in the text of the data elements. In general, these rules follow the ICD coding rules. An important general guideline is to code the 'direct' cause instead of the 'underlying' cause. More information about this guidance can be found in the relevant sections of the data elements. Terms used in the coding manual have the meanings given in the glossary.

By 2008, 11 countries – AT, CY, DK, FR, IE, IT, LV, NL, MT, PT, SE – have implemented the EU IDB and made their data available on the web via the internet, though at still varying levels of detail and completeness of the IDB data set. Many of them – AT, CY, DK, IE, LV, NL, MT – have extended their data collection from 'Home and Leisure Accidents' to 'All Injuries', providing them with detailed external cause information – e.g. activity, type of sports, place of occurrence, mechanism, involved products and a narrative description of the injury scenario – comparable across all sectors of injuries (European Commission 2012).

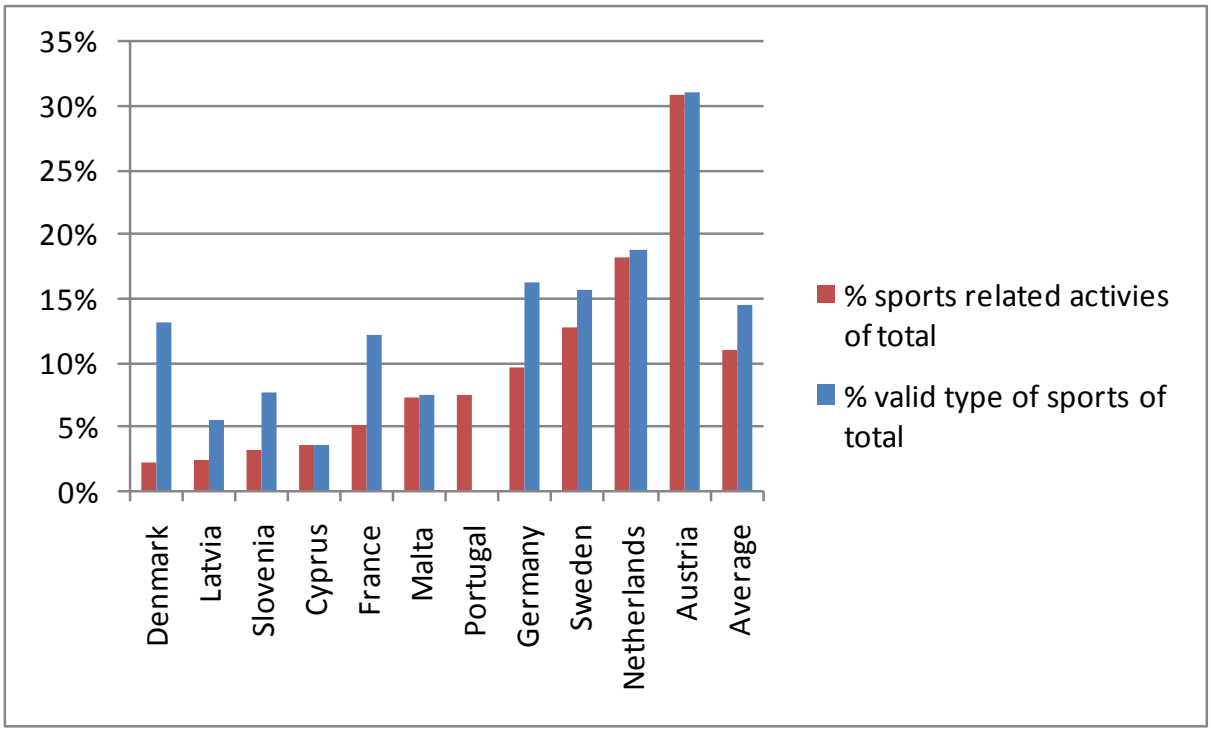


Table/figure 6: EU IDB core data elements and extension modules for specific cases

6.2 Methodology

A three year average of EU IDB data (2006 – 2008) of the eligible eleven IDB countries is used in the report to indicate the EU scope of sports injuries. All cases with any given sport activity during injury" have been used. The data were extracted in August 2011. 57.905 cases out of 793.482 cases matched the search criterion, representing 14% of all cases. For the projection it has been assumed that the sample from eleven countries is an unbiased, random sample of all sport injuries treated in emergency departments in the entire EU-27. For time series all available IDB data 1996 – 2008 were used.

The results for two definitions of sports injuries are given in table/figure 7. One is by the IDB variable "activity" the other one is by variable type of sports (see chapter "IDB definition of sports injuries"). The differences reflect national variations in the implementation of the IDB standards, which shall be ironed out in the forthcoming years in the course of the JAMIE-project (Eurosafe 2012a). For the current analysis the definition by type of sports has been used as far as available. Table/figure 8 shows the availability and total number of EU IDB cases data used for this study.



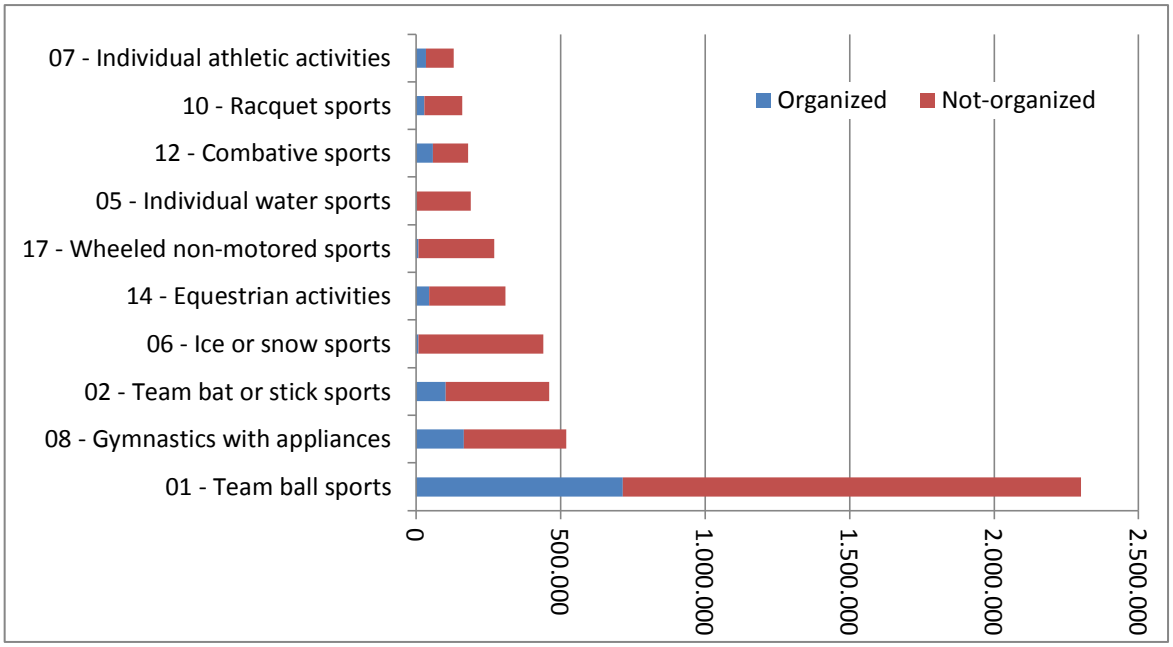
Table/figure 7: Share of cases of sports injuries from all EU IDB cases by country and two different definitions of sports injuries. Source: EU IDB 2006-2008

	2006	2007	2008	sum
Austria	2.328	8.477	11.444	22.249
Cyprus	3.842	2.697	4.974	11.513
Denmark	4.000	4.018	78.663	86.681
France *	12.588	12.692	-	25.280
Germany	429	2.598	2.960	5.987
Latvia	31.746	32.902	36.845	101.493
Malta	1.541	1.785	1.794	5.120
Netherlands	93.234	105.650	96.963	295.847
Portugal *	23.079	15.520	15.419	54.018
Slovenia	29.871	28.987	26.982	85.840
Sweden	2.500	47.484	49.470	99.454
All injury data	169.491	234.598	310.095	714.184
HLA data*	35.667	28.212	15.419	79.298
Total	205.158	262.810	325.514	793.482

Table/figure 8: EU IDB data retrieved for analysis. Source: EU IDB 2006-2008 (*Home, leisure and sport data)

6.3 Results

”Team ball sports” account for about 40% of all hospital treated sports injuries. It is known from various studies (Van der Sman et al. 2003) that this high share does not only reflect that team ball sports are very popular and widely practiced, but also a relatively high injury risk, which is mainly caused by the characteristics of team sport and its typical one-to-situations. By specific type of ball sports the ranking is: Soccer (74%), Basketball (8%), Volleyball (7%), and Handball (3%). The majority of sports injuries result from participation in non-organized sports according to the EU IDB records (Table/figure 9).



Table/figure 9: Estimated number of hospital treated injuries in the EU-27 by organizational framework (from: Bauer & Steiner 2009, figure 13)

The share of women varies substantially among the top 10 types of sport. In most types of sports more men get injured than women (67% overall); notable exceptions are gymnastics (57% women) and horse riding (88% women). This of course reflects gender preferences in the types of sports (table/figure 10).

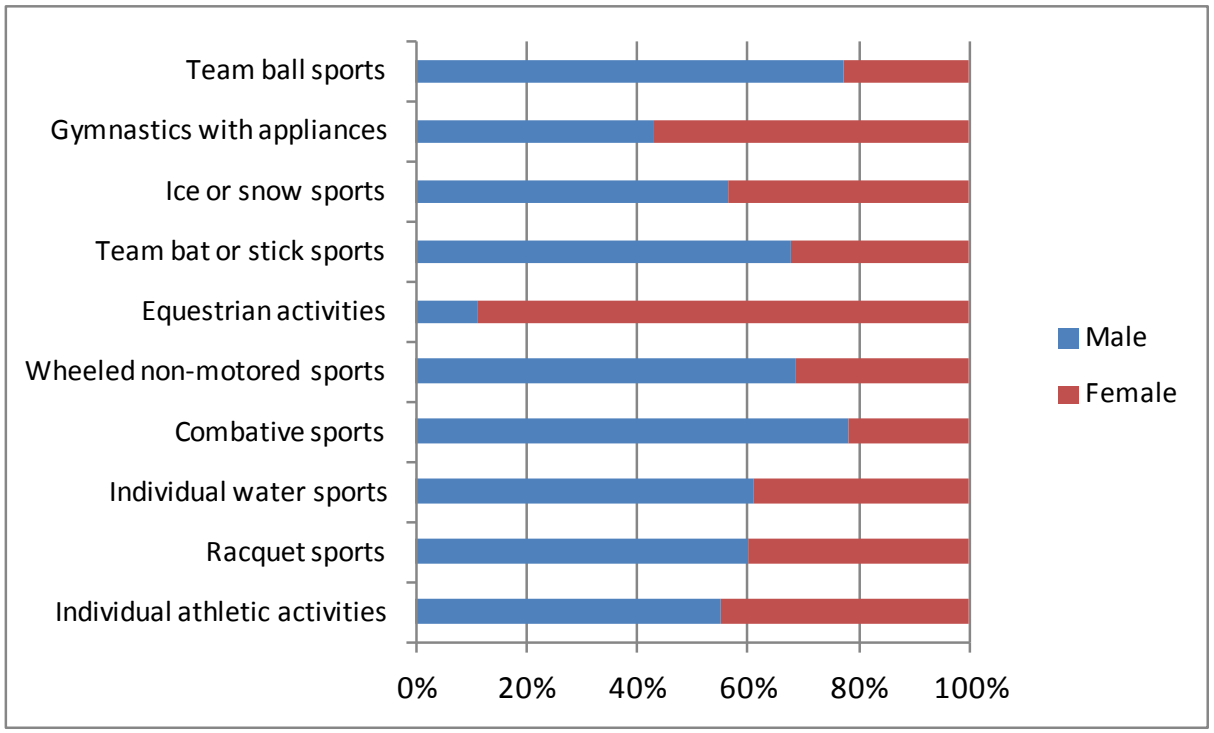
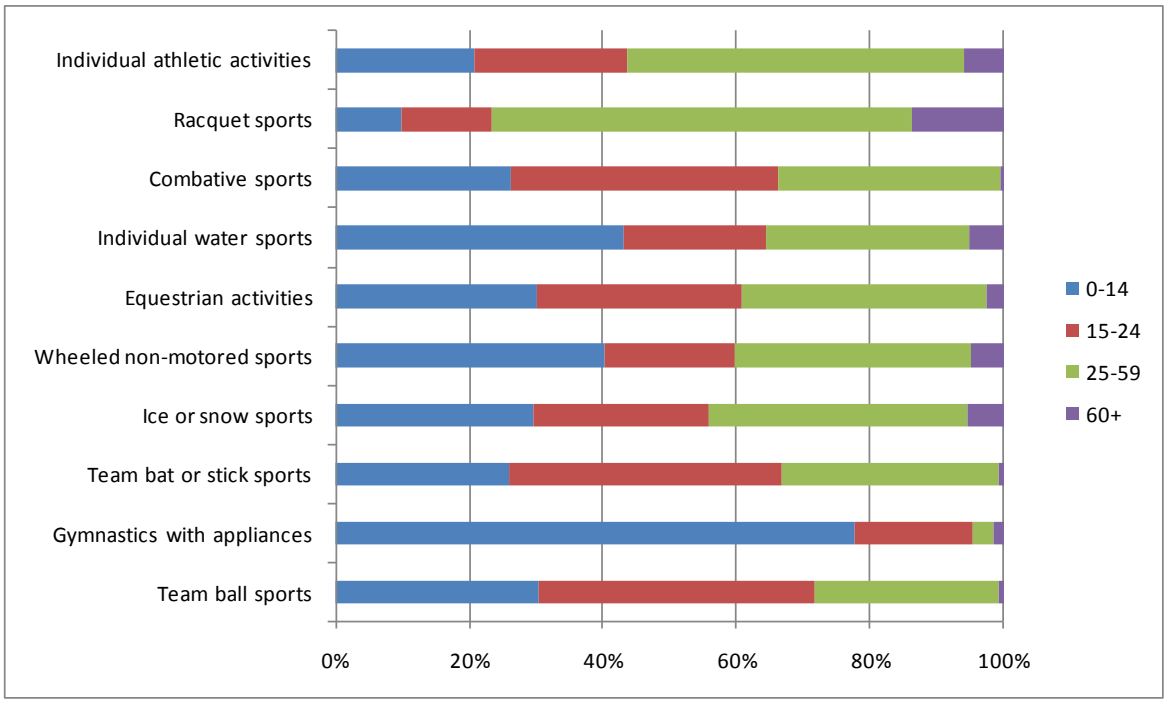


