Injuries in Swiss non-professional soccer: characteristics, causes, costs, and prevention

Inauguraldissertation

zur

Erlangung der Würde eines Dr. sc. med.

vorgelegt der

Medizinischen Fakultät

der Universität Basel

von

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aus Rapperswil SG

Basel, 2018

Genehmigt von der Medizinischen Fakultät

auf Antrag von

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Basel, den 17.12.2018

Dekan

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ACKNOWLEDGEMENTS

I would like to sincerely thank all the people who have contributed to the development and finalization of this PhD thesis.

First of all, I want to thank my supervisors, Prof. Dr. Uwe Pühse and Prof. Dr. Markus Gerber. I am really grateful that they gave me the opportunity to do my PhD thesis in the Department of Sport, Exercise and Health (DSBG) at the University of Basel and that they supported me during this interesting and instructive period. Uwe, I appreciate enormously that you made it possible for me to write this PhD thesis while working. In particular, I also want to thank you, Markus, for your sharp eye and for your precise and constructive feedback on my publications. I have benefited greatly from your vast experience.

I have profound gratitude for Dr. Markus Lamprecht, who had the initial idea for this project and who encouraged me to take up the challenge of a doctoral thesis. My sincere thanks go to you for many clever and knowledgeable answers to my questions, for your feedback on manuscripts, abstracts and presentations, and for countless interesting discussions. Your door was always open to me and your positive support enabled me to successfully complete this PhD thesis.

In the same way, I am very grateful to Dr. Hanspeter Stamm. You always had good advice for me. Huge thanks go to you for your support with statistical questions and for your encouragement during the publication process. I am also very grateful that I found my way to “Lamprecht und Stamm Sozialforschung und Beratung“ after my studies. Here I have had the opportunity to further develop my skills and to work independently on interesting projects. At this point I would also like to thank my colleagues Rahel Bürgi and Adrian Fischer for their support.

I also respectfully thank PD Dr. Kai-Uwe Schmitt of the Department of Health Sciences and Technology at the ETH Zurich for accepting the role as external expert and for his work evaluating my thesis.

Furthermore, I would like to express my special thanks to Philippe Gassmann and Edith Müller Loretz of the Swiss National Accident Insurance Fund (Suva) for their financial support with the surveys, which made it possible to write this PhD thesis, and for their great interest in soccer-related injuries and their prevention. I would particularly like to thank Philippe for his valuable cooperation in preparing the data collection, for numerous constructive and interesting meetings, and for integrating the results into the prevention strategy.

Another hearty thank you goes to Misha Kavka, and again to Markus Lamprecht and Hanspeter Stamm for proofreading my PhD thesis. Thank you very much for your corrections and suggestions, which have improved my work.

Many thanks are also due to all of my colleagues in the field of sport science at the DSBG, who helped to create a motivating atmosphere for my work. I always felt welcome in the team and was able to benefit from many interesting conversations. In particular, I would like to thank Dr. Flora Colledge for reviewing my publications with respect to the English language.

Last but not least, my deepest thanks go to my family and to all my friends. Above all, I am infinitely grateful to my parents Guido and Lucia Gebert, to Martin S. Kohler, to my brother Markus Gebert, and to Stephanie M. Scherrer for encouraging me, helping me to find a solution to every problem, and always being there for me.

SUMMARY

Background and aims

Soccer is a very popular sport in Switzerland. In addition to an increasing number of formal players who play soccer in clubs, many also undertake this sport in non-organised, informal contexts. However, playing soccer is associated with a high risk of injury. In Switzerland, both the number of soccer-related injuries and the corresponding costs have increased considerably in recent years. Consequently, soccer injuries represent a substantial financial and psychosocial burden for society. In recent years, various preventive measures have been taken to reduce injuries related to soccer in Switzerland. In order to be able to develop effective prevention strategies, knowledge about injury characteristics, causes, mechanisms and risk factors is essential. Nevertheless, there are fewer studies focussing on injuries in non-professional soccer than in professional soccer. In particular, detailed information is scarce about soccer-related injuries amongst specific groups of players, injury causes and mechanisms, and injury costs. Likewise, little is known about the implementation of preventive measures in the real-world context of amateur soccer. This is primarily due to the fact that such investigations are very time-consuming and difficult to carry out.

Thus, the overall aim of this PhD thesis is to expand the knowledge about injuries in Swiss non-professional soccer, in particular by focussing on injury setting, characteristics, causes, and costs. Another fundamental aim of this thesis is to analyse changes in the incidence of injury in Swiss amateur soccer and to examine the implementation of preventive measures in a real-world context.

Methods

Two fully structured, retrospective telephone surveys were conducted. In the first survey, the Suva study, a random sample of 708 persons who were injured while playing soccer between July 2013 and June 2014 and who reported this accident to the Swiss National Accident Insurance Fund (Suva) were interviewed in detail about the injury context, injury

characteristics and injury causes. One year after the accident, the responses from the interviews were linked to the corresponding injury costs provided by Suva.

In the second survey, the coaches study carried out in 2015, a representative sample of 1008 Swiss amateur soccer coaches were interviewed about the frequency of injuries in their teams and the implementation of preventive measures and injury prevention programmes. 1076 injuries which occurred during 3964 amateur soccer games and 525 injuries which occurred during 8338 training sessions were analysed. The information collected was compared with two previous surveys of Swiss amateur soccer coaches conducted in 2008 (n = 1015) and 2004 (n = 1029).

Results

Analysis showed that 30% of injuries in non-professional soccer requiring medical attention happened during informal soccer play, 21% during formal training and 49% during formal soccer games. Furthermore, there were key differences between these non-professional soccer settings with regard to injury characteristics, causes and injury incidence. We identified players in the 30+/40+ league as a target group for injury prevention. Their injury incidence was significantly higher compared to players from other leagues; they were more likely to report a severe game injury; and they caused above-average injury costs. In addition, 30+/40+ league teams less frequently implemented preventive measures and injury prevention programmes than teams from other leagues.

Changes in the incidence of injury in amateur soccer between 2004, 2008, and 2015 indicate that Swiss amateur soccer may have increased in intensity, including higher forces of impact and speeds. We observed an increase in the incidence of injuries requiring medical attention, of contact injuries during games, and of non-contact injuries during training. Furthermore, during games, the incidence of bone fractures and sprains as well as knee and upper limb injuries also increased during this period.

In the 2015 survey we found that Swiss amateur soccer coaches are generally willing to implement preventive measures. However, only 22% of coaches implemented an existing prevention programme according to minimal standards. This proportion was the same as in the 2008 survey, although an additional prevention programme was available in 2015.

Knee injuries were not only common in Swiss non-professional soccer, but they also had notable impact in terms of severity and costs of an injury. A significant increase of the incidence of knee injuries was found between 2004 and 2015. With respect to injury causes, the proportion of injuries caused by contact with an opponent and foul play was significantly higher during formal games than during formal training and informal play. Based on the

referees' assessment, in 27% of injuries foul play was the cause of injury during formal games. A detailed analysis of injury situations showed that being tackled by an opponent was associated with a higher likelihood of reporting a severe injury while foul play was not. Additionally, twisting and turning was a frequent cause of severe injuries and high injury costs.

Conclusions

The studies presented within this PhD thesis provide a detailed picture of injuries in Swiss non-professional soccer, which should form the basis for further improvements in injury prevention. New approaches are needed to increase the proper implementation of prevention programmes in Swiss amateur soccer in general and in individual risk groups such as 30+/40+ league players in particular. In addition, the reduction of contact and foul play injuries during games must be a central objective in the future. To this end, various measures must be considered, such as rule adjustments, stricter rule enforcement by referees, and less competitive ways of playing adapted to amateur soccer leagues.

COMMON ABBREVIATIONS

CHF	Swiss francs
CI	confidence interval
€	Euros
FIFA	the Fédération Internationale de Football Association
SD	standard deviation
SFV	Swiss Football Association
SSB	Suva “Sport Basic” injury prevention programme
Suva	Swiss National Accident Insurance Fund
11/11+	FIFA “The 11” and “11+” injury prevention programmes

CHAPTER 1

INTRODUCTION AND BACKGROUND

1.1 Non-professional soccer – at once healthy and harmful

Soccer is one of the most popular sports worldwide. According to the “Big Count“ survey of the Fédération Internationale de Football Association (FIFA), 265 million people played soccer in 2006, of whom 226 million were unregistered occasional players and 39 million were registered club-based players [1]. For those who do not play soccer with a club, the term “informal players” will be used in the course of this thesis. In other sources, they have also been described as non-organised or recreational players. In accordance with the choice of “informal” in this thesis, players engaged in club soccer, who play soccer in organised ways, will be referred to as “formal players” or “amateur players”. Professional players make up only a very small proportion of all formal players [1].

From the perspective of physical activity and health promotion, the high number of soccer players is gratifying, since a physically active lifestyle is beneficial to health [2-5]. Research confirms that playing soccer has substantial health-promoting effects [6-12]. In their systematic review and meta-analysis, Milanovic et al. [9] highlighted various benefits of soccer for physical fitness and health, such as improvements in blood pressure, resting heart rate, fat mass, low-density lipoprotein cholesterol, and countermovement jump performance.

However, playing soccer is also associated with a higher risk of injury than many other sports [13-17]. The incidence of injuries has been investigated particularly in relation to amateur soccer, often with a distinction made between competitive games and training. Research shows that the overall injury incidence in various amateur soccer populations ranges from 5.1 to 12.4 per 1000 hours of play [18-22] with a substantially higher injury risk during competitive games than during training [21, 23]. The differential incidence of injury ranges from 2.0 to 5.7 per 1000 hours for training and from 10.5 to 42.5 per 1000 hours for games, respectively [18, 19, 24-32]. In comparison, injury rates in professional soccer were found to range from 1.4 to 5.8 injuries per 1000 hours for training and from 8.7 to 65.9 injuries per 1000 hours for competition [33]. To what extent the incidence of injury for amateur players differs from professional players has not yet been conclusively clarified, since methodological differences make accurate comparisons of study results difficult. A recent study used the same research design to compare injury rates of Dutch amateur and professional soccer players and found a higher injury incidence during training among amateur players, whereas among professional players the incidence of injury during games was higher [32]. The same study reported that the risk of moderate or severe injury was significantly higher among amateur players. Another study, however, showed that the injury incidence was lower among amateur players compared to professional players during both games and training [18]. Overall, findings with respect to the association of skill level and injury rate are contradictory

[23, 34, 35]. Consequently, no conclusive statement can be made with respect to how the level of play affects the likelihood of injury.

Only two studies based on data from emergency departments have dealt with the question of whether the risk of injury in non-professional soccer has changed in recent years [36, 37]. In Belgium, a significant decrease from 7.6 to 6.0 injuries per 100 amateur players was recorded between 2000 and 2010 [37]. In contrast, an increase in soccer injuries amongst adult players (including informal players) was observed in the USA between 2000 and 2012, which outstripped the increase in participation [36]. However, these data do not allow the calculation of exposure-related incidence rates, which is essential for drawing reliable conclusions about changes. Additionally, one study about US high school soccer tracked non-concussion and concussion injury rates (calculated as athlete-exposures) between the 2005/06 and 2013/14 seasons [38]. This study found a decreasing non-concussion injury rate for boys and a stable non-concussion injury rate for girls, while the concussion injury rate increased for both genders. More information about shifts in the incidence of injury in non-professional soccer is not available.

Although the findings from professional soccer are not transferable to non-professional soccer, they also deserve mention. The annual injury incidence in professional soccer was recorded at different periods between 1982 and 2012, and was predominantly classified as stable [39-42] or even slightly decreasing [43, 44]. However, an increase of muscle injuries was observed over a 15-season period in French professional soccer [40]. All in all, these results are more consistent than the findings in non-professional soccer.

1.2 Soccer-related accidents in Switzerland

Soccer-related accidents are also an important issue in Switzerland. The distribution of leisure-time accidents in Switzerland, shown in Figure 1.1, indicates that 36% of all such accidents occur during sports and play [45]. This percentage has remained stable in recent years. However, the absolute number of leisure-time accidents has increased over the years. 39% of sports-related accidents occur during ball games and 26% during winter sports. Accidents caused by playing soccer are particularly significant in the former group. They account for 64% of ball game injuries and 25% of all sport-related injuries.

In order to develop a better understanding of the injury rates in a sport, it is important to gather information about the number of participants and changes to this population. As the study “Sport Schweiz 2014” showed, nearly 8% of the 15- to 74-year-old Swiss population at that time played soccer, which corresponded to 480,000 persons [46]. Of these, 39%

(187,000 persons) were formal players. The proportion of the soccer-playing population amongst 15- to 74-year-olds did not change substantially between the years 2000, 2008 and 2014 [46, 47]. However, the absolute number of formal and informal players in this population increased from approximately 430,000 in 2008 to 480,000 in 2014 [48, 49]. It is likely that this increase was caused by population growth [50]. According to “Sport Schweiz 2014” and “Sport Schweiz 2008”, the total number of formal players also increased from approximately 176,000 in 2008 to 187,000 in 2014 [46, 47].