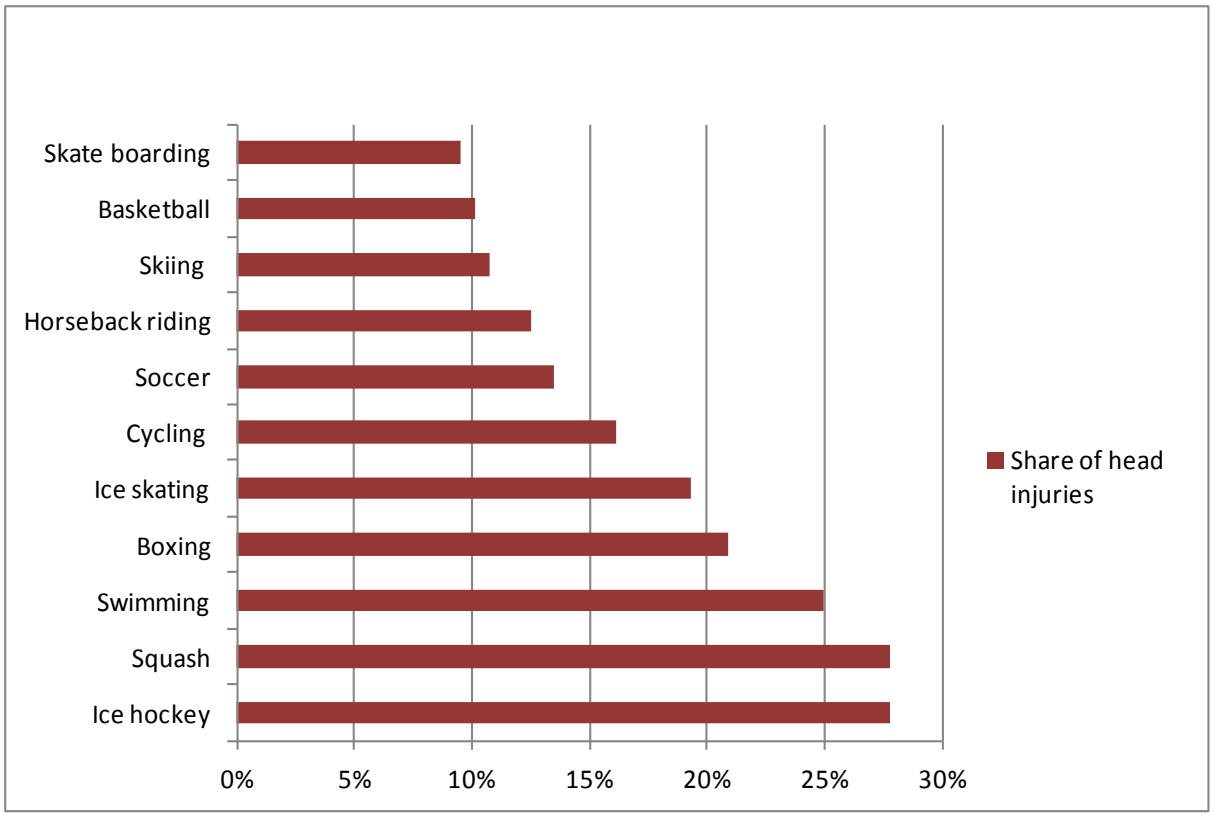
Figure 10: Estimated number of hospital treated injuries in the EU-27 by gender

There are also substantial differences in the preferences of age groups (table/figure 10). Gymnastics with appliances are dominated by children, probably because these are commonly practiced in schools, but much less attractive (or available) for adults. Racquet sports seem to be much less practiced by children, adolescents and young adults than by the older generations (table/figure 11).



Table/figure 11: Top 10 type of sports by age-group of injury victims

The knowledge of the specific injury patterns for each type of sport is important to know in order to adequately address the issue of personal protection equipment in sports. Table/figure 12 ranks the main type of sports by their share of head injuries. In fact, head injuries comprise various types of injuries, from cuts which are quite frequent in squash to brain damage due to lack of oxygen, which is common in near-drowning. Sport helmet protect in particular from traumatic brain injuries due to severe blows. While helmets are well established e.g. in ice-hockey, cycling and horseback-riding, they are much less accepted in squash, and unknown in soccer and basketball.



Table/figure 12: Top 10 type of sports with the highest shares of head injuries

The share of women injured in sports injuries has been steadily increasing in the last 10 years, from 26% in 1998 to 33% in 2007, which is probably caused by an increasing share of women practicing sports (table/figure 13).



Table/figure 13: Sports injuries by sex and year (1996-2008)

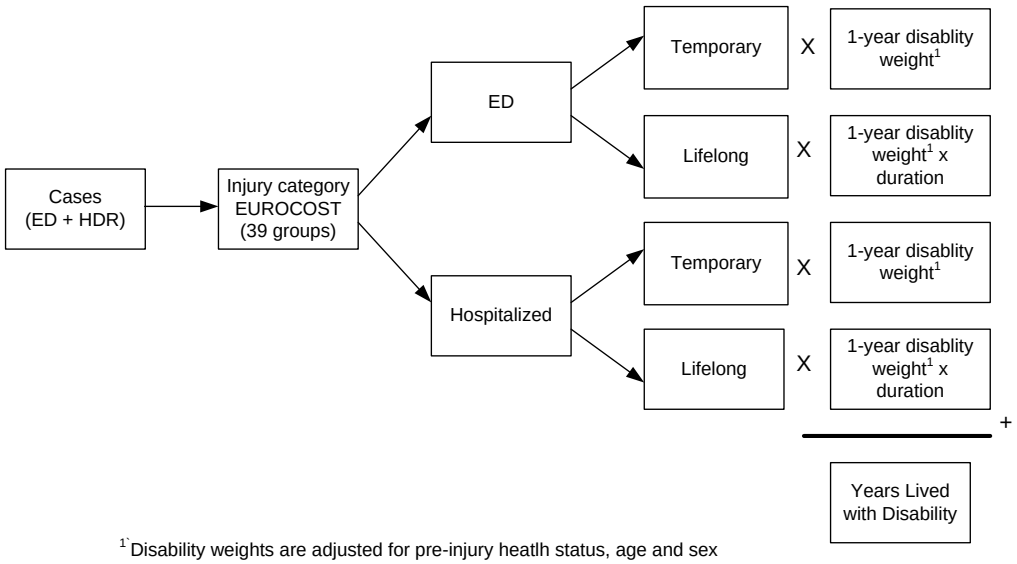
7 Disabilities

7.1 Methodology

Probably the most expensive and most grievous consequences of injuries are long-term or even life-long disabilities. It is clear that sport injuries lead in many cases to long-term consequences, e.g. due to ligament ruptures. So far, there are no comparable measures available which allow for the comparison of groups of injuries regarding their risk of disabilities. The various national and regional data, which are based on insurance or welfare statistics (e.g. on disability pensions, attendance allowances, restrictions of employability), are hardly comparable due to the varying systems.

Usual indicators for severity, as the commonly used Abbreviated Injury Scale (AIS) (Association for the Advancement of Automotive Medicine 2005) are less vivid, as they do not provide a distinction between severe injuries which can be cured completely and injuries which affects the life permanently. Such severity indicators do not allow for estimating the health burden of groups of injuries in terms of disability-Adjusted Life Years (DALYs), which is a convincing measure for the overall health burden due to a specific disease. DALYs combine mortality and morbidity indicators into one easily understandable measure and are the simple sum of Year of Life Lost (YLLs) due to premature death, and Years Lived with Disabilities YLDs (Murray 1996, Polinder et al. 2007).

A relatively new method for calculating the risk for disability of injuries has been proposed by Van Beeck et al. (2007), the so-called Injury Disability Weight (IDW) (see also Haagsma et al. 2008, 2010, Belt & al. 2010). Van Beek & at (2007) have established probability weights for long-term disabilities assigned to 39 groups of ICD injury diagnoses, and this methodology has been further developed for the EU IDB under the INTEGRIS-project ("Improved methodology for data collection on accidents and disabilities"). The INTEGRIS disability component is calculated by multiplying the number of injury cases with a certain health outcome and a predefined empirically established disability weight (table/figure 14). For example, an injury patient with brain-skull injury treated at the ED has a disability weight of 0.09, whereas for hospitalized patients the disability weight is 0.241. 13% of the ED and 23% of the HDR cases with brain-skull injury suffer from lifelong consequences; the disability weight for these lifelong consequences is 0.323. The YLD of lifelong injury is then calculated by multiplying the number of cases with lifelong injury, the disability weight and the average duration.



1` Disability weights are adjusted for pre-injury heatlh status, age and sex

Table/figure 14: Conceptual model of the YLD calculation recommended by the INTEGRIS-project (Belt et al 2010)

7.2 Results

The application of these weights on the IDB-cases, where sufficient information about the diagnoses were available (92.367 cases) lead to the estimate, that 4.6% of all sports injuries result in temporary disabilities, which can be cured within one year, and 0.5% lead to permanent disabilities (actually disabilities which cannot be cured within one year). This preliminary estimate means that there are annually about 30.000 new cases of permanent disabilities due to sport injuries in the EU-27 (table/figure 15).

Basic figures	
EU IDB cases processed [1]	92.367
Estimated share of cases with temporary disability [2]	4.61%
Estimated share of cases with permanent disability [2]	0.52%
Estimated cases in EU-27	
Estimated no. of sport injuries per year in EU27, treated in hospitals [3]	5.800.000
Temporary disabled	267.000
Life-long disabled	30.000
Sources	
[1] EU IDB 2006-2008 [2] Belt et al. (2010) [3] Bauer & Steiner (2009)	

Figure/table 15: Estimated number of disabilities due to sport injuries in the EU-27

8 The health burden of sport injuries

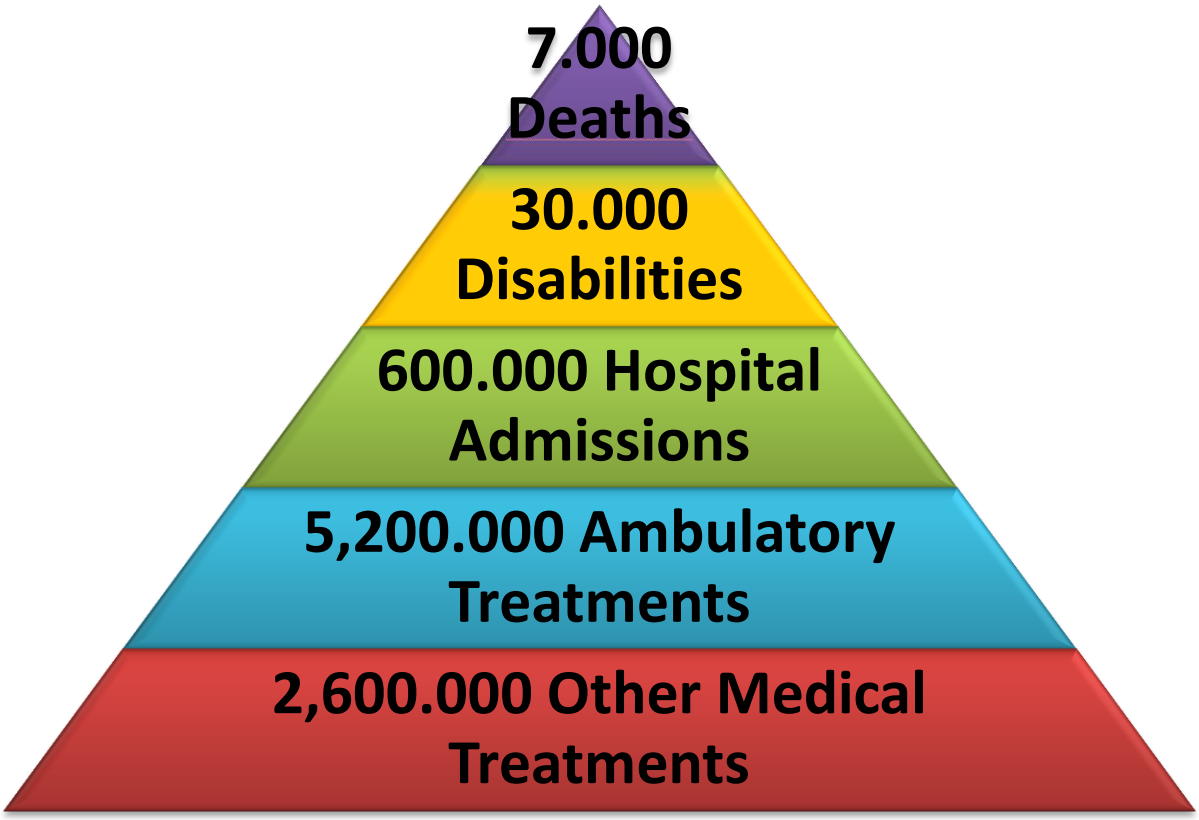
Annually, about 4.5 million people aged 15 years and above have to be treated in hospital for a sports injury as defined by the EU IDB catalogue of sports. Of those aged 15 years and above, 25% of sports injuries affect the 15-24 old category. When children under the age of 15 are included, the estimate is 5.8 million sports injuries treated in hospitals annually in the EU-27 (table/figure 15), which is about 14% of all unintentional injuries ("accidents"). Additionally roughly 2.6 million more are medically treated outside hospitals, e.g. in doctor's offices. The latter figure is only a rough indicator, based on an older study carried out in 2003, based on analyses of various national household surveys (Bauer 2003). Nevertheless, this figure is quoted here, as most probably better estimates will be available in the future due to the implementation of the European Health Interview System, which will ask explicitly for accidents and injuries at home and during leisure activities and consequent medical consultations (Eurostat 2006, 2010, 2012). This system is to provide indicator ECHI 19a (Home, leisure, school related injuries: self-reported incidence). Although there is no explicit question or answer category regarding sport, but nevertheless with using the shares established by the EU IDB monitoring system estimates on all medical treatments of sport injuries will be possible.

Bauer and Steiner (2009) have developed a comprehensive picture on all injuries for the responsible policy domains (road, work-place, school, sport, home and leisure, interpersonal violence and self-harm) by forms of treatment, indicating the severity of injuries (deaths, hospital admissions, ambulatory treatments, other medical treatments). This table allows for a comparison of the importance of sport injuries with other injuries (table/figure 16).

	Road traffic	Work-place	School	Sports	Home, Leisure	Total of unintentional injuries	Homicide, assault	Suicide, self-harm	Total of all injuries
Fatalites	50 530	6 080	?	**7 000**	115 460	**179 070**	5 540	58 940	**255 850**
	20%	2%	?	**3%**	45%	**70%**	2%	23%	**100%**
Hospital Admissions	1 000 000	300 000	100 000	**600 000**	4 500 000	**6 500 000**	300 000	400 000	**7 200 000**
	14%	4%	1%	**8%**	63%	**90%**	4%	6%	**100%**
Hospital Outpatients	3 300 000	3 200 000	600 000	**5 200 000**	20 800 000	**33 100 000**	1 500 000	200 000	**34 800 000**
	9%	9%	2%	**15%**	60%	**95%**	4%	1%	**100%**
All Hospital Patients	4 300 000	3 500 000	700 000	**5 800 000**	25 300 000	**39 600 000**	1 800 000	600 000	**42 000 000**
	10%	8%	2%	**14%**	60%	**94%**	4%	1%	**100%**
Other medically treated	1 900 000	1 500 000	300 000	**2 600 000**	11 200 000	**17 500 000**	800 000	300 000	**18 600 000**
All medically treated	6 200 000	5 000 000	1 000 000	**8 400 000**	36 500 000	**57 100 000**	2 600 000	900 000	**60 600 000**

Table/figure 16: Comprehensive view on injuries by domains responsible for prevention (Bauer & Steiner 2009)

5.8. million in hospitals treated sport injuries (or 8.4. medically treated injuries in total) count for about 14% of all unintentional injuries ("accidents"). About 9% (or 0.6 million cases) have to be admitted for further treatment. This share, which can be seen as a rough indicator for the average severity of sport injuries, is significantly lower than for all unintentional injuries (20%) and for road traffic injuries in particular (30%). The cut-off of sport from table/figure 15 and the inclusion of the estimate on disabilities allows for the common representation of the health burden in form of the "injury pyramid" (table/figure 17).



Table/figure 17: The Sport injury Pyramid for the European Union (EU-27) including disabilities

9 Estimated health costs of sport injuries in the EU

9.1 Methodology

Similar to the indicators for the burden of disease, cost estimates allow for rapid comparisons of several diseases or groups of injuries. Cost estimates reflect also frequency and severity by a joint measure indicating the health care needed. Moreover, cost estimates provide the opportunity to show where and how much expenditures might be saved, in particular through the reduction of frequency and severity of injuries due to prevention programmes. In past years many cost-of-injuries studies have been carried out and extensive knowledge about this approach has been gained (Van Beek & Mulder 1998, Koffijberg et al. 1998).

Generally, two approaches can be distinguished. The first approach targets on expressing all damages due to injuries in monetary terms: health care, rehabilitation, damages to properties, loss of productivity due to sick leaves and disabilities, accident annuities, disability annuities etc. The intention is to provide a comprehensive estimate as accurate and complete as possible, in order to make aware that prevention will pay off. Numerous models have been proposed, but comparable data from EU member states for applying such comprehensive models are hardly achievable, or only at high expenses. The second approach targets on cost estimates which can be easier derived on the basis of routinely published data, in order to get comparable data for various topics, countries or years at low costs. The second approach accepts that such cost indicators reflect only parts of the true costs to societies, e.g. only the direct health care costs.

In order to make injury costs internationally comparable, such a uniform method has been developed in the framework of the so-called EUROCOST-project, which was co-funded by the European Public Health Programme, based on treatments in hospitals in EU member states. The method has been originally developed in the Netherlands (Mulder et al 2002) and its application has been comprehensively described in the final report on the EUROCOST project (Meerding et al. 2002, Polinder et al. 2004, 2005, 2007). In this report only the major characteristics of the method are referred.

The method uses an incidence-based approach, calculating the medical costs of injuries occurring in a specific year. The incidence-based approach multiplies the incidence of specific patient groups (defined by injury type and severity level, age and sex) with the average costs of that patient group. Subsequently, the costs of all pa-

tient groups are summed up. Two primary data sources were used to estimate the incidence of injuries: Emergency Department (ED) based surveillance systems and Hospital Discharge Registers (HDR). For this reason, the calculation of medical costs of injury is restricted to ED costs and inpatient hospital costs. The definition of unit costs (costs per ED-visit and costs per in-hospital day) were internationally harmonised as well in this project. The cost calculations are directed primarily at the economic costs of injury, and do not include the 'human costs' and does not cover direct non-medical costs and indirect costs.

For the purpose of this report, which is to provide a cost indicator at EU level, which in principle could be reported and monitored as a matter of routine in forthcoming years, the unit costs published by Polider et al. (2004, 2008) have been updated by the average inflation rate for the Euro-zone (17 countries). For the years 1999-2011 the average annual rate was 2.06% (Eurostat 2012), summing up to an estimated cost increase of 31.37% till the beginning of 2012. This approach assumes that the cost development in hospital care has been the same as the general inflation. Table/figure 18 shows the resulting estimated costs per cost units.

Country	Unit cost inpatient day (€)	Unit cost ED visit (€)
Austria	461	97
Denmark	465	113
France	380	99
Italy	363	81
Latvia	219	57
Malta	280	74
Netherlands	365	99
Portugal	298	78
Slovenia	291	76
Wales	227	103
Median value 1999 [1]	330	90
Estimated median value 1.1.2012 [2]	434	118
Sources		
[1] Polider et al. 2004: EUROCOST-study		
[2] Correction for the inflation rate 1999-2011: 13 years, average 2,06% p.a., total 31.37% (Eurostat 2012)		

Figure/Table 18: Cost per inpatient day and ambulatory treatment in various EU-countries

Further assumptions are needed regarding the medical costs of fatalities. Some victims die immediately without any medical intervention and without creating costs in the health care system, while others die after a more or less long period of finally not successful treatment. The relation of fatal injuries in the Austrian hospital discharge statistics and in the mortality statistics indicates that about the half of deceased injury victims die in hospitals. Without further analysis of this relation in other European countries it has been assumed, that the average treatment costs of a fatal sport injury are 50% of the estimated average costs of a victim admitted to hospital. Treatment costs for deceased persons need to be added, since the estimated number of in-patients is based on IDB-data, which cover almost exclusively non-fatal injuries. Furthermore it has been assumed – also without analysis of this cost-relation in European countries - that the average costs per GP-patient are the same for ED patients.

9.2 Results

The application of the cost factors of table 17 to the estimated figures of figure/table 15 (Bauer & Steiner 2009) leads to estimated direct health costs of sport injuries of at least 2.4 billion € in 2012, as tabled in figure/table 19.

	Cases per year [1]	Average cost per case (€) [2]	Estimated total costs per year (€) [3]
Fatalites	7.000	434 x 5.4 = 2.344	3500 x 2344 = 8.200.000
In-Patients	600.000	434 x 5.4 + 118 = 2.462	600000 x 2462 = 1.477.200.000
ED-Patients	5.200.000	118	5200000 x 118 = 613.600.000
GP-Patients	2.600.000	118	2600000 x 118 = 312.000.000
Total	8.400.000		2.411.000.000
[1] Bauer & Steiner 2009			
[2] Polider et al. 2004: Average costs per inpatient case comprise 2.344 € for admission of 5,4 days on average plus 118 € ED costs of one follow-up treatment; estimated values for 2012, adjusted for the inflation 1999-2011, EUROSTAT, 2012.			
[3] 50% of fatalities assumed to occur in hospitals			

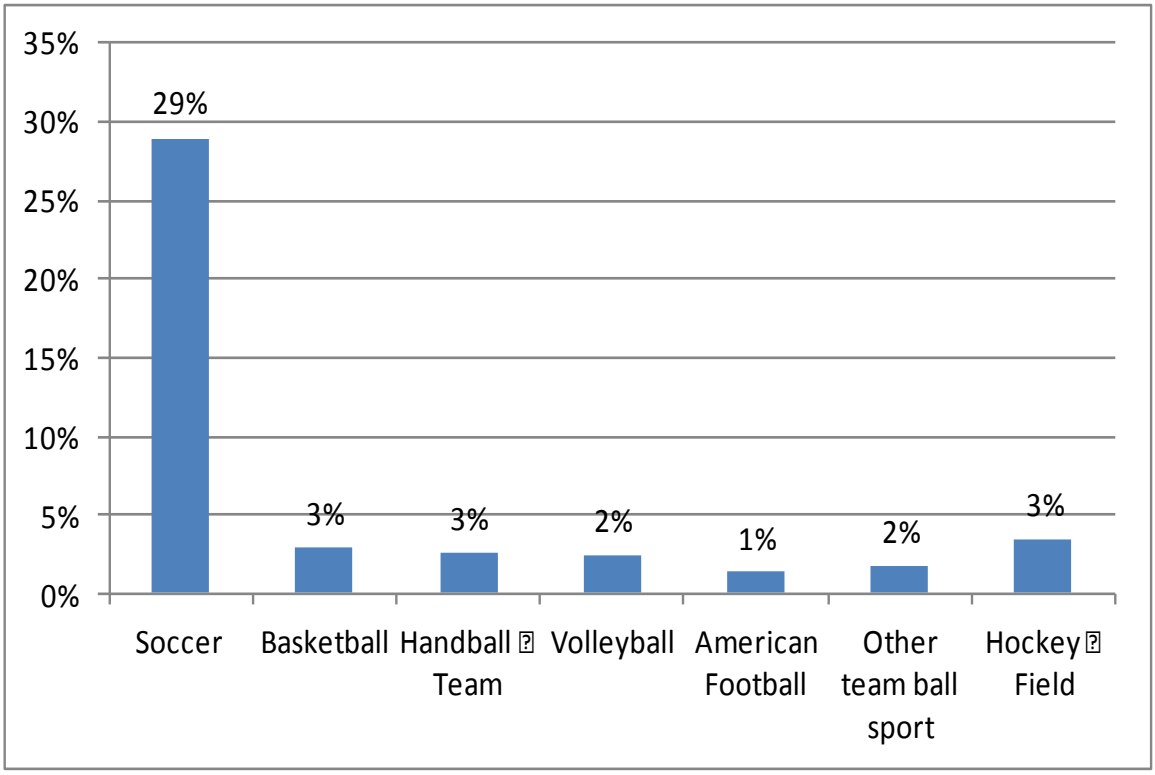
Table/Figure 19: The medical cost of sports injuries in the European Union (EU27)

This methodology allows for indications e.g. of general settings, activities, injury types or age groups that should be given priority in injury control policy in Europe.

10 EU IDB results on injuries in team-ball-sports

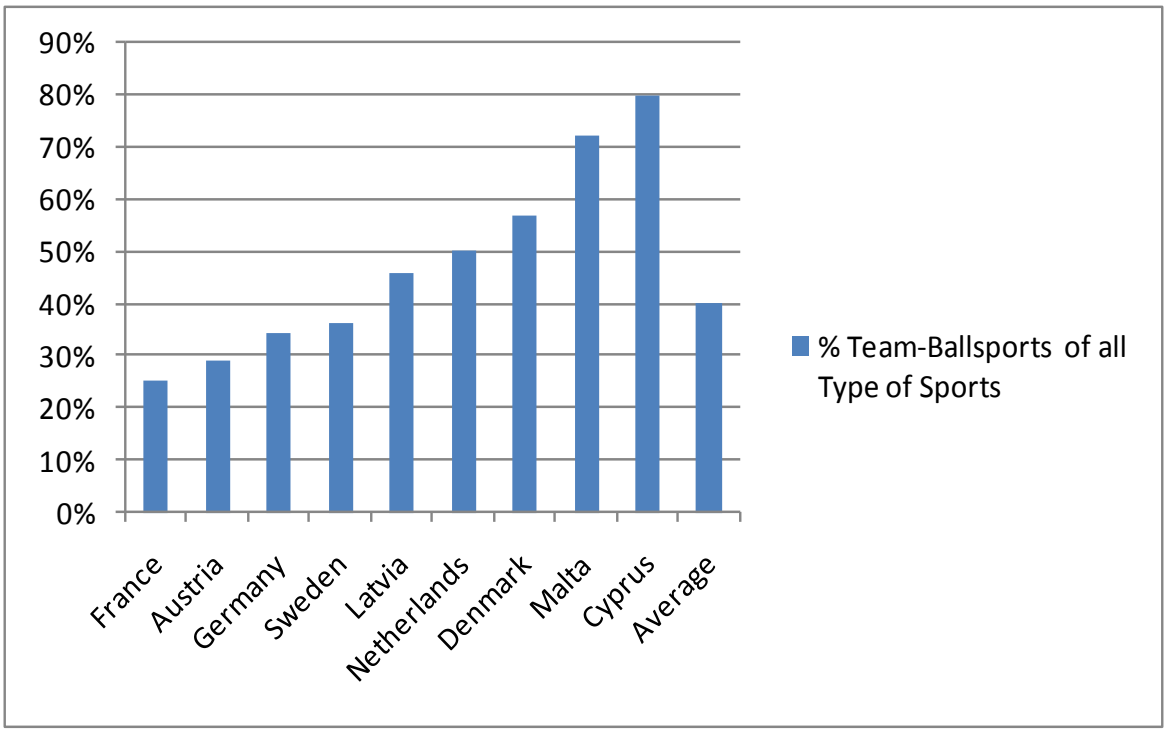
10.1 General results

The project "Safety in sports" focuses in particular at team ball sports which has been identified as "high risk sports" due to high frequency of injuries in relation to the time of activity. All types of team ball sports together count for 43% of all sport injuries in the EU (table/figure 20). Football, which is by far the most popular team ball sport, has by far the biggest share also of the injuries. For the most common team-ball-sports (football, handball, basketball, volleyball, rugby, and field-hockey) inventories of prevention measures has been produced as specific deliverables of the "Safety in Sports" project (Henke & Luig 2010, Luig & Henke 2010, Steinwender 2010a, 2010b, 2010c, 2010d, 2010e). In order to complement these inventories additional analyses of the injury patterns have been carried out. For this analysis the data of nine countries could be used (AT, CY, DE, DK, FR, MT, NL, LV, SE) while the data from two countries (PT, SI) does not differentiate between sports. Table/figure 20 shows the percentage of team ball sports in all sports injuries for these nine countries jointly. Although this sample of countries cannot be considered as representative for the entire EU of 27 member states in statistical terms, the results can be taken as the currently best available estimates. When, in the future, the IDB injury monitoring system will be implemented in additional countries the accuracy and validity of the estimates given will improve.