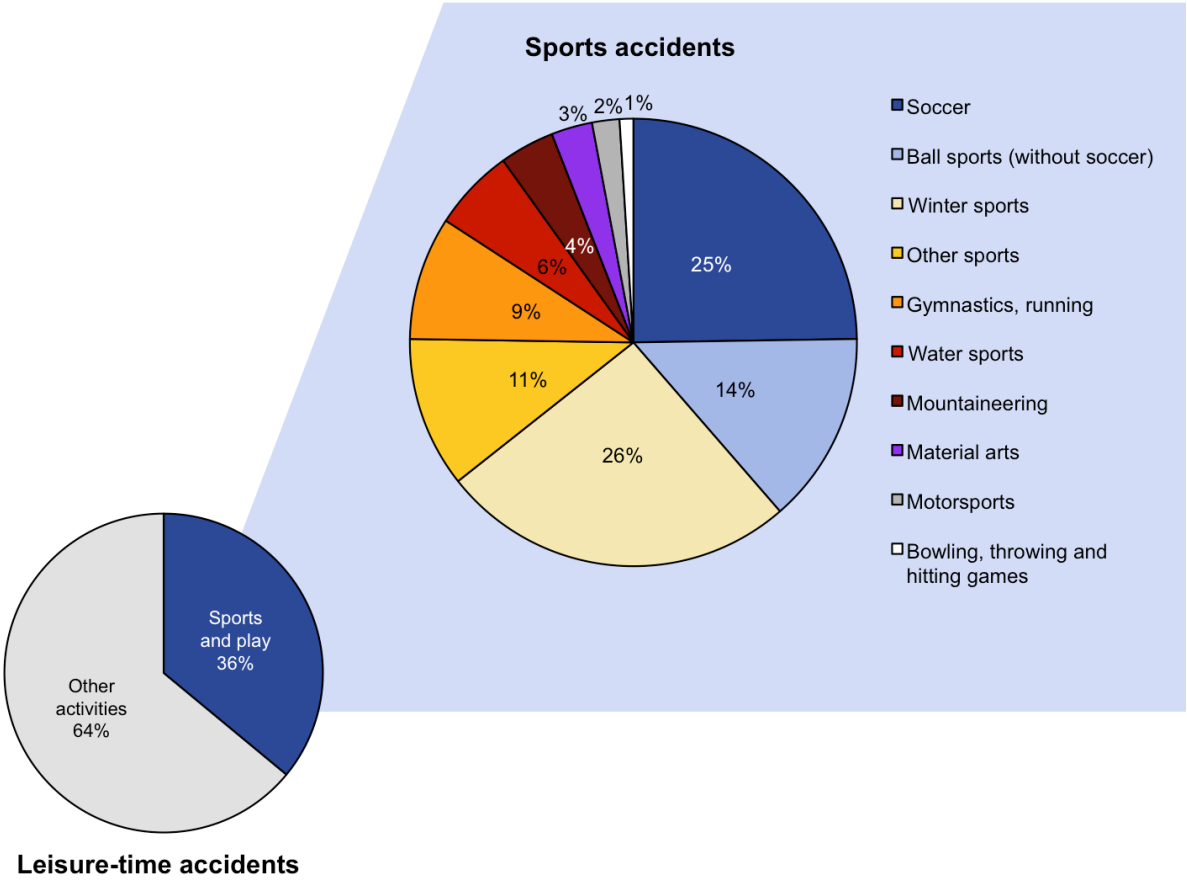

Figure 1.1. Leisure-time and sports accidents in Switzerland (2012-2016) [45].

This finding is confirmed by the statistics from the Swiss Football Association (SFV), which also includes children and shows a major increase of 35% in the number of all formal players between the years 2000 and 2018 (see Figure 1.2) [51, 52]. At an increase of 46%, the number of youth players has grown the most. This growth was observed at all junior levels, with the greatest increases in the youngest bands: Junior A (17- to 19-year-olds) 36%, Junior B (15- to 16-year-olds) 33%, Junior C (13- to 14-year-olds) 27%, Junior D (11- to 12-year-olds) 28%, Junior E (9- to 10-year-olds) 51%, Junior F (7- to 8-year-olds) 180%. Furthermore, the strong increase starting in 2015 was mainly attributable to the youngest age

group. In 2015, juniors under the age of seven (Junior G) were licensed for the first time and thus became formal players.

The increase in the number of adult formal players, registered at 22%, has been less pronounced [51, 52]. However, there are significant differences between various groups of adults, and the exact statistic does not reach back to the year 2000. While the number of male active players participating in Super League, Challenge League, Promotion League, and 1st to 5th amateur league soccer has not changed substantially since the year 2008, the number of male veteran players participating in 30+, 40+, and 50+ leagues (which are composed according to age) has increased by 41% from 40,792 to 57,915 players. Veteran players meanwhile account for 51% of all adult formal players. The number of female adult players has increased by 74% since 2008.

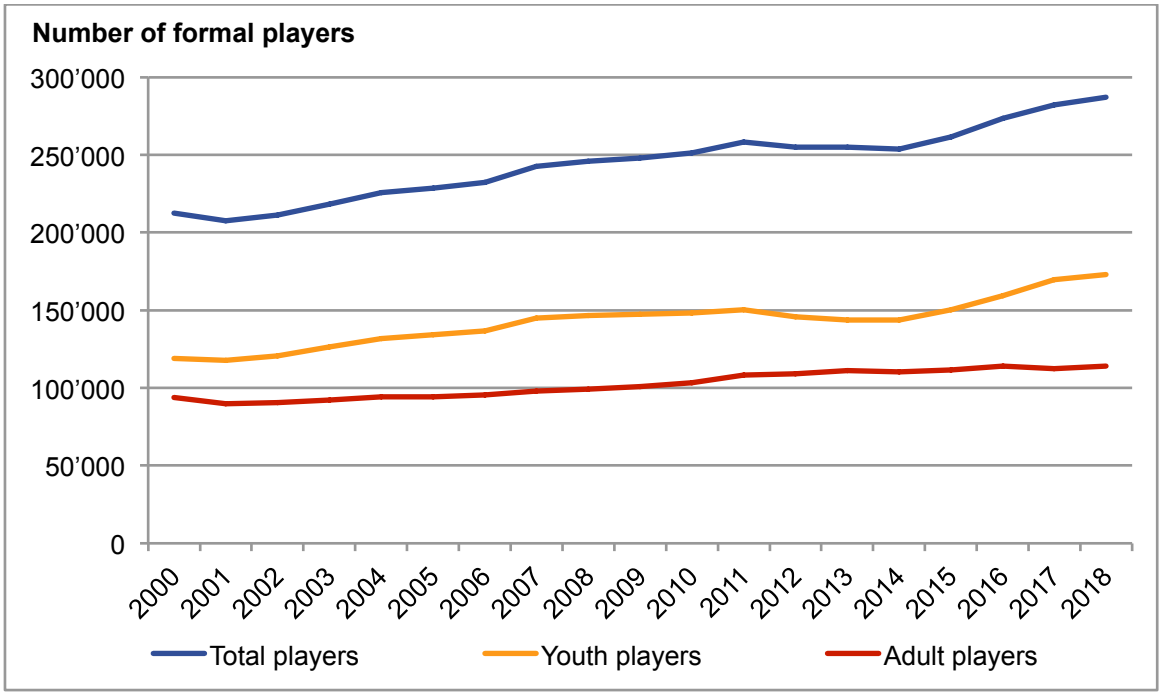

Figure 1.2. Increase of formal soccer players in Switzerland between the years 2000 and 2018 [51, 52].

Since frequency of training and thus exposure time is higher for formal soccer players than for informal soccer players [35], it can be anticipated that an increase of formal players would be associated with an increase in the number of injuries during the same period. Figure 1.3 charts the number of soccer-related accidents in Switzerland since the year 2000 based on two data sources. While the Swiss Accident Insurance Database [53] only records injuries amongst the Swiss working population, the Swiss Competence Centre for Accident

Prevention [54] extrapolates the number of soccer accidents based on the entire Swiss population (including children, unemployed and retired persons). According to the Swiss Accident Insurance Database [53], the number of soccer-related injuries sustained by the working population increased by 17% from 37,622 to 44,027 between the years 2000 and 2016. This finding is in line with the 22% increase amongst adult formal soccer players shown in Figure 1.2 [51]. With respect to the data of the Swiss Competence Centre for Accident Prevention [54], as expected, the number of recorded injuries per year is substantially higher. Additionally, a somewhat more pronounced increase in the number of soccer-related injuries across the entire Swiss population was observed between the years 2005 and 2015. To explain this development, the increasing number of youth formal players must be taken into consideration. Overall, the number of accidents in Swiss non-professional soccer seems to be associated with the number of formal players.

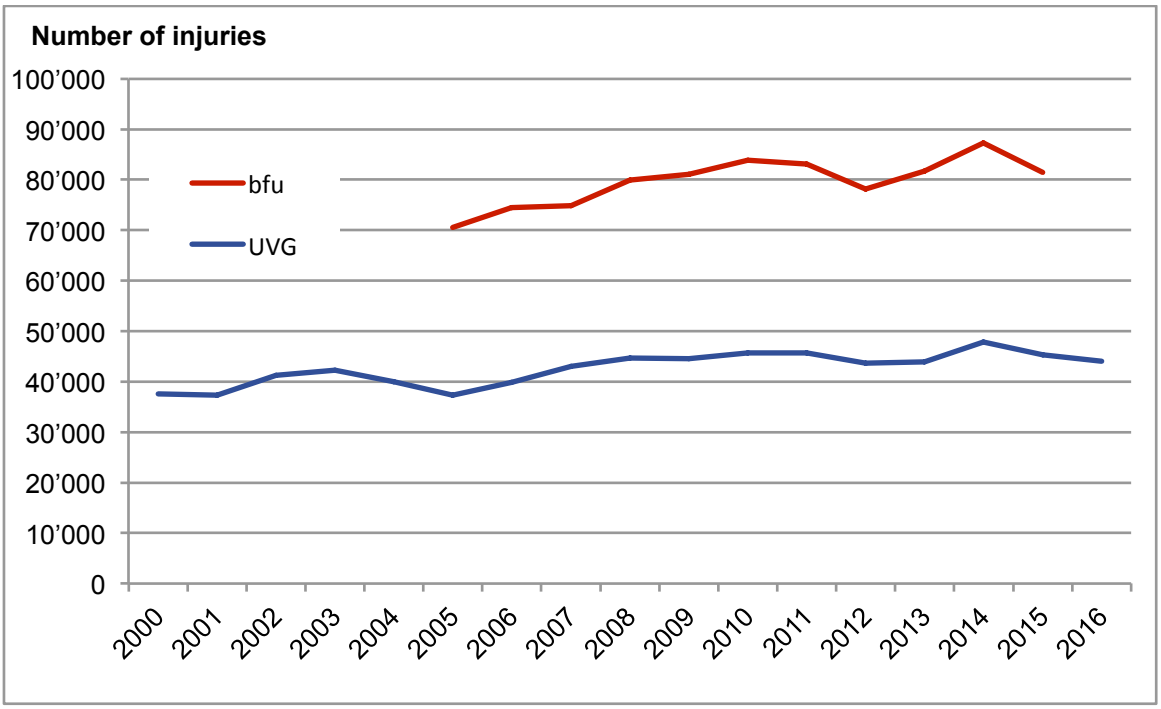

Figure 1.3. Soccer-related injuries in Switzerland between the years 2000 and 2016 according to the Swiss Accident Insurance Database of the working population (UVG) [53] and between the years 2005 and 2015 according to the new database of the Swiss Competence Centre for Accident Prevention (bfu) [54].

1.3 Costs associated with soccer-related injuries in Switzerland

The economic burden associated with soccer-related injuries is high [53, 55]. In the Netherlands, an analysis of the injury costs of patients visiting an Emergency Department identified soccer-related injuries amongst the 15- to 24-year-old population as highly cost-intensive [55]. In particular, injuries affecting the knee, which are common in soccer, are associated with high injury costs, since they often result in a long and expensive rehabilitation [37, 56-59]. Comprehensive and detailed research about the costs of different soccer accidents is missing.

In 2016, the Swiss working population was responsible for soccer-related injury costs of 211 million Swiss francs (CHF) [53]. Extrapolated to the entire population of Switzerland, it can be assumed that the total injury costs of soccer accidents are much higher. As Figure 1.4 shows, soccer-related injury costs substantially increased between the years 2000 and 2016. Only between the years 2003 and 2007 did cost of soccer-related injuries stagnate.