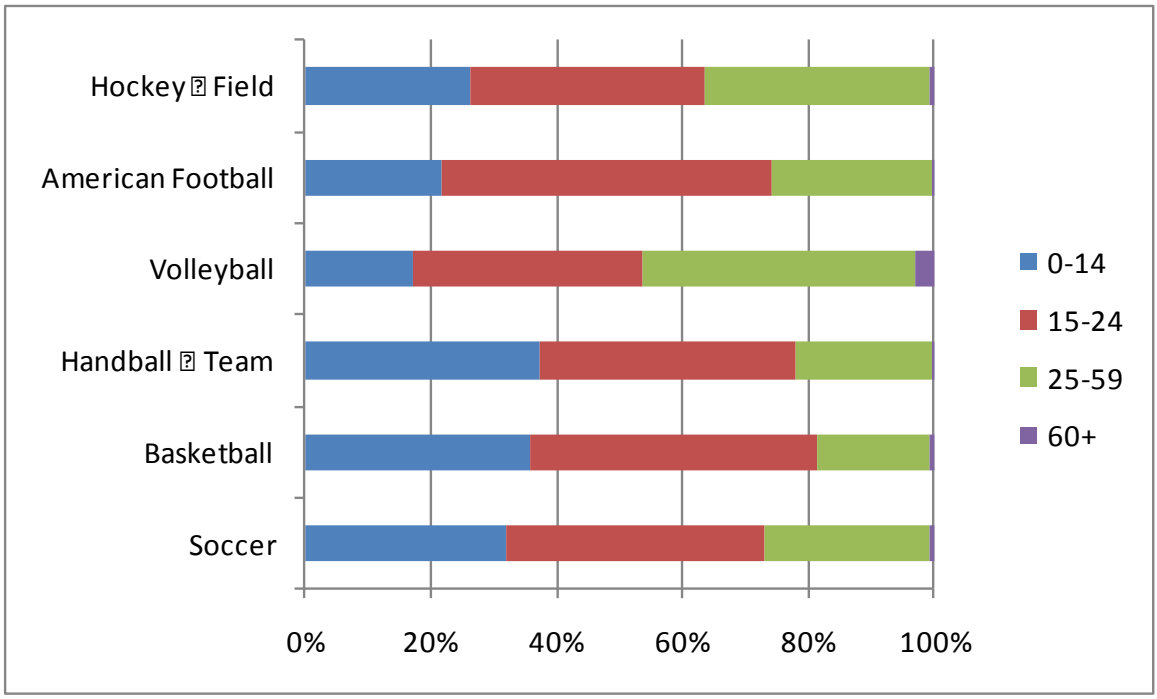
Table/figure 20: Share of team ball sports in all sport injuries in the EU-27 (Source: EU IDB 2006-2008)

The share of team ball sports of all sport injuries varies quite substantially between countries, from 25% (France) to 80% (Cyprus): see table/figure 21. It must be assumed that this result is not only the expression of the different popularity of team ball sports in these countries, but also of biases of the national sampling methods, which are based on randomly selected hospitals and their specific catchment populations of patients. It must be concluded that for the given sample and for the time being, valid analyses regarding national differences are not possible. The weighted median for all countries is 40%, which is a credible estimate for the entire EU-27, underlining the dominant contribution of team ball sports, in particular of football, to the entire burden of sport injuries.

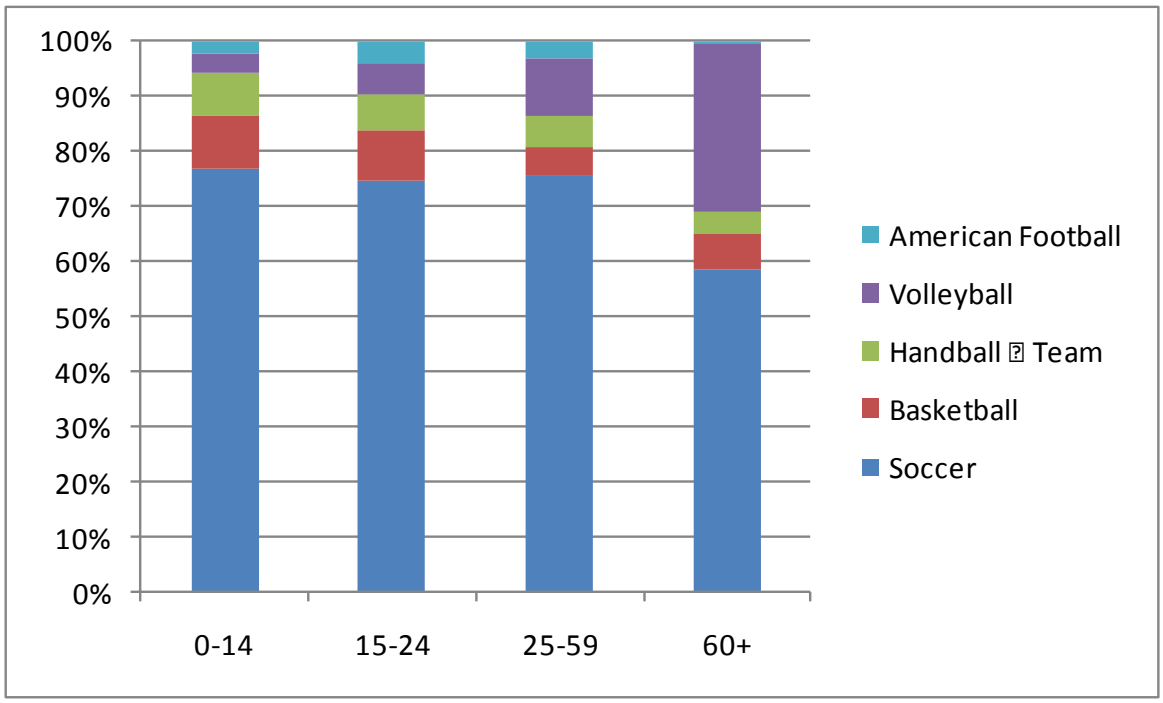


Table/figure 21: Share of team ball sports of all sport injuries in nine EU countries

The distribution of age groups in team ball sports is quite similar, reflecting that these types of sport are mainly played by younger ages. Only in volleyball less children, but more persons older than 59 get injured, probably due to the fact that volleyball is less popular amongst children, but more attractive for older sportspersons (table/figure 22 and 23).

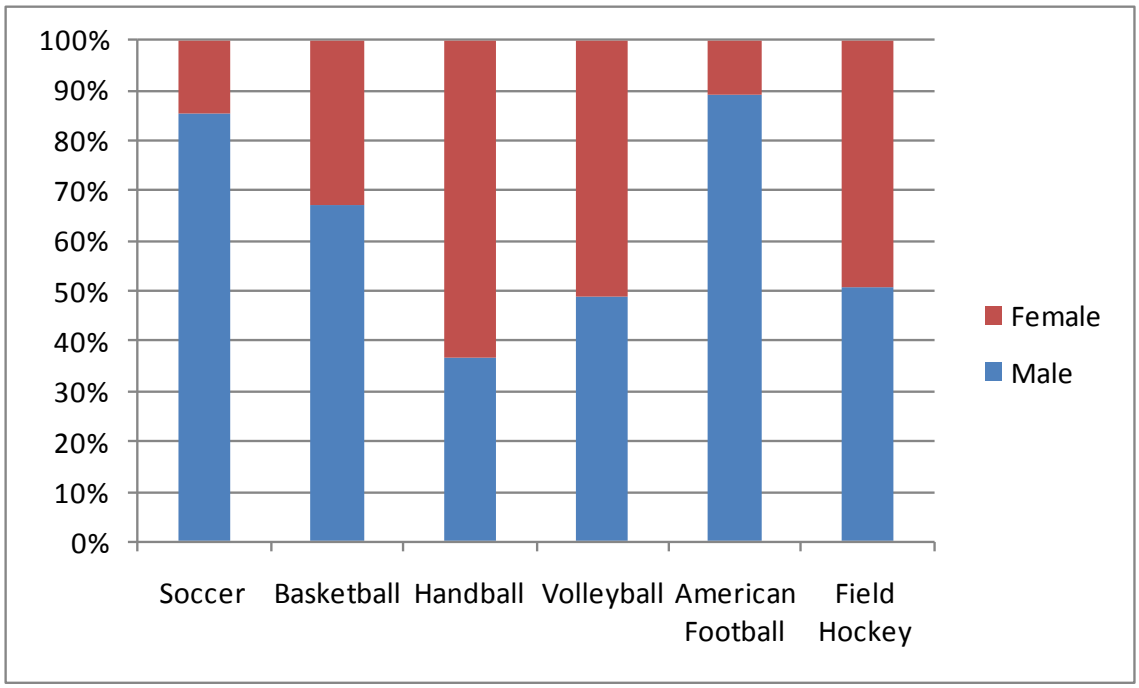


Table/figure 12: Selected team-ball-sports by age-group of injury victim



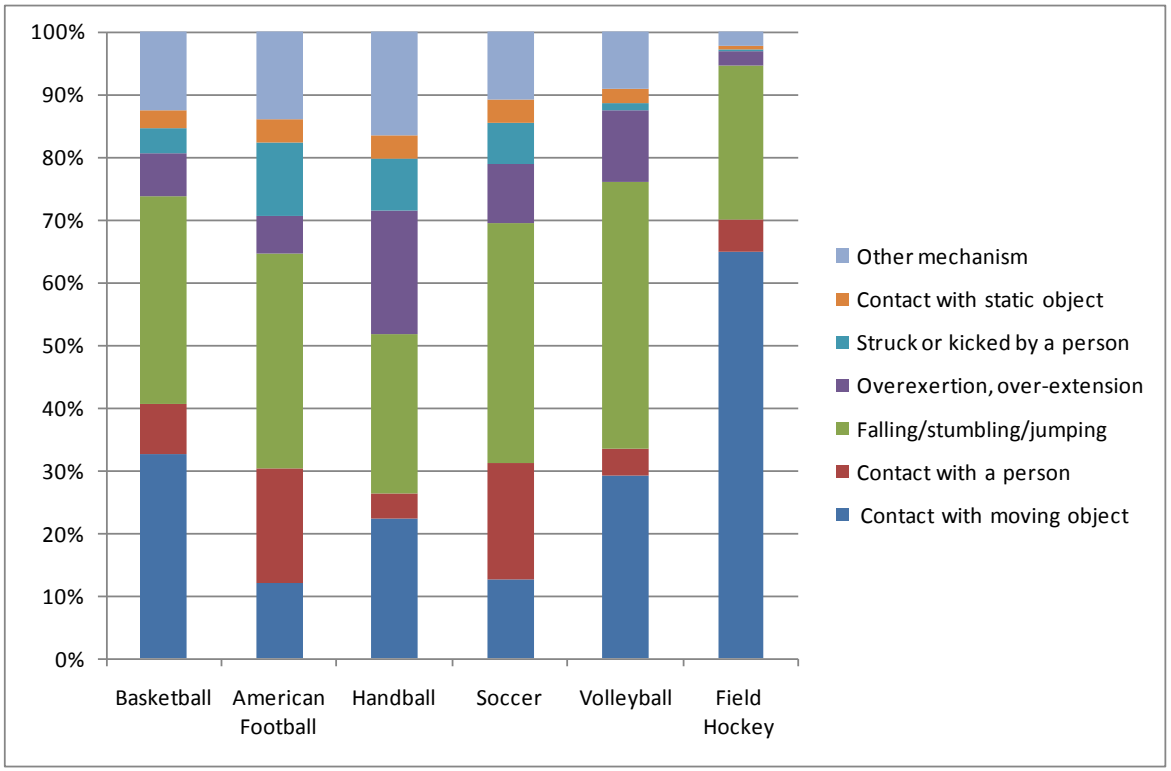
Table/figure 23: Type of Team-Ball-Sports by age-group of injury victim

Men and women have clear preferences when playing a team ball sport, which results in similar distributions of female and male injury victims. In handball and volleyball more women get injured, while in rugby (and American football), football and basketball the majority of patients are male. In Field-hockey the shares of men and women are balanced (table/figure 24).