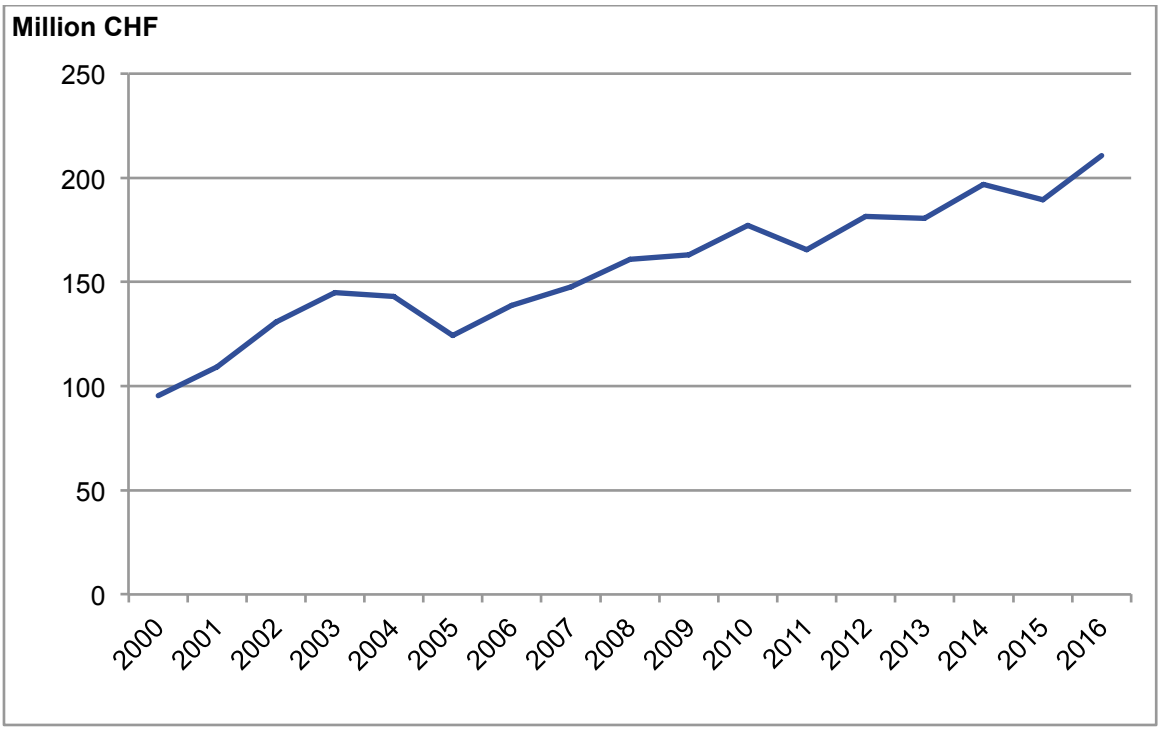

Figure 1.4. Overview of soccer-related injury costs in Switzerland between the years 2000 and 2016 according to the Swiss Accident Insurance Database of the working population (UVG), in million CHF [53].

Overall, soccer-related injury costs have increased by 121% since 2000, which is substantially more than the above-mentioned 17% increase of soccer-related injuries amongst the working population. This finding indicates that each single soccer injury has become more and more cost-intensive. On the one hand, this may be attributable to the fact that the treatments have become more complex and hence more expensive. On the other hand, injuries may have become more serious. To assess this, more information about the characteristics and aetiology of these injuries is needed.

1.4 Characteristics, aetiology and risk factors of soccer injuries

Even though considerably fewer studies have focussed on amateur and informal soccer, as compared to professional and elite soccer, different findings about the characteristics and causes of injury have been confirmed. Over 80% of injuries in amateur soccer affect the lower extremities [21, 22, 35, 60-62] and the most frequently injured body regions are the ankle, knee, and thigh [19, 21, 22, 24, 63-66].

Contact with another player is an important cause of soccer-related injuries [67]. The percentage of injuries caused by contact with an opponent varies from 41% to 56%, depending on the amateur soccer population [21, 30, 35, 38, 66, 68]. A somewhat lower proportion of contact injuries was found amongst veteran soccer players, at 35% [19]. Taking all amateur soccer populations into account, however, the percentage of contact injuries is higher during games than during training [19, 21, 24, 30, 38, 67, 69]; in games, this can reach as high as 70%. Likewise, injuries caused by foul play occur more often during games [30, 67]. Between 23% and 28% of game injuries are attributed to unfair behaviour on the part of the opponent [21, 30, 67].

The most common injury mechanisms in professional and elite soccer are tackling, running, being tackled, shooting, twisting and turning, jumping and landing [70]. With respect to amateur soccer, literature about injury mechanisms is scarce, and in relation to informal soccer no information exists at all. For amateur players in New Zealand running, being tackled, and tackling were the most frequent injury mechanisms during matches, while running, tackling, and ball skills were the most frequent injury mechanisms during training [71]. In US high school soccer general play, chasing a loose ball, dribbling, and defending were identified as the most frequent injury mechanisms [38].

In 2005, a model for injury causation in sport was proposed by Bahr and Krosshaug [72]. On the one hand, they named internal risk factors such as age, sex, body composition, health, physical fitness, anatomy, skill level, and psychological factors, on the other hand, they listed

external factors such as equipment, environment, and sport factors (e.g. rules, referees, coaching). With respect to amateur soccer, age and especially previous injuries have been reported as important risk factors for future injury [34, 63, 64, 69, 73-79]. Insufficient recovery time from injury and playing against medical advice are also associated with recurrent injuries in amateur soccer [18, 74]. In addition, there are some further possible factors, undermined, however, by less evidence and partially contradictory research results, that influence injury risk in amateur soccer: the characteristics of the player (female sex, taller height, joint instability, higher body mass index), fitness and physical overloading, general health behaviour and psychosocial stress, skills and position, adequacy of warm-up, playing field conditions, equipment (taping, braces), and foul play [35, 37, 57, 68, 74, 79-85].

Knowledge about injury characteristics, causes, mechanisms and risk factors is essential for the development of effective prevention strategies [72, 86-88]. Based on the knowledge presented above, prevention strategies were launched, on the basis of which various exercise-based injury-prevention programmes have been developed, introduced, and evaluated during the last 20 years [86].

1.5 Injury prevention in Swiss non-professional soccer

Since, as shown in the previous sections, many accidents happen in non-professional soccer and the costs associated with these accidents are rising, injury prevention plays a decisive role. The positive effect of injury prevention programmes on the risk of injury in professional, amateur, and youth soccer has been verified by various review studies [84, 86, 89-94]. Faude et al. [86] concluded that exercise-based injury prevention programmes can reduce injury incidence by 30% to 50% depending on the frequency of implementation. However, there are also individual studies that have been unable to confirm a positive effect from prevention programmes, pointing instead to conflicting evidence [95-98]. These authors attribute the lack of positive results to the low number of training sessions amongst some amateur soccer teams [95-98]. Neuromuscular training, moreover, needs to be performed two to three times a week to have a preventive effect on lower-extremity injuries [99-101]. Another reason given for the absence of effects is the low compliance of players [96, 102, 103]. Aside from concerns about the application of preventive exercises, the question arises whether the use of prevention programmes does in fact reduce the economic burden of soccer-related injuries. Three studies have confirmed a significant reduction of injury costs through the implementation of a prevention programme [104-106]. Since effective prevention programmes are already available and have been tested in randomised controlled trials, the

next step is to ensure the optimal implementation and application of these measures in real-world settings [84].

Two prevention programmes have been launched in Swiss amateur soccer during the last 15 years. The first of these, “The 11“, was developed by FIFA as a warm-up programme to reduce the most common soccer injuries [107]. This prevention programme was integrated into the education of Swiss soccer coaches from 2004 onwards by way of a teach-the-teacher strategy [28]. It included a fair play rule and ten exercises focusing on core stabilisation, eccentric muscle training, proprioception, dynamic stabilisation, and plyometric training [107]. The implementation of “The 11” and its effect on injury incidence was evaluated four years after its launch in Switzerland [28]. 80% of all Swiss coaches by then knew about the prevention programme and 57% had implemented “The 11” or selected exercises from the programme. Amongst teams that used “The 11”, game injury incidence decreased by 17% and training injury incidence decreased by 19% between 2004 and 2008. By comparison, amongst teams that did not use this prevention programme, game injury incidence remained unchanged while training injury incidence increased by 9%.

In 2009, a revised version of “The 11” was disseminated and called “11+”, which comprises 15 exercises divided into three parts [108, 109]. It is designed for amateur and informal soccer players aged 14 years and older, and is meant to be integrated as a 20-minutes warm-up prior to every training session. The six exercises of part one (straight ahead, hip out, hip in, circling partner, jumping with shoulder, quick forwards and backwards sprints) focus on low-speed running exercises and active stretching; part two includes six core and leg strength, plyometric and balance exercises spanning three levels of increasing difficulty (the bench, sideways bench, hamstrings, single-leg stance, squats, jumping). Finally, part three consists of three moderate- and high-speed exercises in combination with planting and cutting movements (across the pitch, bounding, plant and cut).

With “Sport Basics”, an additional prevention programme was launched in 2011 by Suva and integrated into the education of coaches by the SFV [110] instead of “The 11”. It includes six basic exercises ("Basics") and four additional exercises with a higher level of difficulty ("Basics Plus") [111]. The programme was developed for athletes across a range of different ball sports. The exercises, which take 10 minutes, focus on strengthening the core and stabilising the axis of the leg, and it is recommended that they be integrated into the warm-up programme. The six basic exercises consist of sit-ups, back raises, side bridges, squats, one-legged sideways jumps, and bridges, while the additional exercises include single leg stance, side plank rotations, lunges, and lunges with rotation.

In Swiss amateur soccer further measures have been taken to prevent injuries. In 2007 regional associations of the SFV introduced a ranking-relevant penalty point system for

teams in low-level amateur and youth soccer [112, 113]. For each yellow or red card, a team receives penalty points, which accumulate over the entire season. To determine the final ranking of a team, the number of victories and draws counts first and then penalty points are deducted before goal difference is taken into consideration. In addition, the clubs with the highest level of fair play have been given honourable mention in Swiss amateur soccer since the 2009/10 season [114]. Finally, further preventive measures were launched by Suva, such as a project to enhance safety at fun tournaments as well as an entertaining online test to determine one's personal injury risk [115].

CHAPTER 2

AIMS OF THE PHD THESIS

2.1 Aims of the PhD thesis

As shown in the previous chapter, soccer is a popular sport, but it causes a high number of injuries annually. As a consequence, the financial and psychosocial burden on society is high. Over the years, research has revealed much about the causes and characteristics of soccer-related injuries. Although most of the research has focussed on professional and elite soccer, some informative studies on injuries in amateur soccer have also been carried out. The number of studies that include informal soccer and focus on various non-professional soccer settings, however, is very limited.

In Switzerland, longitudinal data about the number of injuries in non-professional soccer and the corresponding costs is available. In addition, a study has been carried out of the implementation and impact of a prevention programme in Swiss amateur soccer between the years 2004 and 2008 [28]. However, more detailed, up-to-date information is missing about the causes and characteristics of injury in Swiss non-professional soccer and about the success of implementing injury prevention in a real-world context. This is due to the fact that the collection of such data is extremely time-consuming and difficult to carry out [116]. Nevertheless, detailed knowledge about injuries and injury prevention in non-professional soccer could form the basis for developing and improving prevention strategies, which could in turn have cost-saving effects.

Therefore, the overall aim of this PhD thesis is to investigate the occurrence of accidents in Swiss non-professional soccer in more detail. It seeks to clarify the settings in which non-professional players are injured and to analyse injury characteristics and causes. Additionally, it will be shown which injuries tend to have serious consequences, on the one hand for the person concerned and on the other hand for society in the form of costs. Finally, a longitudinal overview of injury incidence will be presented and the implementation of preventive measures in Swiss amateur soccer will be assessed. The findings of this PhD thesis will be then used by Suva to further enhance injury prevention in Swiss non-professional soccer and to identify new approaches to preventive measures.

During the course of this PhD project, two cross-sectional, retrospective telephone surveys were conducted to address the goals as defined (the questionnaires can be found in Appendix B and Appendix C, respectively). The Suva study focussed on persons who were injured while playing soccer and who reported this accident to Suva. They were interviewed in detail about their injury, and every injury was linked to its costs. Since the costs were provided by Suva, the best possible database was available. In the second study, which focussed on coaches, a representative sample of Swiss amateur soccer coaches were interviewed about the frequency of injuries in their teams, the implementation of preventive measures, and the use of injury prevention programmes. The results of this coaches study

were compared to two previous surveys of Swiss amateur soccer coaches carried out in 2004 and 2008. Overall, a comprehensive and unique database was created, resulting in five publications. In what follows, the objectives of each publication are listed in detail.

Publication I (Suva study):

To expand on previous research by focussing on soccer-related accidents in a broad sample of non-professional soccer players, including both formal and informal soccer players, and to define factors which influence injury severity. Further objectives are to analyse injury settings, injury characteristics (e.g., body region, injury type), underlying causes (e.g., contact with an opponent, specific injury situation, foul play), and preventive behaviours of the players.

Publication II (Suva study):

To compare incidences, causes and characteristics of soccer-related injuries across different settings in non-professional soccer.

Publication III (Suva study):

To provide a wide variety of information on the costs of injuries in non-professional soccer. Further objectives are to describe who causes high injury costs, which injuries are cost-relevant, and which injury situations lead to high costs.

Publication IV (coaches study):

To compare injury incidences in Swiss amateur soccer between the years 2004, 2008, and 2015. Further objectives are to determine how the injury characteristics and injury causes changed in amateur soccer over these years and how the incidence of injury changed in different leagues.

Publication V (coaches study):

To explore the state and development of injury prevention in Swiss amateur soccer and to examine the association between the injury incidence in respective teams and the implementation of prevention programmes in these teams in 2015. Further objectives are to examine to what extent prevention programmes are implemented in teams from different amateur leagues.

CHAPTER 3

PUBLICATION I: INJURIES IN FORMAL AND INFORMAL NON-PROFESSIONAL SOCCER – AN OVERVIEW OF INJURY CONTEXT, CAUSES AND CHARACTERISTICS

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Markus Lamprecht

Published version*

European Journal of Sport Science. 2018;18(8):1168-1176

Doi: 10.1080/17461391.2018.1475507

* Minor editorial modification have been made due to harmonisation of the thesis

Abstract

The objective of this study is to analyse context, causes and characteristics of injuries in non-professional soccer. Therefore, a retrospective telephone survey was carried out with persons who were injured while playing soccer and who reported this accident to the Swiss National Accident Insurance Fund (Suva). Based on these data, an analysis of 708 soccer injuries was performed. The findings show that 30.1% of the injuries occurred during informal soccer play, and 75.4% of the injured persons were soccer club members. 53.0% of all injuries were caused by contact and 29.5% by foul play. Foul play was not associated with injury severity. With respect to injury severity, twisting/turning and being tackled by an opponent were identified as the most influential injury causes. Moreover, the risk of being severely injured was particularly high among players of the 30+/40+ amateur leagues. In conclusion, the findings highlight that 30+/40+ league players are a major target group for the prevention of severe soccer injuries. Soccer clubs may constitute an appropriate multiplier for implementing prevention strategies such as fair play education, healthy play behaviours, and prevention programmes. Finally, a better understanding of injury situations leading to severe injuries is needed to improve injury prevention.

Keywords: injury severity, injury setting, amateur soccer, foul play

Introduction

In Switzerland, soccer is a popular leisure time activity. According to the study "Sport Schweiz 2014", 7.8% of 15- to 74-year-olds play soccer [49]. As a consequence, it is the most popular team sport in Switzerland. Of the extrapolated 480,000 persons practicing soccer, about 290,000 play informally (with family and friends, in fun tournaments, etc.) and 190,000 play formally in a soccer club [46]. The high number of players leads to a considerable number of soccer related injuries. In Switzerland, annually, approximately 48,000 accidents occur during informal and formal soccer play among working people aged 15 to 64 years [117]. This leads to direct costs amounting to CHF 180 million (≈ EUR 168 million). Projected on the entire Swiss population (including children, non-working or retired people), the estimated number of accidents accounts for 80,000 incidents per year [54]. Therefore, the final cost resulting from formal or informal soccer accidents substantially exceeds the estimated CHF 180 million. In summary, soccer injuries constitute a significant financial burden and are therefore an important public health issue.

Despite these insights, the number of available studies focussing on non-professional soccer is still limited and the existing research is flawed by some methodological shortcomings, which prevent far-reaching conclusions: First, an increasing number of investigations has focussed on different amateur soccer teams from individual leagues [18, 21, 32, 65, 95]. For instance, van Beijsterveldt et al. [32] found a higher overall injury incidence for amateur soccer players compared to professional ones and they confirmed a higher risk of sustaining a moderate or severe injury for amateur players. Another study reported a similar injury incidence among veteran soccer players (aged 32 years and older) compared to other male soccer populations, indicating the need for preventive measures in this setting [19]. However, these studies were based on restricted samples and thus do not allow a generalisation to broader populations.

Second, attempts have been made to obtain more representative insights by using data from nationwide insurance systems [37, 64, 74, 118]. These data allow a deeper understanding with respect to injury incidence and characteristics in amateur soccer. For instance, McNoe and Chalmers [118] reported a higher injury incidence (50.2 injuries per 1000 hours) for competitions compared to trainings (9.0 injuries per 1000 hours). Additionally, Mufty et al. [37] concluded that the number of injuries decreased between the seasons 1999/2000 and 2009/2010, and that female players sustained more severe injuries than men. Furthermore, according to Herrero et al. [64], the most common injuries in amateur soccer affect the knee, and players aged 30 years and older have an increased injury risk. Chalmers et al. [74] highlighted that injury prevention programmes should focus on female and adult players. The preventive behaviour of community-level soccer players was examined in detail by McNoe

and Chalmers [118] who found that 81% of players performed physical conditioning (at least once) in the off-season. Despite these insights, little information was provided by the aforementioned studies regarding the causes of amateur soccer injuries and the setting in which they occurred.

Third, two studies provided a general overview of nationwide soccer injuries (including both formal and informal soccer) either by referring to data collected in large-scale surveys [66] or in emergency departments [36]. While these studies focussed on injury diagnosis, and age and gender differences, they did not provide information regarding the context and causes of non-professional soccer injuries. However, these insights are necessary to obtain essential information needed to design effective injury prevention strategies.

Therefore, the objective of the present study was to expand on previous research by focussing on soccer accidents in a broad sample of non-professional soccer players, by including both formal and informal soccer, and by placing a special emphasis on the setting in which the accident occurred, specific injury characteristics (e.g., body region, injury type), underlying causes (e.g., contact with an opponent, specific injury situation, foul play), and preventive behaviours of the players. An additional purpose was to find out to what degree these factors explain injury severity.

Methods

A retrospective telephone survey was carried out, which was supported by the Swiss National Accident Insurance Fund (Suva). This is an organisation under public law, which is responsible for compulsory accident insurance for working people in Switzerland. According to Art. 2 HRA (Human Research Act) and Art. 25 HRO (Human Research Ordinance), an ethical committee's approval is not required for anonymised surveys in Switzerland. However, the recruitment of participants for this survey was conducted under the data protection regulations of Suva.

Study population and recruitment

The recruitment process is described in Figure 3.1. As already mentioned, working people in Switzerland are involved in approximately 48,000 soccer accidents annually, of which 30,000 are recorded by Suva [117]. With the target of interviewing at least 800 persons, a randomly selected sample of 2,835 persons was contacted by an information letter (including a pre-written declaration of consent) and those who did not respond were contacted by telephone. The telephone-based recruitment was stopped when enough people had given their consent. In total, 1055 (37.2%) persons who had sustained a soccer injury consented either in written form or orally to take part in the study. Within this sample, 822 interviews could be carried out (77.9% response rate).

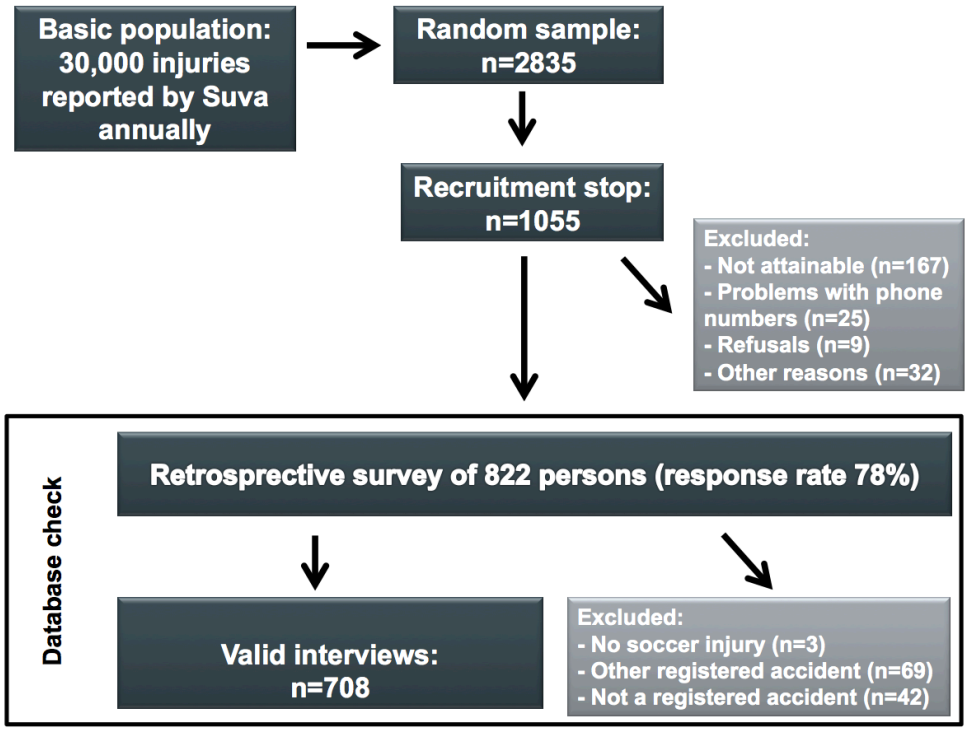

Figure 3.1. Recruitment and exclusions based on a database check.

Procedure

Initially, the risk factors for injuries in soccer were identified by a literature research. On this basis, a semi-structured questionnaire was developed and pretested. This analysis supplied enough data points to create a standardised questionnaire including 86 questions. The data used in the present study are based on soccer injuries that occurred between July 2013 and June 2014. On average, the interviews were carried out 6.1 months (SD = 2.10) after the injury has happened, because the injury must first be reported to Suva by the injured person. However, 79.2% of the respondents reported remembering the accident well or very well. The average duration of an interview was 16.2 minutes.

Data screening and final sample

First, some characteristics of the insured people who participated in the survey (n = 822) were compared with the rest of the random sample (n = 2013) in order to check for a selection bias. While no significant differences were found with regard to age ($t(1395.18) = -1.17$, $p = 0.241$), a small selection bias was identified with regard to gender ($\chi^2(1,2835) = 13.017$, $p < 0.001$) and nationality ($\chi^2(1,2766) = 9.492$, $p = 0.002$), with a higher rate of women (5.8% vs. 3.0%) and Swiss citizens (78.6% vs. 73.0%) among the respondents. Second, an extensive data screening was carried out. Based on this screening, three persons were directly excluded for not reporting any soccer injury. Finally, the Suva data pool allowed us to test whether the information provided during the telephone interviews corresponded with the official Suva records. In several cases, the type of injury described in the interview did not match with the Suva record (see Figure 3.1). With these cases excluded, 708 valid injuries were included in the analysis. The overall average age of the 708 respondents was 28.6 (SD = 10.5) years and 6.1% were female.

Definitions and reliability

Forced absence from sport due to an accident was defined as the number of days until the insured person had fully recovered and could participate in sport activities [119]. Based on the number of days absent from sport, a distinction was made between four degrees of injury severity: mild (<7 days), moderate (1-4 weeks), severe (1-4 months), and extremely severe (>4 months) [120].

The respondents were asked whether their injury was caused by foul play and how the referee judged the situation. In addition, a classification of injury situations was carried out based on short statements regarding the course of events. Referring to the work of Hawkins et al. [121], 19 categories were created; two categories (diving and throwing) were not

included and one additional category (kicking the ball simultaneously) was added. Using this categorisation, adequate intrarater reliability (κ = 0.85, $p < 0.001$, 95%-CI 0.78-0.92) and interrater reliability (κ = 0.79, $p < 0.001$, 95%-CI 0.72-0.90) were found in the present study.

Statistical analyses

Statistical analyses were performed with SPSS software (version 22.0). To describe injury setting, injury characteristics, injury causes, and preventive behaviours of the players, descriptive statistics were calculated. χ^2 statistics for nominal variables and Mann-Whitney U for categorical variables were applied to examine statistical differences between dominant and standing leg and between soccer club members and non-members. The significance level was set at $p \leq 0.05$ for general analyses.

To find out to what degree different factors explain injury severity, logistic regression models were calculated using injury severity as dependent variable with the two manifestations of non-severe injury (less than 4 weeks) and severe injury (more than 1 month). Only factors which were associated with injury severity in bivariate analyses were included in the models and odds ratios (OR) with a 95% confidence interval (95%-CI) were displayed. Due to multicollinearity, it was not possible to simultaneously include all predictors. Therefore, three separate models were tested. Preventive behaviours (adjusted footwear, number of preventive measures) and previous injury were included in all models. Model 1 and 2 included all injuries and both models controlled for participants‘ gender, age (categorical variable: 15-24 years reference category, 25-34 years, 35-44 years, 45+ years) and warm-up; while Model 1 focused on injury characteristics (five most frequently reported body regions and injury types), Model 2 placed and emphasis on the underlying causes (foul play, five most frequently reported injury situations). Model 3 only included accidents from formal soccer play that occurred during games of the official amateur championship. In this model, a special focus was placed on injury characteristics (five most frequently reported body regions and injury types), type of league (1st-3rd, 4th-5th, 30+/40+, junior, women’s), and timing (first vs. second half). As Swiss soccer leagues are organised according to players’ age and gender, these two factors were excluded from Model 3. Due to their limited statistical power, injury situations and warm-up were not included.

Results

Setting and leagues

Figure 3.2 presents the setting in which the interviewed persons were injured. 69.9% of all accidents occurred during formal soccer play (game and training) and 30.1% during informal soccer play (including playing during free time, during a fun tournament, in other sports clubs, in school sport, in alternative leagues, and other). 75.4% of the respondents were soccer club members. Considering formal soccer game injuries only, 10.3% of the accidents happened in 1st-2nd amateur leagues, 13.5% in 3rd amateur leagues, 19.9% in 4th amateur leagues, 12.9% in 5th amateur leagues, 14.4% in 30+/40+ leagues, 14.7% in junior leagues, 7.9% in women's leagues, and 6.5% in other leagues. 43.6% of these injuries occurred during the first half.