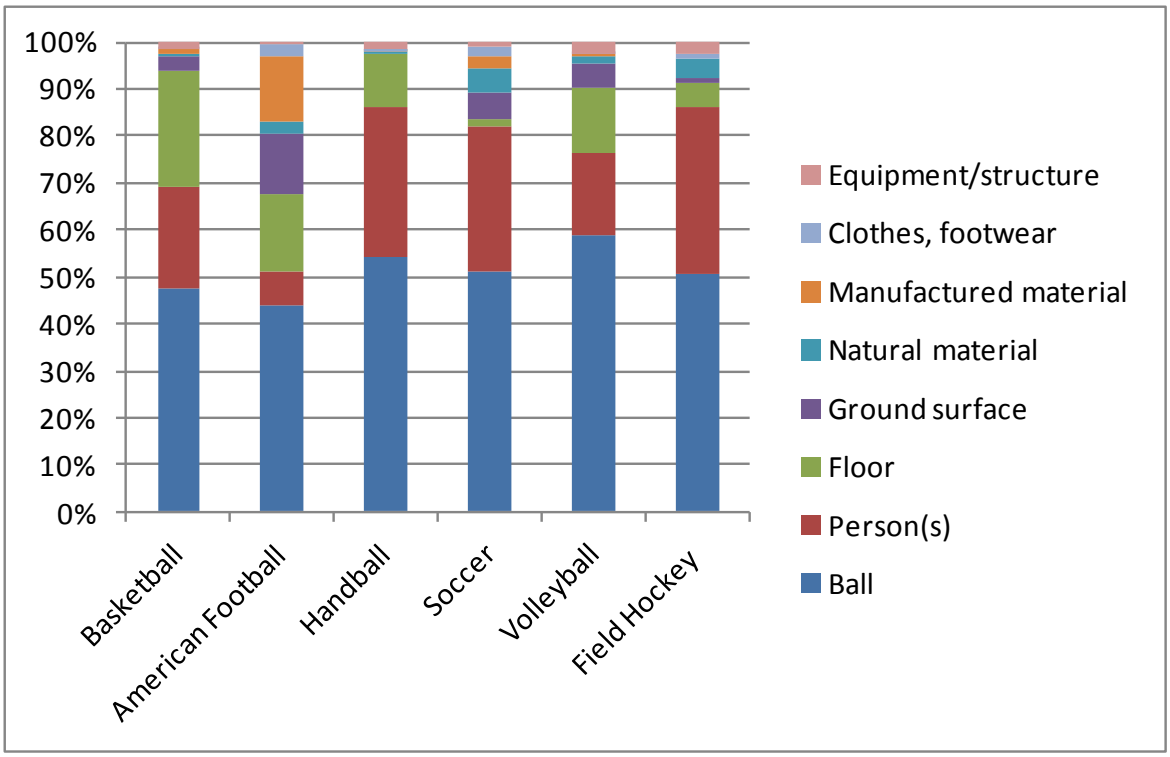
Table/figure 24: Selected team-ball-sports by sex of injury victim

The various characteristics of the sports lead to different distributions of accident mechanisms (mechanisms causing the loss of control leading to the injury). Direct bodily contact with other players have not unexpected the highest shares in rugby (and American football) and football. Falling and stumbling play an important role in all team ball sports, whereas the typical one-to-one situation causes many falls, although in many cases without direct bodily contact with an opponent. Overexertion is most frequent in handball with its frequent jumps and quick changes of directions of movements (table/figure 25).



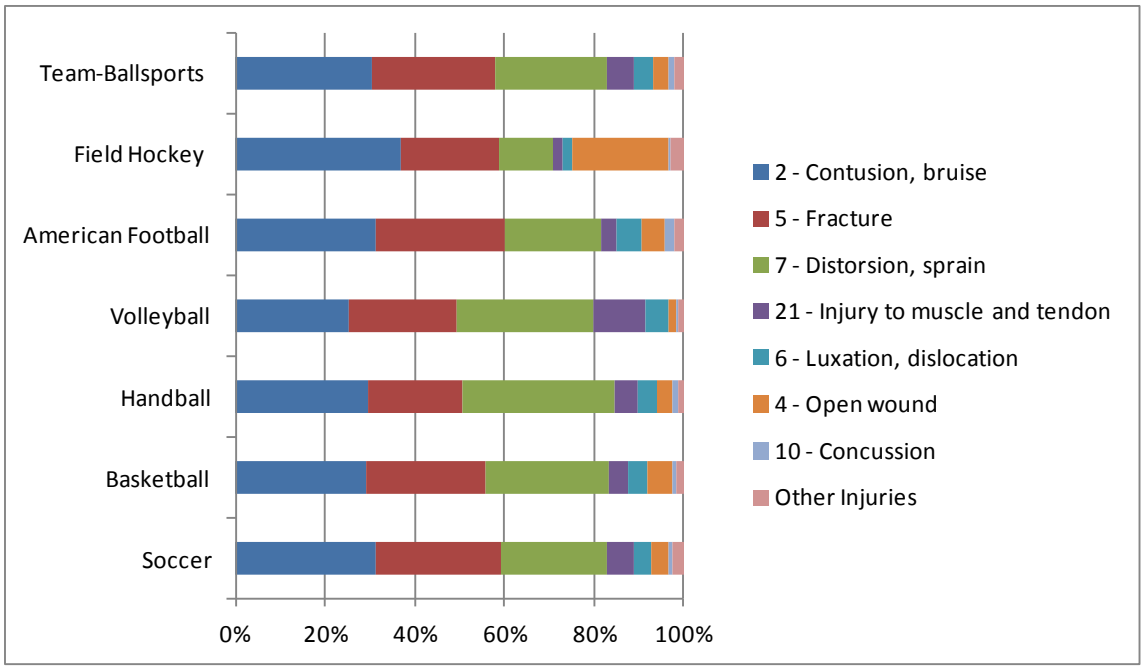
Table/figure 25: Accident mechanisms in selected team-ball-sports

Contacts with a moving object ply a dominant role in field-hockey, and an important role in basketball, volleyball and handball, while the ball is the most common object causing the accident (table/figure 26).



Table/figure 26: Object categories related to injuries in selected team-ball-sports (top eight object categories set to 100%)

Most common types of injuries are in all team ball sports contusions and bruises, distortions and sprains, and fractures, although with varying shares. All other types of injuries count for only about 20%. A cross-check with other information sources on the distribution of types of injuries in sport reveals that in the EU IDB data probably teeth and injuries probably are underestimated. Frequently, patients with such injuries do not seek help in general emergency departments, but go directly to dental or ophtalmologic clinics. Open wounds have a significant share only in field hockey, where e.g. cuts are not uncommon as consequent of contacts with the ball or the opponent's stick (table/figure 27).



Table/figure 27: Type of injuries in selected team-ball-sports

An analysis of the 41.730 EU IDB cases of team ball sport injuries according to the INTEGRIS disability estimation reveals that about 7% of injuries in team-ball-sports result in long-term consequences, and thereof about 3% in lifelong disabilities (figure 19). The risk for disabilities in team-ball-sports is higher than the average of all types of sport (about 5%; see table 22). There are only slight differences between types of ball sport for the risk for long-term disabilities. The risk in football seems to be slightly higher than in other team ball sports, but the difference is not significant (table/figure 28).

Type of sport	EU IDB cases	Estimated share of cases with lifelong disability	Estimated share of cases with temporary disability
Soccer	28.469	3,2%	4,1%
Basketball	3.036	2,0%	3,2%
Handball	6.058	2,2%	3,6%
Volleyball	1.698	2,9%	3,9%
American Football	1.290	2,2%	4,5%
Other ball-sports	1.179	1,2%	2,8%
Total	41.730	2,9%	3,9%

Table/figure 28: Estimated shares of temporary and life-long disabilities in team-ball-sports (EU IDB 2006-2008)

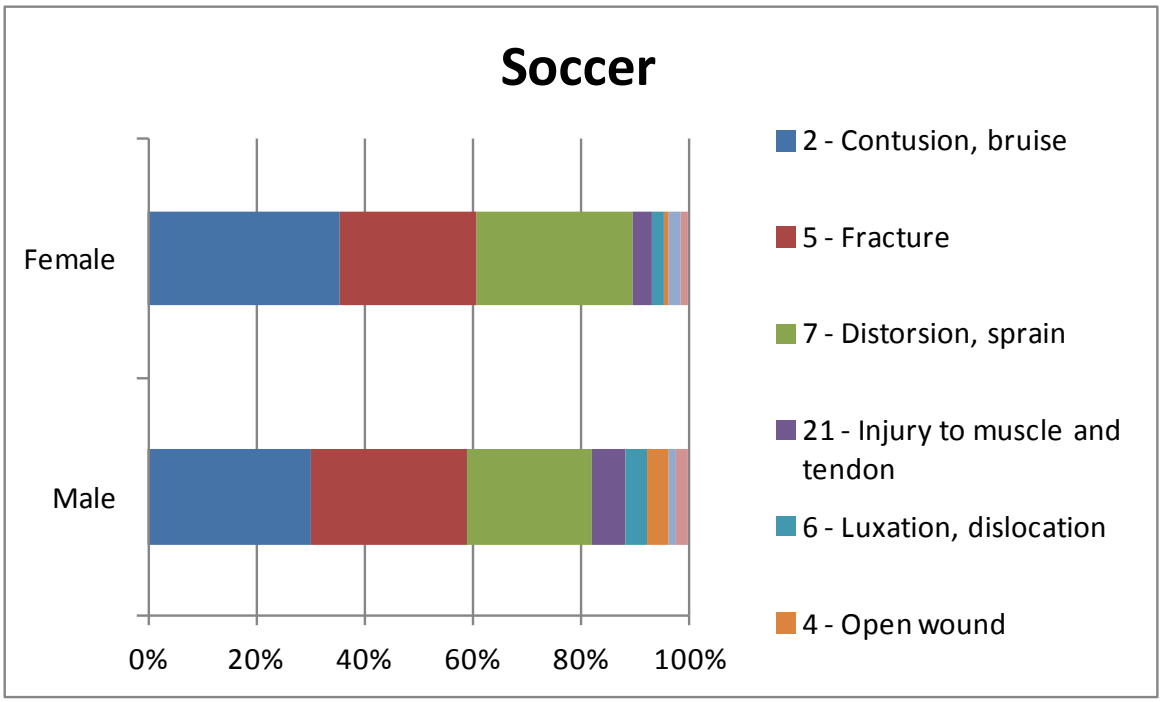
The estimation of direct health costs by applying the EUROCOST methodology as described above, leads to table 28. As the average number of days of hospital care do not differ extremely between team ball-sports, the distribution of costs depend mainly on the frequency of injuries.

Type of sport	Days	ED	Total	
Soccer	127.256.426	161.574.236	288.830.662	70%
Basketball	9.575.161	17.884.000	27.459.160	7%
Handball	4.592.688	14.343.170	18.935.858	5%
Volleyball	17.964.018	14.185.800	32.149.818	8%
American Football	6.863.611	6.463.419	13.327.030	3%
Field Hockey	9.761.580	19.946.673	29.708.253	7%
Total	176.013.482	234.397.298	410.410.780	100%
of all sports			25%	

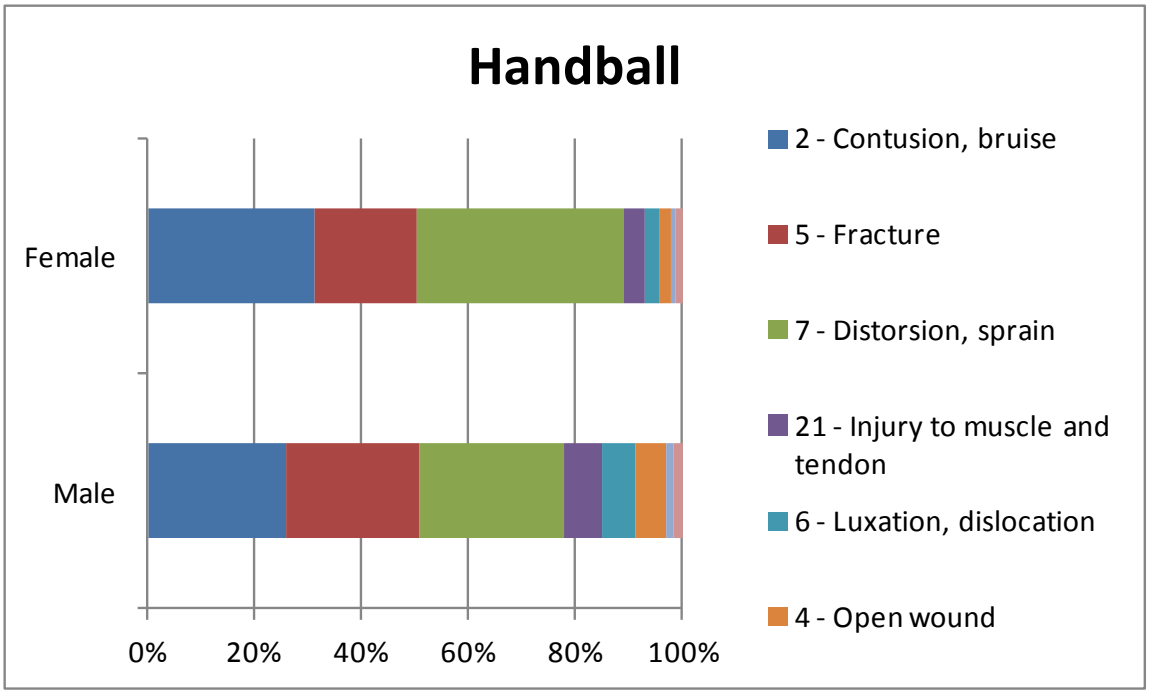
Table/figure 28: The medical cost of high risk team sports in the European Union (EU27)

10.2 Team-ball-sport and gender

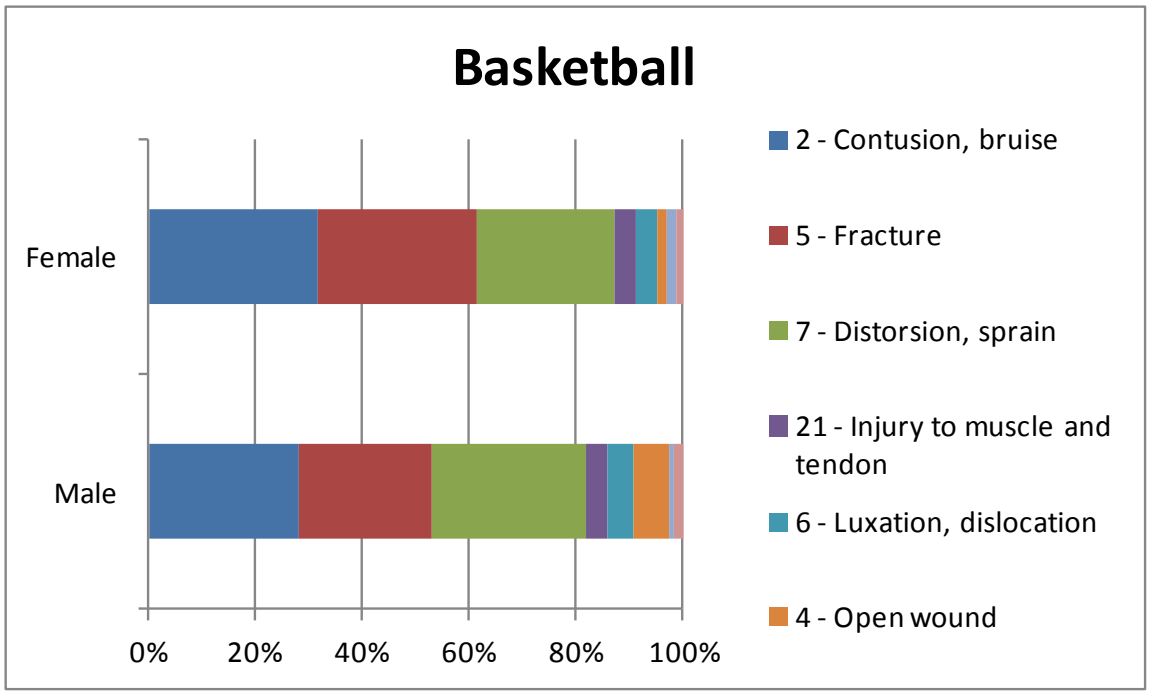
There are slight but quite consistent differences of injury patterns among men and women. Generally in all team ball sports, women tend toward more contusions and bruises as well as distortions and sprains, while other types of injuries as muscle injuries, dislocations and open wounds are less frequent (table/figure 29-34).



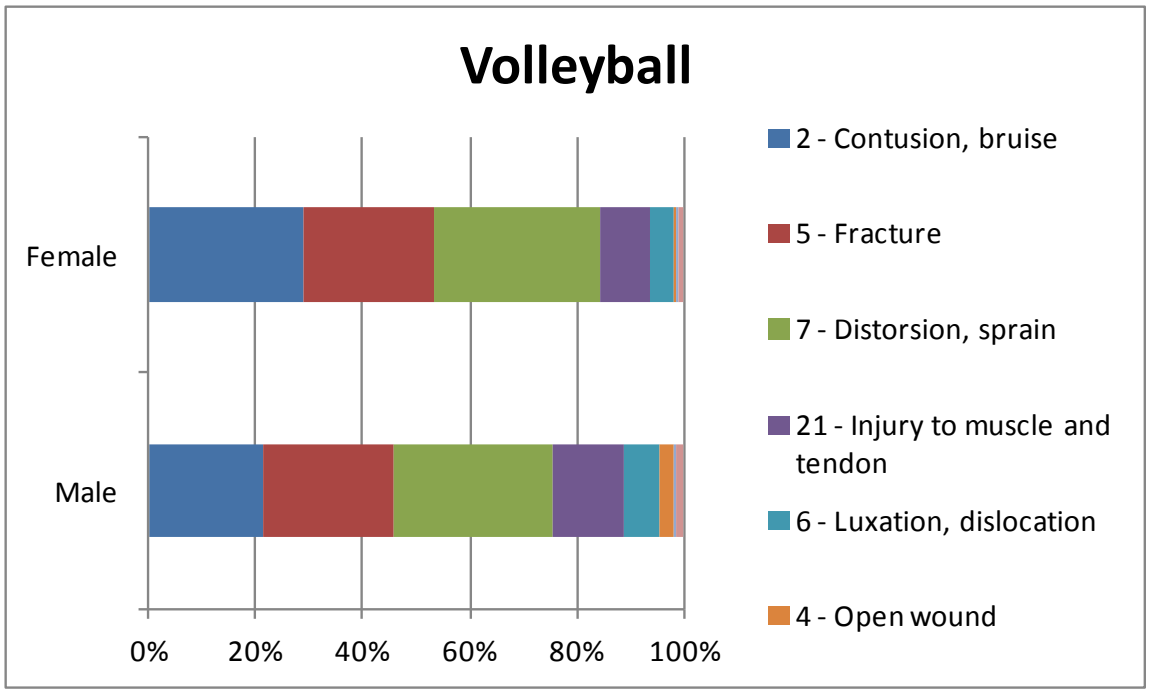
Table/figure 29: Type of injuries in football by sex



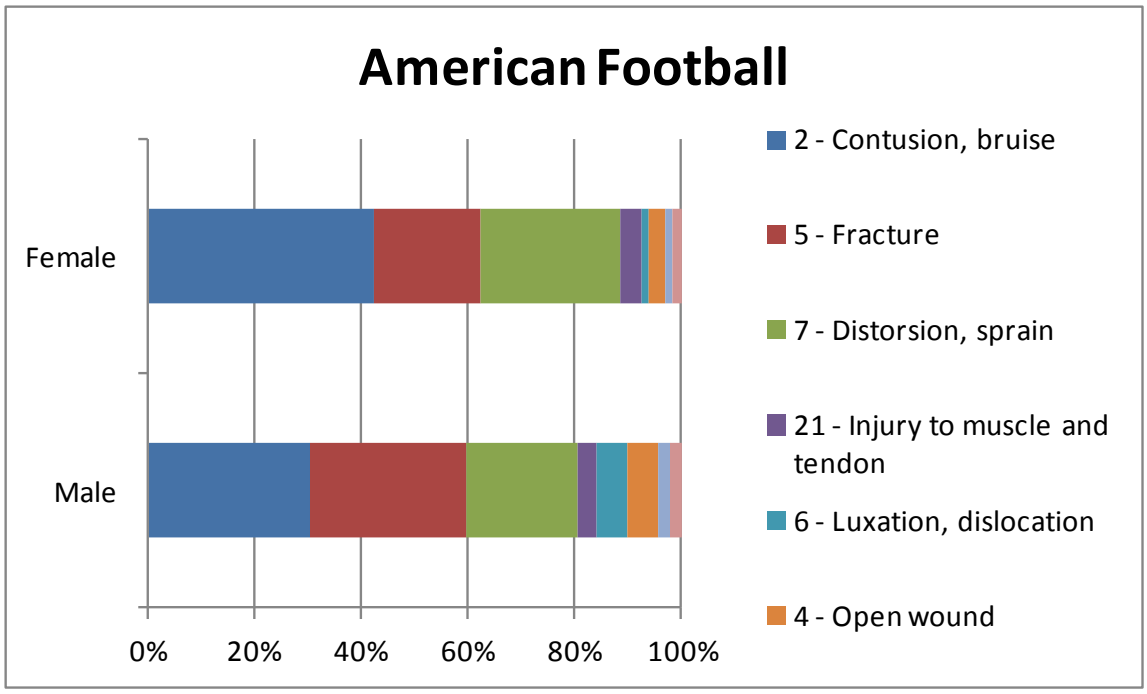
Table/figure 30: Type of injuries in handball by sex



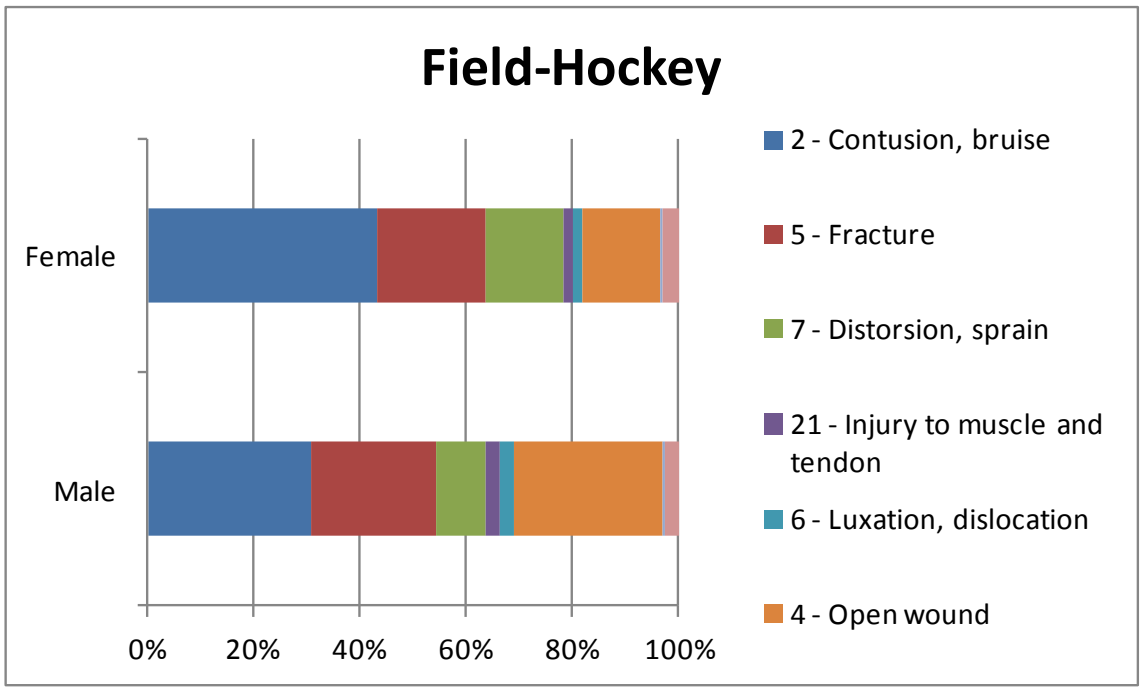
Table/figure 31: Type of injuries in basketball by sex



Table/figure 32: Type of injuries in volleyball by sex



Table/figure 33: Type of injuries in rugby by sex



Table/figure 34: Type of injuries in field-hockey by sex

11 Conclusions and recommendations

11.1 Provide meaningful and comparable indicators for the burden of sport injuries

Within the sport policy sector and within the responsible national sports federations, policies and programmes for injury prevention are not yet a matter of routine, although the challenge is increasingly acknowledged as by the International Olympic Committee when organising world conferences on the prevention of injuries. One obstacle is the lack of valid indicators for the health as well as for the economic burden of sport injuries.

As in all other areas of human activities, where accidents and injuries occur, indicators for the magnitude (frequency and severity) are needed, which allow for comparisons e.g. of

- Time periods (in order to monitor the development of risks over the years),
- Countries (in order to learn from countries with good records),
- Sports (in order to identify sports which the strongest needs for safety management schemes),
- Groups of participants (in order to identify target groups with the strongest needs of precautions), and
- Affected body parts (in order to identify priorities for the development of measures and specific programmes).

There is a great wealth of studies on sport related injuries in the various sports (handball, basketball etc.) and settings (training, competition etc.) allowing for the conclusions on risk factors, injury mechanisms, and effective measures. Nevertheless, these studies hardly allow comparisons, and if they do, comparability is frequently restricted to specific sports, settings, or injuries (e.g. downhill skiing, school sport, or head injuries).

The need for comparable injury surveillance systems has been identified in other risk areas long time ago: work place, road traffic, and – more recently – home and leisure activities. Some countries are already in the position to publish quite detailed statistics on sport injuries, and most of them do it in a converging way. Nevertheless, drawing a picture on the health and economic burden of sport injuries at European level is still not easy and not satisfactory in many respects. The difficulties with completing the current study, which is based on existing data at EU level as mortality

statistics, hospital discharge statistics, emergency department treatment statistics, or household surveys on other injuries, led to the following specific recommendations.

11.1.1 Mortality statistics

The currently available mortality data at EU-level allow only for very rough and dissatisfactory inaccurate estimates of the number of fatal sport injuries. These estimates are based on activities which are "sport" only in a wider sense: swimming, bicycling, mountain hiking. The reason for using such crutch is that the International Classification of Diseases (ICD-10) is hardly fully used in Member States. In particular the "fourth" and the "fifth digit" which specify the setting of an injury (sporting area) and the activity related to an injury (sporting activity) are hardly recorded in Member States, and even if they are available in some countries, data are not accessible through the joint data bases at Eurostat and WHO. Although it is likely (according to the few national statistics) that fatal injuries during typical types of sport are quite rare incidences, better coverage in mortality statistics (ICD code) is highly recommended. It is recommended to implement at least the ICD-10 activity code in the data sets on fatalities, as it seems to be likely that this information is available at national level (e.g. in police reports and/or death certificates).

11.1.2 Hospital discharge statistics

Technically, the situation is similar to the mortality statistics, but practically there is a great difference: The additional burden for hospital staff and patients for collecting additional information on setting and/or activity appears as hardly acceptable. Moreover as there is another solution available – see the following.

11.1.3 Emergency Department Registers

In order to meet the need for useful injury surveillance for guiding prevention, by the year 2009 thirteen EU Member States have established an injury monitoring system in emergency departments using harmonized methods. This system, known as the European Injury Database IDB, covers inpatients (admitted patients) as well as ambulatory treatments, but is implemented only in more or less small national samples of hospitals. Although this system still suffers from many shortcomings (as poor representativeness in many countries, variations of scope, incomplete geographical coverage of the EU), it allows for meaningful estimates of the morbidity of sport injuries in the entire Community. Currently, a joint action of Commission and Member States (JAMIE project) is heading for a roll-out of ED based injury surveillance by promot-

ing a Minimum Data Set, which can be implemented as a matter of routine in all emergency departments, as well as to enhance the quality of estimates of indicators. It is recommended, that all Member States join this effort and pay special attention on sport injuries, e.g. by publishing und using their figures for setting up prevention programmes in the area of sport.