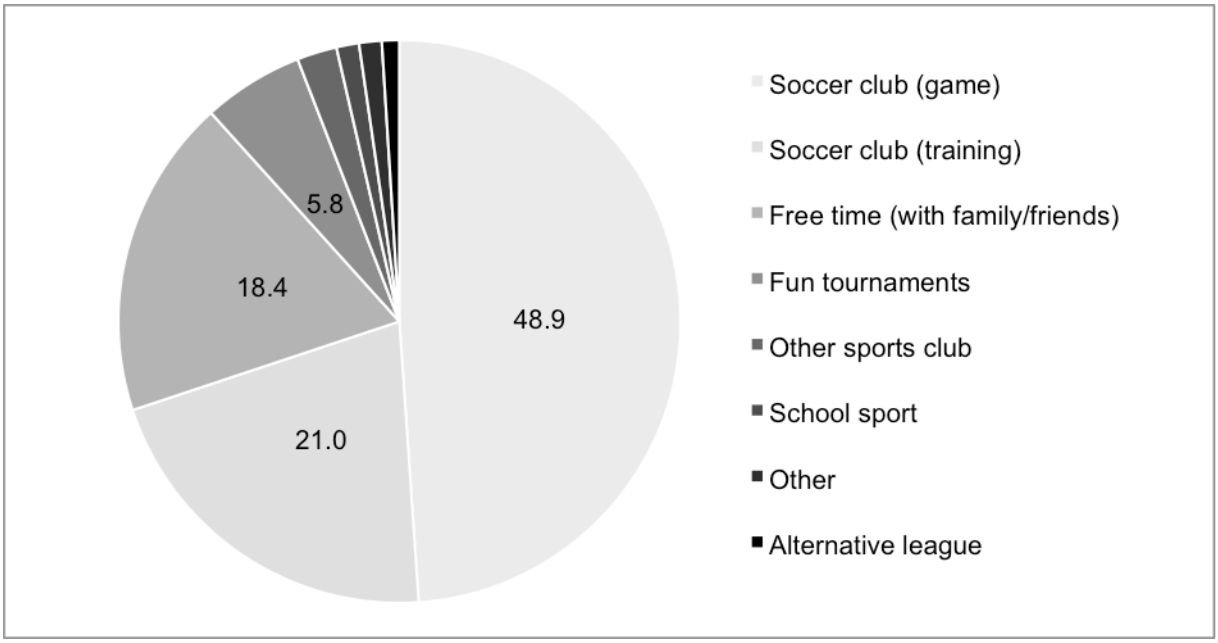

Figure 3.2. Setting of soccer injuries (in percentage). n = 705 (3 persons did not answer this question), percentages under 5% are not labelled.

Injury characteristics

With regard to body region, the majority of injuries affected the lower limb (71.5%), whereas the upper limb (15.7%), the trunk (5.8%), and neck and head (7.1%) were less frequently affected. Ankle (29.0%) and knee (24.7%) were the most frequently injured body regions (see Table 3.1). Interestingly, head and face injuries (6.2%) were almost as common as

those affecting feet and toes (7.6%). Moreover, 26.7% of the interviewed persons reported a recurrent injury of the same body region and they more frequently sustained injuries on their dominant leg (60.2%) than on their standing leg (39.8%, $\chi^2(1,462) = 19.13$, $p < 0.001$). However, the severity of injury did not vary between dominant and standing leg (U = 24,010.50, $p = 0.375$, $r = 0.04$). With regard to injury type, Table 3.1 further shows that the most dominant injury type was ligament sprain or rupture accounting for 44.9% of all injuries.

Injury causes

More than half of all soccer injuries (53.0%) were caused by contact with an opponent. Table 3.1 provides an overview of the specific situations in which the injuries occurred. Being tackled by an opponent, collision, and other contact situations turned out to be the top three injury situations accounting for 41.2% of all soccer injuries. Additionally, twisting/turning was the most common cause for non-contact injuries. In twisting/turning situations, significantly more injuries affected the standing leg (59.2%, $\chi^2(1,462) = 8.57$, $p = 0.003$). Heading and aerial duels also frequently led to injuries (7.6%). The latter includes not only head injuries but also injuries caused by falling and uncontrolled landing.

According to the answers of the respondents, 29.5% of all injuries were caused by foul play. Only considering formal game injuries, 41.2% of the respondents stated that they had been fouled. Hereof, 68.9% reported that the referee penalised their opponent (63.7% free kick but no card, 33.0% yellow card, 3.3% red card). Furthermore, the respondents were asked to provide a subjective assessment of the foul play: 55.7% reported a normal foul play, 14.8% an aggression of their opponent, 13.3% a professional foul, 10.8% a tactical foul, and 5.4% a different reason.

Preventive behaviour

89.7% of the respondents indicated that they had performed a warm-up before they were injured. In 86.8% of these cases, the warm-up lasted more than 10 minutes. 68.6% of the respondents adjusted their footwear to the playing surface and 67.1% wore shin guards.

Additionally, the respondents were asked whether they engaged in preventive behaviours prior to the injury (prompted questioning). In sum, 84.5% of the respondents reported at least three of the following preventive measures: stretching (85.0%), warm-up (84.7%), cardiorespiratory fitness training (72.0%), core strength training (63.0%), general strength training (61.3%), cool down (55.4%), and massage (18.4%).

Furthermore, the respondents rated different statements regarding their play behaviour at the time of injury. Interestingly, soccer club members (U = 34,483.50, $p < 0.001$, $r = 0.18$) were

more willing to accept an injury to achieve an important victory and they more strongly agreed with the suggestion that they would take the risk of hitting their opponent instead of only playing the ball (U = 38,007.50, p = 0.001, r = 0.13).

Table 3.1. Injuries by body region, injury type, and injury situations reported in the survey

Category	Frequency	Percent
Body region		
Ankle	205	29.0
Knee	175	24.7
Foot, toe	54	7.6
Head, face, teeth	44	6.2
Hand, fingers, thumbs	43	6.1
Shoulder, clavicle	40	5.6
Lower leg, Achilles tendon	35	4.9
Breastbone, ribs, upper back	28	4.0
Thigh	28	4.0
Wrist	16	2.3
Lower Back, sacrum, pelvis	12	1.7
Upper arm, elbow, forearm	12	1.7
Hip, groin	9	1.3
Neck, cervical spine	6	0.8
Abdomen	1	0.1
Total	*708*	*100.0*
Injury type		
Ligament sprain, rupture	318	44.9
Contusion, hematoma	110	15.5
Bone fracture	69	9.7
Cartilage/meniscal damage	51	7.2
Strain, torn muscle fibre	42	5.9
Tendon injury, tendinitis, bursitis	27	3.8
Dislocation, luxation	22	3.1
Other bone injury	16	2.3
Concussion	14	2.0
Abrasion, laceration	11	1.6
Axonal injury	4	0.6
Dental injury	3	0.4
Other	21	3.0
Total	*708*	*100.0*

Category	Frequency	Percent
Injury situations		
Tackled	116	16.4
Collision	103	14.5
Other contact	73	10.3
Twisting/turning	57	8.1
Heading	54	7.6
Running	51	7.2
Falling	39	5.5
Hit by ball	38	5.4
Other non contact	35	4.9
Shooting	29	4.1
Kicking the ball simultaneously	23	3.2
Tackling	22	3.1
Kicked	20	2.8
Dribbling	17	2.4
Landing	11	1.6
Use of elbow	7	1.0
Passing	5	0.7
Jumping	2	0.3
Stretching	1	0.1
Not specified	5	0.7
Total	*708*	*100.0*

Severity

6.4% of all reported injuries were mild, 33.0% moderate, 40.3% severe, and 20.2% extremely severe. Table 3.2 presents three logistic regression models testing associations of different factors with injury severity.

As shown in Model 1, the likelihood of reporting a severe injury was significantly increased in respondents with knee injuries. In contrast, ankle injury and injury severity were not associated. Concerning injury type, respondents who reported cartilage and meniscal damages had a nearly six-fold increased risk of reporting a severe injury. As expected, bone fractures were also associated with injury severity. Moreover, respondents aged 35 to 44 years had a four-fold increased odds ratio compared to 15- to 24-year-old players. Finally, while players who reported a previous injury of the same body region were less likely to sustain a severe injury, persons who had performed a warm-up before getting injured had a two-fold increased odds ratio compared to those who did not.

Beyond these findings, in Model 2, a significant association was found between foul play and injury severity (see Table 3.2). Unexpectedly, foul play was associated with a lower likelihood of reporting a severe injury. In contrast, twisting and turning, and being tackled turned out to be injury situations associated with a higher risk of severe injuries.

In Model 3 only formal soccer game injuries were considered. Players of 30+/40+ leagues were more likely to sustain a severe injury during games than players of 1st-3rd amateur leagues and 4th-5th amateur leagues as well as women's leagues and junior leagues. Additionally, a higher risk of severe injuries was found during the first half. Moreover, during formal soccer games, knee injuries were associated with a significantly increased likelihood for severe injuries, and bone fractures show, as expected, high odds ratios.

Table 3.2. Factors associated with injury severity using logistic regression.

	Model 1			Model 2			Model 3*		
	OR	95%-CI	*p*	OR	95%-CI	*p*	OR	95%-CI	*p*
Previous injury	0.65	0.43-0.97	0.034	-	-	n.s.	-	-	n.s.
Adjusted footwear	-	-	n.s.	-	-	n.s.	-	-	n.s.
Number of prev. measures	-	-	n.s.	1.18	1.08-1.30	<0.001	-	-	n.s.
Warm-up	2.24	1.24-4.04	0.008	-	-	n.s.			
Gender	-	-	n.s.	-	-	n.s.			
Age									
15-24 years (Ref)	1			1					
25-34 years	1.99	1.05-3.76	0.033	1.88	1.09-3.23	0.022			
35-44 years	4.44	2.36-8.35	<0.001	4.22	2.37-7.49	<0.001			
45+ years	2.06	1.35-3.14	0.001	1.91	1.31-2.78	0.001			
Ankle	-	-	n.s.				-	-	n.s.
Knee	1.97	1.22-3.18	0.006				2.78	1.42-5.47	0.003
Foot, toe	0.32	0.16-0.66	0.002				0.17	0.04-0.73	0.017
Head, face, teeth	0.13	0.05-0.34	<0.001				0.04	0.01-0.19	<0.001
Hand, fingers, thumbs	0.17	0.08-0.38	<0.001				0.12	0.03-0.53	0.005
Ligament sprain, rupture	1.67	1.06-2.62	0.026				-	-	n.s.
Contusion, hematoma	0.31	0.17-0.56	0.000				0.24	0.11-0.53	<0.001
Bone fracture	5.75	2.63-12.58	<0.001				15.49	3.86-62.26	<0.001
Cartilage/meniscal damage	6.16	1.94-19.61	0.002				-	-	n.s.
Strain, torn muscle fibre	-	-	n.s.				-	-	n.s.
Foul play				0.64	0.43-0.95	0.027	-	-	n.s.
Tackled				1.81	1.10-2.98	0.020			
Collision				-	-	n.s.			
Other contact				-	-	n.s.			
Twisting/turning				2.06	1.04-4.09	0.040			
Heading				-	-	n.s.			
League									
1st-3rd amateur leagues							0.27	0.09-0.80	0.019
4th-5th amateur leagues							0.27	0.09-0.75	0.013
30+/40+ leagues (Ref)							1		
Junior leagues							0.22	0.07-0.70	0.010
Women's leagues							0.14	0.04-0.52	0.004
Other							0.45	0.11-1.91	n.s.
1st half							2.02	1.23-3.60	0.018

Notes: OR = odds ratios; CI = confidence intervals; Ref = reference category; n.s. = not significant.

*For Model 3 only formal soccer game injuries were factored in.

Discussion

The present study provides deeper insights into injury events in amateur and informal soccer and provides unique data about the context, causes and characteristics of these soccer injuries. One key finding of this retrospective survey was that about one third of soccer injuries occurred during informal soccer play. This result is in line with the research of McGrath and Ozeanne-Smith [122] who found that 30% of injuries in adult soccer occurred during informal play in Australia. Overall, three out of four persons who sustained an injury were playing soccer in a club.

With respect to injury characteristics, we found that the dominant leg was more frequently injured than the standing leg [121]. However, there was no association with injury severity. In contrast to previous studies focusing on elite or professional soccer players [43, 123, 124], the ankle and knee, rather than the thigh, were identified as the most frequently injured body regions. This accords with the results of other studies in amateur soccer [36, 64, 66]. Our results indicate a clear need for injury prevention in amateur and informal soccer to place a focus on knee injuries [64, 125]. Such a focus seems warranted not only because of the high prevalence rates, but also because of the severity associated with knee injuries [126]. Nevertheless, Orr et al. [127] found substantial lack of knowledge among female adolescent soccer players, their parents and coaches about the prevention of knee injuries. The fact that a vast majority of the respondents in the present study stated that they had performed at least three preventive measures prior to the injury indicates that there is relatively high awareness among Swiss soccer players with regard to injury prevention.

More than half of all soccer injuries were caused by contact with an opponent, which is in line with previous research in amateur soccer [30, 66]. According to the respondents, about 30% of all injuries involved foul play. Referring only to formal game injuries, over 40% of the interviewed persons considered foul play as the cause of their injury and in a little more than one out of four injuries the referee penalised the corresponding action. These results correspond with other studies analysing foul play in amateur soccer, which emphasise the importance of fair play and suggest that respect for the opponent's health could prevent a number of injuries [30, 66, 68]. However, our results highlight that foul play was not associated with severe injuries. On the contrary, foul play injuries were less likely to be severe [128]. Thus, measures concerning fair play could probably reduce injuries in general, but not severe injuries in particular. Nevertheless, Pilz [129] argued that fair play education in soccer fails to work properly. Even in adolescence, soccer players are taught that breaking rules in the interest of success is an appropriate behaviour. This was reflected in our results. When comparing soccer club members to non-members, we found that the former were more likely to take the risk of hitting the opponent while they also tended to attach more

importance to success than to their own health. Given these behaviour patterns and attitudes, we recognise potential for improvement with respect to injury prevention.