11.1.4 Household surveys

In particular in sports, there are many injuries not medically treated at all (but eventually leading to sick-leaves) or treated in doctor's offices, sometimes in highly specialized offices as for example in Alpine countries for treating the high number of skiing injuries during the winter season. Although the admission rate of sport injuries is less than 10% these injuries are not necessarily minor and shall be depicted by estimates from household surveys, e.g. the European Health Interview System.

11.1.5 Indicators on direct health costs

The EUROCOST study has developed a relatively easily applicable method for deriving estimates of the direct costs of medical treatments in hospitals. Although this methodology underestimates the total economic burden, it has the important advantage, that it can be applied on estimates for fatalities and ED treatments. Costs of sick-leaves, disability annuities, rehabilitation costs etc. are not included, but the EUROCOST indicator can be derived for various sports, age groups, years and countries without imposing huge efforts. Therefore it is recommended that the Commission publishes regularly, e.g. bi-annually the underlying cost factors in order to facilitate the use of the method, and Member States are invited to apply this method when reporting on the burden of injury, also of sport injury.

11.1.6 Indicators on disabilities

The INTEGRIS study has developed a relatively easily applicable method for deriving indicators for temporary and long-term disabilities. It provides a promising opportunity to estimate the probability of long-term consequences, which mean – beside fatalities – most human suffering and highest costs for the national health and welfare systems. Therefore it is recommended that this method is further elaborated and tested and included into national as well as EU-level reports on injuries.

11.1.7 Comprehensive reporting

Generally, it can be concluded that the current report demonstrates that the used methodology for deriving a comprehensive picture of the burden of injury is promising in that sense, that it provides a framework for the calculation of comparable health and health cost indicators: comparable for countries, types of sport, and years, and comparable with other major injury settings (road, workplace, school, other leisure time activities). It could be demonstrated that the monitoring of sport injuries only on the basis of mortality statistics and/or hospital discharge statistics is not sufficient, neither for priority setting in public health nor for guiding injury prevention in a meaningful way. The Ministries of Health are invited to further support the implementation of EU IDB data collection (if not in place yet) and to enhance the quality and to ensure the sustainability of the implementation (if the system is in place) and to publish annual reports on the burden of sport injuries in their countries.

11.2 Link the promotion of HEPA and injury prevention

Sport accounts for about 20% of all (non-fatal) injuries Union-wide, with great differences between Member States. Sport injuries have a decrementing effect to the prospects of success of promoting sport as health enhancing activity. Active sportspersons frequently stop their activity as a consequence of a (severe) injury, and many others do not start activities due to the perceived high risk of injury. Considerable shares of health gains due to sport (savings of expenditures for the treatment of diseases due to lack of activity) get lost due to injuries (additional expenditures for the treatment of these injuries). In order to achieve a maximum of health benefits, both strategies need to be followed: Promoting health enhancing sports and reducing the injury risk without jeopardising the benefits of sport. National ministries of health and ministries of sport as well as the responsible Commission departments are invited to clearly link these both strategies in future programmes on promoting health enhancing physical activity at one hand and in injury prevention at the other.

11.3 Provide better evidence for the health balance of sport

Decisive for the future of the promotion of sport as health enhancing activity appear more and deeper studies in health benefits (savings of expenditures for the treatment of diseases due to lack of activity) versus costs of sport injuries (additional expenditures for the treatment). It is dissatisfactory, that quite remarkable investments are made in promotion programmes without taking into consideration that sport has quite severe side effects which may even annihilate the health gain, at least in certain

high risk sports. Proper guidance of citizens, who are primly interested in maintaining and improving their health, need better evidence in this respect.

11.4 Facilitate the assessing the exposure related injury risk at EU level

The European health statistics can provide the general frame for guiding policy actions, but lack the basis for the calculation of risk related to the number of active participants, hours of exposure, or intensity of the activity. It is desired and recommended, that at least the number of active participants in the various sports are surveyed in EU Member States. This should be a theme of one Euro-Barometer-study.

11.5 Implement injury monitoring in sports clubs and federation

Most sports depend on specific services, provided either by not-for-profit clubs (e.g. in team sports) or by commercial service providers (e.g. in athletics or skiing). It is clear that these institutions providing facilities, equipment, instructions have an important responsibility also for the safety of the members or costumers. In most cases, these service providers have the best knowledge and the best opportunities for reducing the injury risk, by guiding their costumers, by offering safe facilities and equipment, by obeying the rules, by offering appropriate training. Sport clubs and federations are invited to make better use of these opportunities. Data on injuries in their domain of responsibility seem to be pre-requisite, but are obviously not available as a matter of routine. Here the same principle is valid as for policy maker at EU as well as at national level: Without valid data, comparable over the time, no monitoring of the developments is possible, without information about the external causes and circumstances no appropriate measures can be developed, without information about types of injuries and dominantly affected persons no targeted prevention is possible. Sport clubs and their federations at national as well as at European level are invited to establish meaningful injury statistics for their own purposes.

11.6 Facilitate risk management of sport clubs and federations

In order to facilitate further investments into monitoring of sport injuries and the development, test and implementation of safety management schemes in organized sport, the national sport ministries are invited to make better use of available funding opportunities. In probably all European countries governmental subsidies are provided to clubs and federations for promoting sporting activities. The framework of funding can be modified in order to enhance injury control in sport clubs. The minis-

tries of sport are invited to examine this opportunities. The Commission (DG Youth and Education) is invited to initiate actions in the framework of the European Sports Programme on ensuring the physical integrity of sportspersons also in terms of reducing the injury risk when sporting.

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13 Annex: EU IDB coding of sports injuries

With the expansion of the scope of the EU IDB system from home, leisure and sport injuries to all injuries (home, leisure, sport, road, workplace accidents, self-harm, and injuries due to interpersonal violence) a new data dictionary was implemented (Consumer Safety Institute 2005: The Injury Database (IDB) Coding Manual, Version 1.1.). In order to make all available data accessible through one query mask, the data, which were coded according to the former data dictionary (European Commission & Psytel: Coding Manual V2000 for Home and Leisure Accidents, version 2002), have been transcoded. The codes, which are relevant in the given context, are given below.

Activity

V2K	Activity V2K	IDB	Activity IDB
10	Cooking	02.3	Cooking, cleaning
11	Cleaning, maintenance	02.3	Cooking, cleaning
12	Childcare, etc.	02.5	Caring for children and relatives
13	Shopping	02.4	Shopping
14	Gardening	02.7	Maintenance of own home or garden
18	Domestic work, other specified	02.8	Other specified unpaid work
19	Domestic work, unspecified	02.9	Unpaid work, unspecified
20	Repairs	02.6	Do-it-yourself projects
28	Do-it-yourself work, other specified	02.6	Do-it-yourself projects
29	Do-it-yourself work, unspecified	02.6	Do-it-yourself projects
39	Educational activity, unspecified	03.9	Unspecified education
40	Play	05.2	Play
41	Hobby	05.1	Leisure
48	Play and leisure activity, other specified	05.8	Other specified leisure or play
49	Play and leisure activity, unspecified	05.9	Unspecified leisure or play
50	Physical education	03.9	Unspecified education
51	Sports/athletics	04.1	Organised sports and exercise during leisure time
58	Sports, athletics, exercise, other specified	04.8	Other specified sports and exercise during leisure time
59	Sports, athletics, exercise, unspecified	04.9	Unspecified as to organised nature of sports and exercise during

			leisure time
60	Taking meals (eating/drinking)	06.1	Taking meals (eating/drinking)
61	Sleeping, resting	06.2	Sleeping, resting
62	Personal hygiene	06.3	Personal hygiene
68	Vital activity, other specified	06.8	Other specified vital activity
69	Vital activity, unspecified	06.9	Unspecified vital activity
80	General walking around	98.1	General walking around
88	Other specified activity	98.2	Other specified activity
99	Unspecified activity	99.9	Unspecified activity

Type of sport/exercice activity

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
A00	Track running without hurdles	07.04	Track running without hurdles
A01	Hurdle racing	07.05	Hurdle racing
A02	Marathon racing	07.06	Marathon racing
A03	Orienteering and cross-country running	07.07	Cross-country running
A04	Jogging	07.02	Jogging/running
A05	Walking	07.18	Walking
A08	Running, other specified	07.98	Other specified individual athletic activity
A09	Running, unspecified	07.99	Unspecified individual athletic activity
A10	Javelin throwing	07.13	Track & field – Javelin
A11	Shot-putting	07.15	Track & field – Shot putt
A12	Discus-throwing	07.12	Track & field – Discus
A13	Hammer throwing	07.14	Track & field – Hammer throw
A18	Throwing, other specified	07.98	Other specified individual athletic activity
A19	Throwing, unspecified	07.99	Unspecified individual athletic activity
A20	High jumping	07.08	Track & field – High jump
A21	Pole vaulting	07.10	Track & field – Pole vault
A22	Long jumping	07.09	Track & field – Long jump
A23	Hop, step and jump	07.11	Track & field – Triple jump
A28	Jumping, other specified	07.16	Track & field – Other specified

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
A29	Jumping, unspecified	07.17	Track & field – Unspecified
A30	Weight lifting	13.02	Olympic weightlifting
A31	Power lifting	13.01	Power lifting
A38	Lifting, other specified	13.98	Other specified power sport
A39	Lifting, unspecified	13.99	Unspecified power sport
A40	Training of muscle strength	13.03	Strength training/body building
A45	Bodybuilding	13.03	Strength training/body building
A48	Training of muscle strength/bodybuilding, other specified	13.98	Other specified power sport
A49	Training of muscle strength/bodybuilding, unspecified	13.99	Unspecified power sport
A98	Athletics, other specified	07.98	Other specified individual athletic activity
A99	Athletics, unspecified	07.99	Unspecified individual athletic activity
B08	Gymnastics without appliance, other specified	08.12	Gymnastics – Other specified
B09	Gymnastics without appliance, unspecified	08.13	Gymnastics – Unspecified
B10	Horizontal bar	08.04	Gymnastics – High bar
B11	Parallel bars	08.05	Gymnastics – Parallel bars
B12	Boom	08.12	Gymnastics – Other specified
B13	Flying rings	08.07	Gymnastics – Rings
B14	Horse/Swedish box	08.08	Gymnastics – Side horse/pommel horse
B15	Trampoline	08.09	Gymnastics – Trampoline/minitrampoline
B16	Wall bar	08.12	Gymnastics – Other specified
B17	Rope	08.12	Gymnastics – Other specified
B18	Gymnastics with appliance, other specified	08.12	Gymnastics – Other specified
B19	Gymnastics with appliance, unspecified	08.13	Gymnastics – Unspecified
B20	Clubs	09.98	Other specified aesthetic sport
B21	Hoop	09.98	Other specified aesthetic sport
B22	Balls	09.98	Other specified aesthetic sport

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
B23	Skipping rope	09.98	Other specified aesthetic sport
B28	Gymnastics with manual appliance, other specified	08.12	Gymnastics – Other specified
B29	Gymnastics with manual appliance, unspecified	08.13	Gymnastics – Unspecified
B38	Aerobics, other specified	07.98	Other specified individual athletic activity
B39	Aerobics, unspecified	07.98	Other specified individual athletic activity
B98	Gymnastics, other specified	08.12	Gymnastics – Other specified
B99	Gymnastics, unspecified	08.13	Gymnastics – Unspecified
C00	Tennis	10.05	Tennis
C02	Badminton	10.01	Badminton
C03	Table tennis	10.04	Table tennis/Ping-Pong
C08	Sports with racket, other specified	10.98	Other specified racquet sport
C09	Sports with racket, unspecified	10.99	Unspecified racquet sport
C10	Baseball	02.01	Baseball
C11	Cricket	02.02	Cricket
C12	Rounders	02.98	Other specified team bat or stick sport
C18	Sports with bat, other specified	02.98	Other specified team bat or stick sport
C19	Sports with bat, unspecified	02.99	Unspecified team bat or stick sport
C20	Ordinary hockey	02.04	Hockey – Field
C21	Ice hockey	02.03	Hockey – Ice
C22	Bandy	02.98	Other specified team bat or stick sport
C23	Bandy, on ice	02.98	Other specified team bat or stick sport
C24	Roller skate hockey	02.05	Hockey – Other specified
C25	Hurling	02.98	Other specified team bat or stick sport
C26	Camogie	02.98	Other specified team bat or stick sport
C28	Sports with stick, other specified	02.98	Other specified team bat or stick sport
C29	Sports with stick, unspecified	02.99	Unspecified team bat or stick sport
C30	Squash	10.03	Squash
C31	Racket ball	10.02	Racquetball
C38	Sports (with racket) played in en-	10.98	Other specified racquet sport

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
	closed court, other specified		
C39	Sports (with racket) played in enclosed court, unspecified	10.99	Unspecified racquet sport
C98	Sports with racket, bat or stick, other specified	02.98	Other specified team bat or stick sport
C99	Sports with racket, bat or stick, unspecified	02.99	Unspecified team bat or stick sport
D00	Football (soccer)	01.11	Soccer – Unspecified
D01	Rugby	01.08	Rugby
D02	American football	01.02	American Football
D03	Gaelic football	01.03	Gaelic Football
D08	Football, other specified	01.04	Football – Other specified
D09	Football, unspecified	01.05	Football – Unspecified
D10	Handball (team)	01.06	Handball – Team
D12	Handball (enclosed court)	01.06	Handball – Team
D18	Handball, other specified	01.06	Handball – Team
D19	Handball, unspecified	01.06	Handball – Team
D20	Volleyball (conventional)	01.12	Volleyball
D28	Volleyball, other specified	01.12	Volleyball
D29	Volleyball, unspecified	01.12	Volleyball
D30	Basketball (conventional)	01.01	Basketball
D38	Basketball, other specified	01.01	Basketball
D39	Basketball, unspecified	01.01	Basketball
D98	Team sports with ball, other specified	01.98	Other specified team ball sport
D99	Team sports with ball, unspecified	01.99	Unspecified team ball sport
E08	Boxing, other specified	12.02	Boxing
E09	Boxing, unspecified	12.02	Boxing
E10	Greek/Roman wrestling	12.12	Wrestling – Greco-Roman
E11	All-in wrestling	12.11	Wrestling – Freestyle
E18	Wrestling, other specified	12.98	Other specified combative sport
E19	Wrestling, unspecified	12.99	Unspecified combative sport
E20	Jiu-jitsu	12.05	Jujitsu