Being tackled by an opponent, collisions and other contact situations were identified as the most common injury situations. This conflicts with the findings of Hawkins et al. [121] who determined running, being tackled and other non-contact situations to be the most frequent injury mechanisms. However, their study was carried out in professional soccer, which precludes a direct comparison with the present investigation. Thus, different injury mechanisms are conceivable in amateur and professional soccer, possibly due to different playing styles and higher intensity. Concerning severe injuries, situations such as twisting/turning and being tackled were key factors. The latter case involves a situation in which the participant was in ball possession and tackled by an opponent. Such injuries may be prevented by playing the ball more quickly or by improving attention and reaction [130]. Moreover, the present study revealed that the twisting/turning mechanism was associated with severe injuries and with injuries of the standing leg. Generally, it can be assumed that the knee is frequently affected in these injury situations and that the risk for twisting the knee is higher when the leg is loaded with the person's entire weight [131].

The risk for severe injuries was higher among older players. Especially in games of the 30+/40+ leagues, the proportion of severe injuries was high, which makes these players a relevant target group for preventive measures [95]. Due to different age categories and definitions of severe injuries, a comparison with other studies is difficult. Whereas Herrero et al. [64] found a very similar distribution of severe injuries comparing players aged below 30 years with older players, another investigation reported a higher risk for severe injuries with increasing age [68]. In other studies, incidence of injury has been found to increase with age [34, 64, 132] or to be higher for adult players [74].

Finally, the present study indicates that a warm-up and the performance of a higher number of preventive measures could be associated with injury severity. We attribute this to the fact that injuries of different settings (more and less competitive) were included in Model 1 and Model 2 and that a warm-up is well-established in competitive amateur soccer [118].

Limitations

We found a high percentage of severe and extremely severe injuries (61%). This value is considerably higher than in prior investigations focussing on amateur soccer, in which researchers reported between 15% and 31% of injuries as severe [30, 68, 97]. In studies analysing injury incidence and injury patterns in elite or professional soccer, a majority of injuries were classified as slight or minor whereas 9% to 16% of injuries resulted in absences of over 28 days [41, 125, 126]. Although van Beijsterveldt et al. [32] were able to confirm a

higher incidence for moderate and severe injuries in amateur players, the most likely explanation for the divergent findings is that registration of soccer injuries through insurance files is associated with a high percentage of serious injuries [37], because more than half of all sport injuries do not require any treatment at all or are treated by the athletes themselves [133]. On the other hand, it can be assumed that persons who sustained a more severe injury were more likely to participate in the study because their injury event was personally more relevant to them. Aside from this limitation, a recall bias may be of concern because of the time period between injury and interview. Thus, Junge and Dvorak [134] have recommended adopting prospective designs for sports injury studies. However, they also concluded that a retrospective data collection appears to be valid enough to get the measure of an injury's context as well as to record the injured body regions.

Conclusions

Understanding context, causes and characteristics of injuries in amateur and informal soccer is important for the development of appropriate preventive measures. In this regard, amateur soccer clubs – and thus the coaches – could adopt the role of multipliers, through which fair play, healthy play behaviours, and prevention programmes could be promoted. One focus of future research could be to develop and test approaches on how to reduce severe injuries in 30+/40+ league players. At the same time, our results justify more intense and concerted efforts to promote preventive measures in informal soccer. With regard to the prevention of severe injuries, it is well-known that knee injuries are of great importance [64, 68]. However, the present study expands previous knowledge by showing that injury severity is closely associated with twisting/turning and being tackled by the opponent. Clearly, more research about the injury mechanisms in amateur (and informal) soccer play is needed.

Acknowledgments: The present study was funded and supported by the Swiss National Accident Insurance Fund (Suva).

CHAPTER 4

PUBLICATION II: A COMPARISON OF INJURIES IN DIFFERENT NON-PROFESSIONAL SOCCER SETTINGS: INCIDENCE RATES, CAUSES AND CHARACTERISTICS

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Submitted to *The Journal of Sports Medicine and Physical Fitness*

Submission date: 5 October, 2018

* Minor editorial modification have been made due to harmonisation of the thesis

Abstract

Background: There is a lack of data regarding the epidemiology of soccer injuries and the particular accidents in specific non-professional soccer populations. The aim of this study was to analyse incidence, causes and characteristics of soccer injuries, taking into account different settings of formal (amateur) and informal soccer.

Methods: A random sample of persons who had sustained an injury while playing soccer and reported this injury to the Swiss National Accident Insurance Fund (Suva) was retrospectively consulted. 705 injuries were analysed involving three main settings (formal soccer games, formal soccer training, informal soccer) and different amateur soccer leagues.

Results: Knee injuries (p = 0.01) and head injuries (p = 0.005) were observed more frequently in formal games than in informal soccer. Injuries caused by contact with an opponent and foul play occurred more frequently in formal games than in training (p < 0.001) or informal soccer (p < 0.001). Injury incidence was substantially higher for players of 30+/40+ leagues (18.7 injuries per 1000 hours) than for players of other leagues (1st-3rd amateur leagues: 8.5, p = 0.002; 4th-5th amateur leagues: 9.4, p = 0.007; female leagues: 8.2, p = 0.006; junior leagues: 6.7, p < 0.001).

Conclusions: With respect to injury characteristics, causes and injury incidence, essential differences between various non-professional soccer settings exist suggesting that a more specific approach in injury prevention may generate positive effects.

Keywords: amateur soccer, injury mechanism, injury incidence, epidemiology

Introduction

Soccer is the most popular team sport in Switzerland [49]. Amongst the 15- to 74-year-old population, about 480,000 persons play soccer, which corresponds to a percentage of 7.8% [46]. Of these, 190,000 individuals participate in official championships. According to international studies, the overall injury incidence for competitive amateur soccer players ranges from 5.2 to 9.6 per 1000 hours of play [18, 20, 22]. Prior research has compared incidence rates in amateur and professional soccer, yielding inconsistent findings. While van Beijsterveldt et al. [32] compared an amateur cohort to a professional one and found a higher injury incidence in amateur soccer players including an increased risk for moderate and severe injuries, other studies reported a lower [64] or comparable [19] injury risk for specific amateur soccer populations compared with professional players. Given the high number of players involved in amateur soccer and the high injury risk, it is perhaps surprising that only few investigations have provided information about the circumstances leading to injuries in this setting. For instance, previous studies have shown that - as in professional soccer - player to player contact is a frequent injury mechanism in amateur soccer games, causing more than half of all injuries [20, 65]. In training however, non-contact injuries seem to be more common than injuries due to player contact. Interestingly, the frequency of contact injuries does not vary between high- and low-level players when only severe injuries are considered [68].

With regard to the contributing factors which lead to injuries in amateur soccer, contact with another player is the most frequent injury mechanism followed by distortion and turning/twisting [22]. Moreover, in their review on incidence and prevention of soccer injuries Junge and Dvorak found 12% to 28% of all injuries were caused by foul play [67]. However, this review was not exclusively focussed on amateur soccer. These data accord well with another investigation with players of different skill levels, in which almost 30% of traumatic injuries were associated with foul play [30].

Despite these findings, it should be noted that amateur soccer is not a homogenous setting. Only few studies have factored in various levels of amateur soccer, and these have found contradicting results. Peterson et al. [30] compared players from all levels (including top level) and concluded that while low level players had a lower exposure to soccer, they were more likely to get injured. In contrast, Schmikli et al. [66] identified more skilled adult amateur players as a target group for prevention, because they had an increased injury risk. Hammes et al. [19] exclusively focussed on veterans (aged 32 or older) who played competitively in a separate league. They found an injury incidence that was comparable to other male soccer levels, but injury characteristics were different. In summary, these finding clearly underline the importance of research within different amateur soccer populations.

Finally, beside competitive amateur soccer, a high number of people play soccer informally. Of the 15- to 74-year-old Swiss population, 290,000 persons practice soccer outside of clubs and official championships [46]. To the best of our knowledge, no studies exist so far with regard to the epidemiology of soccer injuries in informal settings. Taken together, we suggest that there is a lack of data regarding soccer accidents in specific non-professional soccer populations. Therefore, the aim of the present study was to analyse and compare incidence, causes and characteristics of injuries in different settings of formal and informal non-professional soccer.

Methods

Procedure

A retrospective telephone survey of people who were injured while playing soccer was carried out in 2014. Annually, 45,000 soccer accidents affecting working people are counted in Switzerland of which 30,000 are recorded by the Swiss National Accident Insurance Fund (Suva) [135]. Of these, a random sample of 2835 persons was drawn with the aim of interviewing approximately 800 persons.

The selected persons were initially contacted by an information letter including an informed consent form. For those who did not respond, a second attempt was made by phone. This process was stopped when a total of 1055 (37.2%) persons had given their written or oral consent what allowed to conduct 822 interviews (participation rate: 77.9%). An interview took 16 minutes on average. All participants had sustained a soccer injury between July 2013 and June 2014. To reduce the interval between the accident and the interview, the survey was realised in two phases. On average, 6 months had passed between the accident and the interview.

Data screening and final sample

For not reporting a soccer injury three persons were directly excluded. Comparing the respondents with the rest of the random sample, a small selection bias was identified with respect to gender ($p < 0.001$) and nationality ($p = 0.002$), with the participation rate being higher among women (5.8% vs. 3.0%) and Swiss citizens (78.6% vs. 73.0%). No differences were found with regard to age ($p > 0.05$). In several cases, the type of injury described did not correspond with the information provided by the Suva data pool. Thus, 69 participants referred to another registered soccer accident and 42 to an unregistered injury. Moreover, three participants did not provide details on the injury setting. All these participants were excluded from all further analyses, resulting in a final sample of 705 participants.

Definitions and questionnaire

Only injuries which required medical attention were considered. The classification of injury severity was based on the number of days until the player could practice sports like he did before the injury. The participants were asked whether their injury was caused by contact and by foul play, and they had to specify the referee's decision. Additionally, the participants were asked to describe the injury situation more precisely, which allowed to distinguish 19 different injury categories based on the work of Hawkins et al. [121]. Intrarater ($\kappa = 0.85$, $p <$

0.001, 95%-CI 0.78-0.92) and interrater (κ = 0.79, $p < 0.001$, 95%-CI 0.72-0.90) reliability was calculated to ensure that the categorisation was adequate. Injury incidence was defined as the number of injuries per 1000 playing hours. Therefore, all participants were asked about the number of injuries they had suffered during the past year. Furthermore, participants playing in a soccer club were asked how many hours per week they had played soccer. To obtain an estimate of the exposure time throughout a year, the weekly playing hours were multiplied by 40 weeks. Finally, the respondents had to answer questions about their preventive behaviour prior to the injury.

Statistical analysis

All analyses were performed using SPSS Statistics software (version 22.0). Three main soccer settings were compared: formal games (i.e. persons who were injured during games with their soccer club team), formal training (i.e. persons who were injured during practice with their soccer club team), informal (i.e. persons who were injured while playing recreational soccer with family and friends or a fun tournament). To examine differences between these three settings, χ^2 statistics were applied for nominal variables, and t-tests for continuous variables, whereby the significance level was set at $p < 0.017$ due to Bonferroni correction. For categorical variables, the Kruskal-Wallis test was used (using pairwise comparison function). The χ^2 statistics were also used to identify general differences between leagues and informal settings (significance level at $p \leq 0.05$) and to compare groups of leagues pairwise (significance level at $p \leq 0.003$ due to Bonferroni correction). With respect to injury incidence, a one-way ANOVA including a Games Howell post-hoc test was conducted (because the homogeneity of variances assumption was not met) to examine differences between groups of leagues. In all tables and figures the 95% confidence intervals (95%-CI) are provided.

Results

Of the 705 reported injuries, 48.9% (n = 345) happened during formal soccer games, 21.0% (n = 148) during formal soccer training, and 30.1% (n = 212) during informal soccer play. Out of the injuries which occurred during informal soccer, 61.3% (n = 130) occurred while playing with family or friends, 19.3% (n = 41) during fun tournaments, 7.5% (n = 16) in other sport clubs, 4.2% (n = 9) at school, 3.3% (n = 7) in alternative leagues, and 4.2% (n = 9) in other settings. Whether or not a soccer accident happened in a formal or informal context was not associated with the severity of the injury ($p > 0.05$). Participants who were injured during a formal game were on average 26.3 (SD = 9.2) years old and somewhat younger than participants who were injured during formal training (M = 29.0, SD = 10.9, $p = 0.008$) or during informal soccer (M = 30.5, SD = 11.7, $p < 0.001$). 6.1% (n = 43) of the injuries affected a female player. No significant gender differences were found with respect to the three main injury settings ($p > 0.05$). Unlike injury type ($p > 0.05$), injury location was influenced by the setting ($p = 0.007$). In particular, differences were identified concerning knee injuries ($p = 0.032$), head injuries ($p = 0.010$), and thigh and upper leg injuries ($p = 0.019$). While a higher percentage of knee injuries was identified during formal games (28.1%) compared to informal soccer play (18.4%, $p = 0.010$), the amount of knee injuries in formal training (26.4%) did not significantly differ from the other settings ($p > 0.05$). Additionally, there was a higher percentage of head injuries in formal games (9.0%) than in informal soccer (2.8%, $p = 0.005$), but again no difference was found with respect to formal training (4.7%, $p > 0.05$). Injuries to the thigh and upper leg occurred more frequently in informal soccer (7.1%) than in formal games (2.3%, $p = 0.006$).

As shown in Table 4.1, a significantly higher proportion of contact injuries and foul play injuries (subjective appraisal) were identified in formal games compared to formal training ($p < 0.001$) or informal soccer ($p < 0.001$). Additionally, in formal games every fourth injury (27.4%) was caused by a foul play penalised by the referee. When considering formal game injuries only, there were no significant differences in the proportion of contact injuries between different amateur soccer leagues ($p > 0.05$). However, the amount of foul play injuries differed significantly between leagues (subjective appraisal: $p = 0.031$, penalised by referee: $p = 0.033$). A particularly high foul play rate was found in the 30+ leagues. Focussing on informal soccer settings only (playing with family or friends, fun tournaments), no significant difference with respect to contact and foul play injuries was identified ($p > 0.05$).