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
E21	Karate	12.06	Karate
E22	Judo	12.04	Judo
E23	Aikido	12.01	Aikido
E24	Kendo	12.07	Kendo
E25	Taek-won-do	12.10	Tae kwon do
E28	Asian combat sports, other specified	12.98	Other specified combative sport
E29	Asian combat sports, unspecified	12.98	Other specified combative sport
E30	Fencing (rapier)	12.03	Fencing
E31	Swordplay	12.14	Swordplay
E38	Fencing, other specified	12.03	Fencing
E39	Fencing, unspecified	12.03	Fencing
E98	Combat sports, other specified	12.98	Other specified combative sport
E99	Combat sports, unspecified	12.99	Unspecified combative sport
F00	Cycling on road	17.03	Cycling – Road
F01	Cycling on track	17.04	Cycling – Track/velodrome
F02	Mountainbiking	17.02	Cycling – Mountain
F03	Trick cycling	17.01	Cycling – BMX
F08	Cycling, other specified	17.05	Cycling – Other specified
F09	Cycling, unspecified	17.06	Cycling – Unspecified
F30	Roller-skating	17.08	Roller skating
F31	Roller-skiing	17.09	Roller skiing
F32	Skateboarding	17.10	Skate boarding
F38	Roller-skates/ski/board, other specified	17.98	Other specified wheeled non-motored sport
F39	Roller-skates/ski/board, unspecified	17.98	Other specified wheeled non-motored sport
F98	Non-motorised wheel sports, other specified	17.98	Other specified wheeled non-motored sport
F99	Non-motorised wheel sports, unspecified	17.99	Unspecified wheeled non-motored sport
G00	Automobile sports, on roads	16.05	Motor car racing
G01	Automobile sports, on track	16.05	Motor car racing
G08	Automobile sports, other specified	16.98	Other specified motor sport

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
G09	Automobile sports, unspecifed	16.99	Unspecified motor sport
G10	Motor cycling, roadracing	16.02	Motorcycling, roadracing
G11	Speedway	16.03	Speedway
G12	Motor-cross	16.04	Motocross
G18	Motor cycling, other specified	16.02	Motorcycling, roadracing
G19	Motor cycling, unspecified	16.02	Motorcycling, roadracing
G78	Go-cart racing, other specified	16.06	Go-carting/carting
G79	Go-cart racing, unspecified	16.06	Go-carting/carting
G98	Motor sports, other specified	16.98	Other specified motor sport
G99	Motor sports, unspecified	16.99	Unspecified motor sport
H00	Horse riding	14.02	Endurance riding
H01	Show jumping	14.09	Show jumping
H02	Terrain riding, without obstacles	14.11	Trail or general horseback riding
H03	Terrain riding, with obstacles (military)	14.98	Other specified equestrian activity
H08	Horse riding, other specified	14.98	Other specified equestrian activity
H09	Horse riding, unspecified	14.99	Unspecified equestrian activity
H10	Horse-racing, gallop	14.07	Racing
H11	Trotting race	14.12	Trotting/ harness
H12	Steeplechase	14.10	Steeplechase
H13	Point-to-point racing	14.07	Racing
H18	Horse-racing, other specified	14.07	Racing
H19	Horse-racing, unspecified	14.07	Racing
H20	Polo on horseback	14.05	Polo/polocrosse
H28	Polo, other specified	14.05	Polo/polocrosse
H29	Polo, unspecified	14.05	Polo/polocrosse
H50	Dog racing	98.98	Other specified sport/exercise activity
H51	Agility	98.98	Other specified sport/exercise activity
H58	Sports with dogs, other specified	98.98	Other specified sport/exercise activity
H59	Sports with dogs, unspecified	98.98	Other specified sport/exercise activity
H98	Animal sports, other specified	98.98	Other specified sport/exercise activity
H99	Animal sports, unspecified	98.98	Other specified sport/exercise activity

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
J00	Cross-country skiing	06.06	Skiing – Nordic/cross country
J01	Downhill racing	06.05	Skiing – Alpine/downhill
J02	Slalom	06.09	Skiing – Slalom
J03	Ski jumping	06.08	Skiing – Snow ski jumping
J04	Ski bob	06.04	Luge
J05	Skiboard/snowboard	06.13	Snow boarding
J08	Ski sports, other specified	06.10	Skiing – Other specified
J09	Ski sports, unspecified	06.11	Skiing – Unspecified
J30	Sledge, ordinary	06.04	Luge
J31	Bob sleigh	06.01	Bobsledding
J38	Sledge sports, other specified	06.04	Luge
J39	Sledge sports, unspecified	06.04	Luge
J40	Ice skating	06.03	Ice skating/ice dancing
J41	Figure skating	09.98	Other specified aesthetic sport
J42	Skate racing	06.14	Speed skating
J43	Skating with sail	17.98	Other specified wheeled non-motored sport
J48	Skating sports, other specified	17.98	Other specified wheeled non-motored sport
J49	Skating sports, unspecified	17.98	Other specified wheeled non-motored sport
J50	Snowscooter racing	06.12	Snowmobiling
J58	Sports with snowscooter, other specified	06.12	Snowmobiling
J59	Sports with snowscooter, unspecified	06.12	Snowmobiling
J68	Iceboating, other specified	06.98	Other specified ice or snow sport
J69	Iceboating, unspecified	06.98	Other specified ice or snow sport
J98	Winter sports, other specified	06.98	Other specified ice or snow sport
J99	Winter sports, unspecified	06.99	Unspecified ice or snow sport
K00	Swimming in pool	05.07	Swimming
K01	Swimming in open water	05.07	Swimming
K02	Water polo	03.04	Water polo
K03	Diving (from height into water)	05.01	Diving (from height into water)

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
K08	Swim sports, other specified	03.98	Other specified team water sport
K09	Swim sports, unspecified	03.99	Unspecified team water sport
K10	Diving without equipment	05.98	Other specified individual water sport
K11	Diving with snorkel	05.04	Snorkelling
K12	Scuba-diving	05.03	Scuba diving
K13	Underwater hockey	03.03	Underwater hockey
K18	Underwater sports, other specified	03.98	Other specified team water sport
K19	Underwater sports, unspecified	03.98	Other specified team water sport
K20	Paddling in canoe	04.01	Canoeing
K21	Paddling in kayak	04.03	Kayaking/white-water rafting
K22	Boat-racing	04.98	Other specified boating sport
K28	Rowing/paddling, other specified	4.05	Rowing/ sculling
K29	Rowing/paddling, unspecified	4.05	Rowing/ sculling
K30	Yachting	04.07	Yachting/sailing
K31	Windsurfing	05.10	Wind surfing
K38	Sailing, other specified	04.07	Yachting/sailing
K39	Sailing, unspecified	04.07	Yachting/sailing
K40	Motor boat navigation	04.98	Other specified boating sport
K41	Water scooter sailing	04.02	Jet skiing
K42	Jet-skiing	04.02	Jet skiing
K48	Motor vessel sailing, other specified	04.98	Other specified boating sport
K49	Motor vessel sailing, unspecified	04.98	Other specified boating sport
K58	Water skiing, other specified	05.08	Water skiing
K59	Water skiing, unspecified	05.08	Water skiing
K68	Surfing (without sail), other specified	05.05	Surfing/boogie boarding
K69	Surfing (without sail), unspecified	05.05	Surfing/boogie boarding
K70	River rafting	04.03	Kayaking/white-water rafting
K78	Rafting sports, other specified	04.03	Kayaking/white-water rafting
K79	Rafting sports, unspecified	04.03	Kayaking/white-water rafting
K98	Water sports, other specified	05.98	Other specified individual water sport
K99	Water sports, unspecified	05.99	Unspecified individual water sport

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
L00	Kite-gliding	19.06	Kite-gliding
L01	Hang-gliding	19.03	Hang gliding
L02	Gliding	19.02	Gliding
L08	Sports with gliders, other specified	19.02	Gliding
L09	Sports with gliders, unspecified	19.02	Gliding
L10	Parachute jumping	19.04	Parachuting/sky diving
L18	Parachuting, other specified	19.04	Parachuting/sky diving
L19	Parachuting, unspecified	19.04	Parachuting/sky diving
L20	Flying hot air balloon	19.07	Hot air ballooning
L28	Flying balloon, other specified	19.07	Hot air ballooning
L29	Flying balloon, unspecified	19.07	Hot air ballooning
L38	Bungy jumping, other specified	19.08	Bungee jumping
L39	Bungy jumping, unspecified	19.08	Bungee jumping
L68	Motor flying, other specified	19.09	Motor flying
L69	Motor flying, unspecified	19.09	Motor flying
L98	Air sports, other specified	19.98	Other specified aero sport
L99	Air sports, unspecified	19.99	Unspecified aero sport
M00	Pistol shooting	11.11	Fire-arm shooting
M01	Rifle shooting	11.11	Fire-arm shooting
M02	Field shooting	11.11	Fire-arm shooting
M03	Claypigeon shooting	11.14	Claypigeon shooting
M08	Sports with firearms, other specified	11.11	Fire-arm shooting
M09	Sports with firearms, unspecifed	11.11	Fire-arm shooting
M10	Archery	11.01	Archery
M12	Crossbow	11.01	Archery
M18	Shooting with bow and arrow, other specified	11.01	Archery
M19	Shooting with bow and arrow, un-specified	11.01	Archery
M70	Darts (conventional)	11.08	Darts
M78	Darts, other specified	11.08	Darts
M79	Darts, unspecified	11.08	Darts

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
M98	Weapon sports, other specified	11.98	Other specified target/precision sport
M99	Weapon sports, unspecified	11.99	Unspecified target/precision sports
N08	Golf, other specified	11.09	Golf
N09	Golf, unspecified	11.09	Golf
N10	Ten-pin bowling	11.10	Ten-pin bowling
N11	Lawn bowling	11.05	Lawn bowling
N12	Road bowling	11.06	Road bowling
N18	Bowling, other specified	11.98	Other specified target/precision sport
N19	Bowling, unspecified	11.98	Other specified target/precision sport
N80	Billiard	11.04	Billiards, pool, snooker
N81	Croquet	11.07	Croquet
N82	Boccia	11.02	Bocce, boules
N83	Petanque	11.03	Petanque
N88	Sports with solid balls, other specified	98.98	Other specified sport/exercise activity
N99	Sports with solid balls, unspecified	98.98	Other specified sport/exercise activity
P10	Mountaineering	15.03	Mountaineering
P11	Abseiling	15.01	Abseiling/rappelling
P18	Mountain climbing, other specified	15.06	Rock climbing – outdoors
P19	Mountain climbing, unspecified	15.06	Rock climbing – outdoors
P20	Climbing in caves	15.98	Other specified adventure sport
P28	Cave sports, other specified	15.98	Other specified adventure sport
P29	Cave sports, unspecified	15.99	Unspecified adventure sport
P38	Wall-climbing, other specified	15.98	Other specified adventure sport
P39	Wall-climbing, unspecified	15.99	Unspecified adventure sport
P98	Climbing sports, other specified	15.98	Other specified adventure sport
P99	Climbing sports, unspecified	15.99	Unspecified adventure sport
Q00	Ballet	09.01	Ballet
Q01	Ballroom dancing, etc.	09.02	Ballroom dancing, etc.
Q02	Jitterbug	09.03	Jitterbug
Q08	Dancing, other specified	09.98	Other specified aesthetic sport
Q09	Dancing, unspecified	09.98	Other specified aesthetic sport

V2K	Type of sport/exercice activity V2K	IDB	Type of sport/exercice activity IDB
Q98	Dance sports, other specified	09.98	Other specified aesthetic sport
Q99	Dance sports, unspecified	09.99	Unspecified aesthetic sport
X00	Biathlon	18.01	Biathlon
X01	Triathlon	18.02	Triathlon
X02	Pentathlon	18.03	Pentathlon
X05	Decathlon	18.04	Decathlon
X08	Athlon, other specified	18.98	Other specified multidiscipline sport
X09	Athlon, unspecified	18.99	Unspecified multidiscipline sport
X98	Combined sports, other specified	18.98	Other specified multidiscipline sport
X99	Combined sports, unspecified	18.99	Unspecified multidiscipline sport
Z90	Sports fishing/angling	05.02	Fishing
Z98	Athletics, sports and exercise, other specified	98.98	Other specified sport/exercise activity
Z99	Athletics, sports and exercise, un-specified	99.99	Unspecified sport/exercise activity

TRANSCODING SPECIFICATION V2K TO AI, VERSION 1.3 - MAY 2010
Transcoding principles (May 6, 2010)
Authors: Marc Nectoux, Rovert Bauer, Rupert Kisser, Niko Leventakis

1) One-way coding V2000 > IDB/AI: For each V2000 code an appropriate AI code has be de-fined. The opposite is not the case; For each AI code there is not necessarily a corresponding V2000 code available.

2) V2000 group codes are not transcoded (e.g. water sports) as there might be not the same grouping in AI. (If analyses according to V2000 groups are needed, the detailed AI codes, eventually from different AI groups, have to be used).

3) Same wording/definition of categories in both systems: The AI code has been taken

4) If there are slight differences in wording/definition, the AI code has been taken, which comes closest (e.g. paddling in canoe > canoeing).

5) If V2000 is more specified than AI, the overarching AI code has been taken (e.g. volleyball conventional, volleyball other specified, volleyball unspecified > volleyball).

6) If V2000 is less specified than AI, the AI-code for "other, unspecified" (usually 98) has been taken.