Table 4.1. Injury causes (contact with an opponent, foul play), separately for different soccer settings, leagues (only formal games), and informal settings (n = 701).

	Contact injuries[a]			Injuries due to foul play (subjective appraisal)[b]		Injuries due to foul play (penalised by referee)[c]	
	n	%	95%-CI	%	95%-CI	%	95%-CI
Total	701	52.5	49.8-57.2	29.4	26.0-32.8	17.1	14.2-20.0
Informal	211	37.4	30.9-43.9	21.0	15.5-21.5	-	-
Formal training	147	36.7	28.9-44.5	13.8	8.2-19.4	-	-
Formal games	343	69.1	64.2-74.0	41.2	36.0-46.4	27.4	22.6-32.2
Leagues (only formal games) [d]							
2nd amateur leagues	31	64.5	47.7-81.3	48.4	30.8-66.0	32.3	15.8-48.8
3rd amateur leagues	46	71.7	58.7-84.7	42.2	27.8-56.6	28.9	15.7-42.1
4th amateur leagues	67	70.1	59.1-81.1	37.9	26.2-49.6	30.3	19.2-41.4
5th amateur leagues	44	68.2	54.4-82.0	37.2	22.8-51.6	19.0	7.1-30.9
30+ leagues	21	81.0	64.2-97.8	76.2	58.0-94.4	55.0	33.2-76.8
40+ leagues	28	60.7	42.6-78.8	35.7	18.0-53.4	17.9	3.7-32.1
Juniors	49	75.5	63.5-87.5	44.9	31.0-58.8	34.0	20.5-47.5
Women's leagues	27	81.5	66.9-96.1	40.7	22.2-59.2	26.9	9.9-43.9
Other	22	45.5	24.7-66.3	22.7	5.2-40.2	5.3	0.0-15.4
Informal settings							
Family and friends	130	33.8	25.7-41.9	18.6	11.9-25.3	-	-
Fun tournaments	41	48.8	33.5-64.1	29.3	15.4-43.2	20.5	5.8-35.2
Others	40	37.5	22.5-52.5	20.0	7.6-32.4	-	-

[a] 4 persons were excluded for not knowing whether their injury was caused by contact.

[b] 6 persons were excluded for not knowing whether their injury was caused by foul play.

[c] The total of 17.1% should be interpreted with caution. There is no competent referee in formal training and most of informal soccer. 45 Persons were excluded, 36 for stating that there was no referee and 9 for not knowing the referee's decision.

[d] 1st amateur league only includes 4 cases and is therefore not presented.

With regard to injury situations, being tackled by an opponent (16.3%, n = 115), collisions (14.5%, n = 102), other contact situations (10.4%, n = 73), twisting and turning (8.1%, n = 57), heading and aerial duels (7.7%, n = 54), and running (7.2%, n = 51) were the most frequently reported situations leading to an injury. As presented in Figure 4.1, the most obvious difference with respect to injury situation appears between formal games and informal soccer. Compared to formal training and informal soccer, in formal games, more

injuries were caused by tacklings by an opponent (formal training: $p = 0.001$; informal soccer: $p = 0.015$) and heading or aerial duels (formal training: $p = 0.005$; informal soccer: $p < 0.001$). While collisions ($p = 0.004$) and other contact injuries ($p = 0.012$) happened more frequently in formal games than in informal soccer, running was a more frequent cause of injury during informal soccer play ($p < 0.001$).

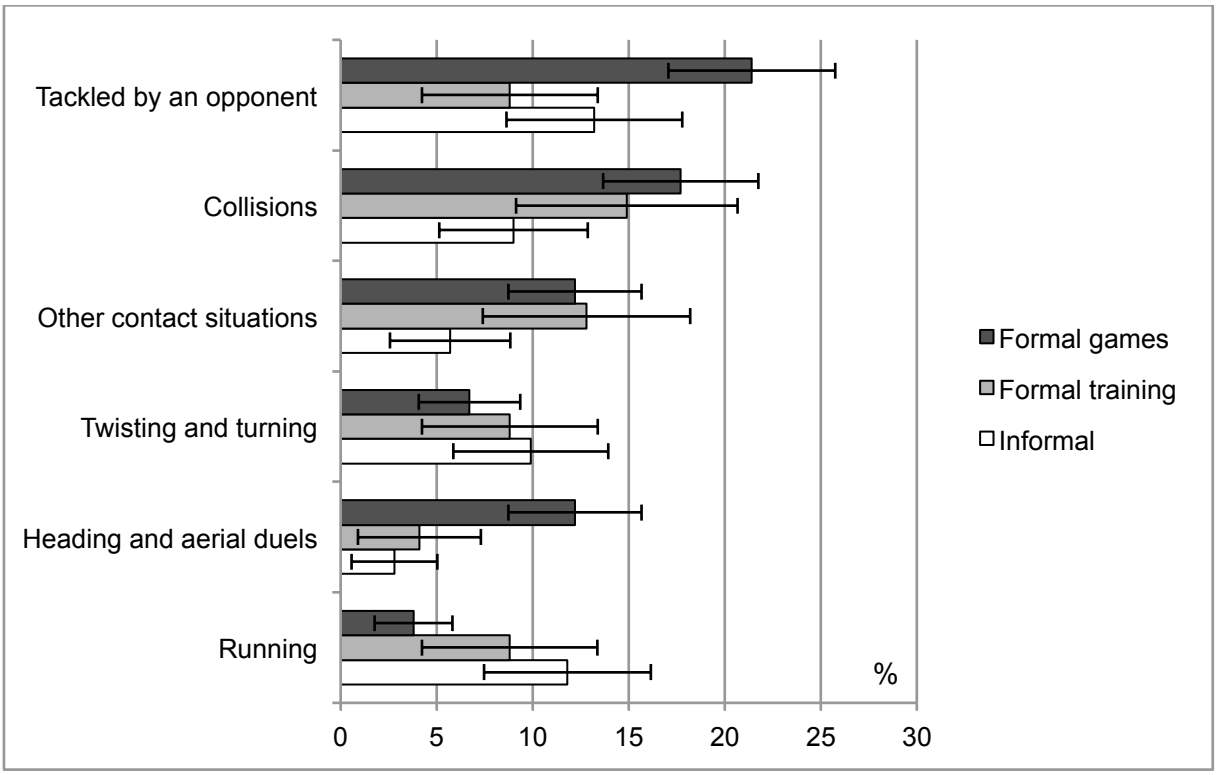

Figure 4.1. Percentages and 95% confidence intervals of situations leading to an injury, separately for different soccer settings (n = 705).

The comparison of different groups of amateur leagues yielded significant differences regarding preventive behaviour (see Table 4.2). Players of the 1st-3rd amateur leagues attached more importance to core strength training than players of any other level ($p \leq 0.001$), except for women's leagues ($p = 0.017$). Additionally, players of 30+/40+ leagues stated less frequently that they had performed a core strength training prior to the injury compared to 4th-5th amateur league players ($p = 0.001$). Less than half of all 30+/40+ leagues players had performed a general strength training.

In soccer club members, the estimated injury incidence was 10.7 (95%-CI 9.7-11.9) per 1000 hours of soccer play. The injury incidence was highest for 30+/40+ league players with 18.7 injuries per 1000 hours exposure and differed significantly from other male (1st-3rd amateur leagues: p = 0.002, 4th-5th amateur leagues: p = 0.007), female (p = 0.006) and junior (p < 0.001) leagues, except for other leagues (p > 0.05).

Table 4.2. Implementation of preventive measures at time of injury and injury incidence by players of different amateur levels (n = 518).

	Core strength training		General strength training		Exposure time	Injury incidence per 1000 hours	
	%	95%-CI	%	95%-CI	Hours/week	Inc.	95%-CI
1st-3rd amateur leagues (n=127)	85.9	79.8-92.0	82.7	76.1-89.3	6.3	8.5	7.5-9.6
4th-5th amateur leagues (n=167)	68.9	61.9-75.9	63.5	56.2-70.8	5.0	9.4	8.1-11.1
30+/40+ leagues (n=81)	46.9	36.0-57.8	44.4	33.6-55.2	2.8	18.7	14.4-23.9
Junior leagues (n=66)	56.1	44.1-68.1	71.2	60.3-82.1	6.3	6.7	6.0-7.4
Women's leagues (n=35)	68.6	53.2-84.0	74.3	59.8-88.8	5.4	8.2	6.0-11.3
Other (n=42)	55.6	41.1-70.1	37.8	23.6-52.0	2.9	15.6	12.6-18.9

Discussion

The major outcome of this study is that substantial differences exist between various non-professional soccer settings with respect to injury characteristics, causes and incidence. A particularly high incidence rate was found among 30+/40+ league players.

For formal soccer players, an incidence rate of 10.7 injuries per 1000 hours of soccer participation was calculated. Even though other studies in amateur [20, 32] and professional [42, 125] soccer found similar or somewhat lower injury rates, a direct comparison of the results is difficult as the present study only included participants who had sustained at least one injury. This may have led to an above average proportion of injury-prone persons and thus an increased injury incidence.

Nevertheless, the presented comparisons between the injury incidences of different amateur soccer leagues should be reliable. Players of 30+/40+ leagues were identified as high-risk group having an increased injury incidence of 18.7 injuries per 1000 hours of play. Based on the fact that players of 30+/40+ leagues had a relatively low exposure time of 2.8 hours per week, it can be assumed that they mainly play in a competitive setting and practice soccer up to once per week. Generally, an increased injury risk in games of veteran soccer players has been reported previously [64], which together with the low training to game ratio leads to an increased overall injury incidence [19]. Hammes et al. [19] calculated a somewhat lower injury incidence of 12.4 injuries per 1000 hours of soccer, because they only included veteran teams (players aged 32 years and older) that performed weekly training sessions, which led to a higher training to game ratio of 2:1. Of particular interest in this context is that players of 30+/40+ leagues reported less frequently that they participated in injury prevention measures compared to players of other leagues. Compared with other levels, physical conditioning is less frequently part of the training sessions in veteran soccer [118]. Thus, adjusted prevention strategies for 30+/40+ league players seem warranted to reduce the high injury risk in this particular group [95].

While injury severity and injury type did not differ between settings (formal games, formal training, informal soccer), a higher percentage of knee injuries was identified in formal games compared to informal soccer. Considering the fact that knee injuries are predominantly caused without contact [30], this difference could be explained by the less competitive character of the game in informal soccer which leads to lower speed and slower changes of direction. Focussing on medical attention injuries in formal amateur soccer, Herrero et al. [64] reported a percentage of knee injuries (29.9%) comparable to our study, whereas Schmikli et al. [66] registered a lower percentage (19.3%), most likely because less severe injuries were also included in their study. Other investigations yielded comparable percentages of knee injuries in amateur soccer (between 15.1% and 24.3%) [21, 32, 65].

Injuries that resulted from contact with an opponent occurred more frequently during formal games than during formal training [21] or informal playing, which corroborates a higher level of physical play in formal games of amateur soccer [124]. This leads to a high proportion (41.2%) of injuries caused by foul play in this setting. In our study, more than one quarter of injuries during amateur soccer games happened due to foul play, if the referee's decision was taken into account. This result is in line with other studies carried out in amateur soccer [21] and different levels of professional soccer [67].

Moreover, little is known so far about injury situations in amateur soccer. The present study points out that injuries caused by a tackling of an opponent happen more than twice as frequently during formal games as during formal training [121], while injuries caused by collisions and other contact situations (pushing, duel without clear ball possession, etc.) occur with a comparable frequency. Injuries caused by heading and aerial duels represent an explicit problem of competitive amateur soccer. Injury situations involving contact with an opponent were significantly less frequent in informal soccer. By contrast, a higher amount of injuries were self-inflicted, for example while running. In summary, although the present study provides preliminary insights regarding the underlying injury mechanisms, more research is needed to gain a more complete understanding of the most relevant factors leading to injuries in different soccer settings and across amateur soccer levels.

Limitations

A major strength of the present study was that the design allowed a distinction between injuries of players involved in different settings. Despite this strength, several limitations preclude a broad generalisation of the findings. First, the present study exclusively included medical attention injuries, and it was assumed that the respondents correctly reported the diagnosis of their physician. This procedure led to a high number of severe injuries in the present data set. Additionally, it is likely that persons who sustained a severe injury were more willing to participate in the present study. Second, it is possible that the time period between injury and interview may have caused a recall bias. While we acknowledge that injury incidence could thus be underestimated in the present study, retrospective data collection seems to be a suitable method to obtain relevant information about the context and characteristics of an injury [134]. Third, the exposure time was extrapolated based on participants' statements about the duration of their weekly soccer playing at time of the injury, which may have led to calculations of injury incidences which are not completely accurate.

Conclusions

This study clearly highlights the need for attractive and specific prevention programs addressing players of 30+ and 40+ amateur soccer leagues. Generally, differences in injury causes and characteristics by setting indicate that a more targeted approach of injury prevention is needed. Furthermore, playing competitive amateur soccer involves a higher risk of contact and foul play injuries compared to amateur soccer training or informal soccer. Therefore, players, coaches, referees and club officials in amateur soccer need to be more involved in fair play measures to promote a cooperative play.

Acknowledgments: The study was funded and supported by the Swiss National Accident Insurance Fund (Suva).

CHAPTER 5

PUBLICATION III: COSTS RESULTING FROM NON-PROFESSIONAL SOCCER INJURIES IN SWITZERLAND – A DETAILED ANALYSIS

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Published version*

Journal of Sport and Health Science, 2018 (in press)

Doi: 10.1016/j.jshs.2018.08.001

* Minor editorial modification have been made due to harmonisation of the thesis

Abstract

Background: Soccer injuries constitute an important public health problem and cause a high economic burden. Nevertheless, comprehensive data regarding injury costs in non-professional soccer are missing. The aim of this study was to determine which groups of non-professional soccer athletes, injury types, and injury situations cause high injury costs.

Methods: A cross-sectional, retrospective telephone survey was carried out with a random sample of persons who had sustained a soccer injury between July 2013 and June 2014 and who had reported this accident to the Swiss National Accident Insurance Fund (Suva). One year after the corresponding accident, every injury was linked to its costs and to the answers obtained in the interview about injury setting, injury characteristics, and injury causes. Finally, the costs of 702 injuries were analysed.

Results: The average cost of an injury in non-professional soccer amounted to Euro (€) 4030 (bias-corrected and accelerated 95% confidence intervals (BCa 95%-CI): 3427-4719). Persons aged 30 years and older experienced 35% of soccer injuries but accounted for 49% of all costs. A total of 58% of all costs were the result of injuries that occurred during amateur games. In particular, game injuries sustained by players in separate leagues for players aged 30+/40+ years led to high average costs of € 8190 (BCa 95%-CI 5036-11,645). Accounting for 25% of all injuries, knee injuries were responsible for 53% of all costs. While contact and foul play did not lead to above-average costs, twisting/turning situations were highly cost-relevant, leading to an average sum of € 7710 (BCa 95%-CI 5376-10,466) per injury.

Conclusions: Non-professional soccer players aged 30 years and older and particularly players in 30+ and 40+ leagues had above-average injury costs. Furthermore, the prevention of knee injuries, non-contact and non-foul play injuries, and injuries caused by twisting and turning should be of highest priority in decreasing health care costs.

Keywords: amateur soccer, cost analysis, injury causes, injury characteristics, injury costs

Introduction

Although epidemiological research shows that a physically active lifestyle is beneficial to health [2-5], sport participation is also associated with a high risk for injuries [136, 137]. In Switzerland, 35% of all leisure time accidents in the working population occur in the sports sector [117]. This results in 186,000 registered injuries annually and an associated cost (including treatment and costs related to income replacement) of Swiss francs (CHF) 931 million (≈Euro (€) 791 million). Of all sport accidents, 40% occur during ball games, 27% during winter sport, and 9% during gymnastics or running. Soccer accidents account for 64% of all ball game injuries, whereas floor ball (including field and roller hockey) and volleyball account for 7% each [117]. Hence, soccer injuries constitute a high economic burden on society. Annually, 45,000 soccer-related injuries are sustained by the Swiss working population, associated with a financial burden of approximately CHF 180 million (≈ € 153 million) [117]. It can be assumed that the final costs of soccer accidents are much greater when the entire Swiss population is considered, because it has been estimated that annually more than 80,000 soccer-related injuries occur in Switzerland [138]. A detailed cost model including the whole spectrum of minor and severe injuries in the Netherlands found soccer injuries sustained by young men to be particularly cost-intensive [55].

Nevertheless, previous research about the costs of soccer-related injuries is scarce. Pritchett [59] highlighted that knee injuries accounted for 11.7% of injuries and led to 28.2% of all soccer-related costs in 1981. To the best of our knowledge, no data regarding the costs of specific soccer injuries have been published in the scientific literature since then.

Certain studies have provided data on injury costs in various other sports [56, 57, 139, 140]. Cumps et al. [56] surveyed 72 out of 82 Flemish sports federations and found that the highest medical costs resulted from anterior cruciate ligament injuries, followed by other knee injuries. Injuries affecting the knee frequently occur in amateur or recreational soccer, as shown in a number of recent studies [22, 64-66]. Based on these insights, it can be expected that knee injuries are responsible for the high injury costs in soccer. This finding was also highlighted by Krist et al. [104], who found that preventive exercises have the potential to reduce injury-related costs among male soccer players, and they suggested that this cost reduction would be mainly due to the lower proportion of knee injuries.

However, comprehensive and detailed information about the financial repercussions of soccer accidents and related injuries is missing. Specifically, there is a lack of knowledge concerning groups of non-professional soccer athletes, injury types and locations, and injury situations causing high healthcare and income replacement costs. Nevertheless, more accurate knowledge about the cost of non-professional soccer injuries can influence policy-making with regard to the implementation of preventive strategies. Accordingly, the aim of the present study was to explore a wide variety of information on the costs of soccer injuries

that could potentially decrease the economic burden of these accidents by supporting the development of cost-effective prevention strategies. Accordingly, in the present article we will examine (1) which groups of non-professional soccer athletes, (2) which types of injuries, and (3) which injury situations are associated with a high financial burden.

Methods

Procedures

In the present study, a cross-sectional, retrospective survey design was used. The Swiss National Accident Insurance Fund (Suva) is responsible for compulsory accident insurance of the working population in Switzerland and insures approximately one-half of all employees. Persons who had sustained a soccer injury between July 2013 and June 2014 and who had consulted a physician were interviewed by telephone about their accident. Because insured persons often report injuries to Suva after some delay, the interviews were carried out, on average, 6.1 months (SD = 2.1) after the accident occurred. The standardised questionnaire consisted of 86 questions (about injury setting, injury characteristics, injury causes, and preventive behaviour) and had been newly developed in collaboration with experts from Suva and taking into account previous surveys. An interview took 16 minutes on average. For the recruitment process, the data protection regulations of Suva were followed. In referring to Art. 2 HRA (Human Research Act) and to Art. 25 HRO (Human Research Ordinance) an ethical committee's approval was not required for this anonymised survey.

Recruitment

Suva records 30,000 soccer injuries annually [117]. With the aim of interviewing at least 800 non-professional soccer athletes about their soccer accident, a random sample of 2835 injuries was drawn. After having linked these injuries to a policy holder, the selected persons were contacted by an information letter via mail, which included a pre-written declaration of consent. Candidates who did not respond in written form were recruited by telephone. When a sufficient amount of respondents (n = 1055, 37.2%) had given their written or oral consent to participate in the study, the telephone-based recruitment was terminated. On the basis of this sample, 822 interviews (77.9% response rate) were conducted.

Final sample

A data screening was carried out. First, three respondents were excluded because their injuries had not been directly caused by playing soccer. Second, the information provided during the telephone interviews was compared with the official Suva record. When the type of injury described in the interview did not correspond with the Suva medical record, we assumed that the respondent provided information about another soccer accident. More precisely, 69 participants referred to another registered soccer accident and 42 to an unregistered injury. These participants were excluded from all further analyses. Finally, 702

injuries could be linked to their costs (determined one year after the accident), whereas six additional cases did not enter the analyses because their costs were not borne by Suva.

Assessment of injury and injury costs

Given the fact that this study relates to insurance records, only injuries requiring medical attention are considered. The cost of an injury consists of treatment costs and income replacement costs and is presented in Euros (€). The costs were recorded in Swiss franc (CHF) and converted to Euros using the average exchange rate from the years 2013, 2014, and 2015, when the costs were incurred (CHF 1 = € 0.85 according to the Swiss National Bank). For the analysis, different leagues were aggregated into the following groups: 1st to 3rd amateur leagues (male), 4th to 5th amateur leagues (male), 30+/40+ leagues (male), juniors (male), women's leagues, and other. Additionally, a distinction was made between severe and non-severe injuries. Following Hägglund et al. [120], injuries that resulted in more than 28 days of absence from sport participation were classified as severe. A reinjury was defined as an injury of the same type affecting the same body site as a previously sustained injury [119]. Furthermore, the respondents were asked to describe the situation in which the injury occurred. Based on this information, a classification of 19 different injury situations was used, referring to the work of Hawkins et al. [121]. With respect to the classification, both intrarater ($\kappa = 0.85$, $p < 0.001$, 95%-CI 0.78-0.92) and interrater ($\kappa = 0.79$, $p < 0.001$, 95%-CI 0.72-0.90) reliability were satisfactory. Moreover, the respondents were asked if their injury was caused by contact with an opponent. If so, they indicated whether the injury occurred owing to foul play and whether the foul play was penalised by the referee.

Statistical analysis

Statistical analyses were performed with SPSS software (version 23.0). The Kolmogorov-Smirnov-test was used to examine whether the distribution of injury costs significantly differed from a normal distribution. Total costs ($p < 0.001$), treatment costs ($p < 0.001$), and income replacement costs ($p < 0.001$) were all significantly non-normal. However, for cost data highly skewed distributions are usual [141]. Nevertheless, Thompson and Barber [141] recommended providing the arithmetic mean as the most informative measure because it allows extrapolations to support healthcare policy decisions. As a consequence, in the text, tables, and figures, the arithmetic mean is listed in the present study. Additionally, the median is provided in the tables since this value is less sensitive to skewed data. A t-test was used to examine whether the mean costs of two independent groups were significantly different from each other, and the differences between several independent groups were examined by an analyses of variance (ANOVAs). A *p*-value lower than 0.05 was considered

significant. Because robust methods are recommended for non-normally distributed data, bias corrected and accelerated 95% confidence intervals were calculated using non-parametric bootstrapping with 1000 replications (BCa 95%-CI) [141, 142]. Furthermore, the subgroups consisted of at least 25 respondents so that the Central Limit Theorem guaranteed approximate normality [142, 143].

Results

The 702 injuries included in our analysis incurred a total cost of € 2,829,205, of which € 1,467,539 were treatment-related costs and € 1,361,666 were income-replacement-related costs. An injury led to average total costs of € 4030 (BCa 95%-CI 3427-4719), of which € 2090 (BCa 95%-CI 1814-2413) were associated with treatment and € 1940 (BCa 95%-CI 1614-2287) were associated with income replacement. However, the total median costs were considerably lower (€ 792, interquartile range = 280-2815). As expected a severe injury (>28 days until recovery) caused much higher average total costs (€ 6014, BCa 95%-CI 5170-6892) than milder injuries (€ 1020, BCa 95%-CI 666-1536, t(651.8) = -8.975, $p < 0.001$).

What groups account for high injury costs?

With respect to injury costs, age and gender were significant factors (see Table 5.1). Although they experienced 35.3% of soccer injuries, persons aged ≥30 years accounted for nearly half of all injury costs. Their average income replacement costs (€ 3074, BCa 95%-CI 2328-3820) were twice as high as those of the younger age group (€ 1320, BCa 95%-CI 1044-1645, t(335.3) = -3.962, $p < 0.001$), whereas the treatment costs did not differ significantly (15-29 years: € 1878, BCa 95%-CI 1557-2239; ≥30 years: € 2480, BCa 95%-CI 1916-3053). Injuries to male respondents accounted for almost all costs; and, owing to their higher income replacement costs, their injuries led to significantly higher average costs. The average income replacement costs of male respondents (€ 2045, BCa 95%-CI 1711-2410) were significantly higher than those of female respondents (€ 316, BCa 95%-CI 164-496, t(574.0) = 8.052, $p < 0.001$), whereas treatment costs were comparable for both groups (male: € 2134, BCa 95%-CI 1846-2435; female: € 1427, BCa 95%-CI 713-2187). Previous injury and membership in a soccer club did not significantly influence the injury costs.

Table 5.1. Injury costs depending on selected age groups, gender, previous injury, soccer club membership, and setting (in Euros)

		Costs per injury					
	n (%)	Median	Mean	BCa 95%-CI	*p*-value	Total costs	% of total costs
Age (years)					0.014		
15-24	328 (46.7)	609	3054	2371-3833		1001701	35.4
25-34	202 (28.8)	924	4767	3597-6007		962886	34.0
35-44	97 (13.8)	1108	5891	4224-7733		571472	20.2
≥45	75 (10.7)	606	3909	2338-5701		293146	10.4
15-29	454 (64.7)	657	3198	2635-3872	0.002	1451744	51.3
≥30	248 (35.3)	1024	5554	4423-6842		1377461	48.7
Gender					<0.001		
Male	659 (93.9)	808	4179	3557-4880		2754271	97.4
Female	43 (6.1)	362	1743	882-2663		74934	2.6
Previous Injury					n.s.		
≤12 months ago	45 (6.5)	685	2473	1161-4010		111268	3.9
>12 months ago	136 (19.6)	568	3479	2480-4583		473166	16.8
None	513 (73.9)	876	4362	3701-5085		2237913	79.3
Soccer club membership*					n.s.		
Member	528 (75.2)	848	4273	3589-4936		2256377	79.8
Non-member	174 (24.8)	626	3292	2203-4556		572828	20.2
Setting					0.020		
Amateur games	342 (48.9)	881	4784	3866-5881		1636057	58.2
Training / informal soccer	357 (51.1)	710	3293	2562-4122		1175655	41.8

Note: The sum of respondents did not always add to 702 because individual questions were not answered by all respondents

*Regardless of the setting in which the injury occurred.

Abbreviations: BCa 95%-CI= bias-corrected and accelerated 95% confidence intervals calculated by using non-parametric bootstrapping with 1000 replications; n.s.= not significant.

Injuries that happened during amateur games accounted for a substantial proportion of all costs. With regard to average injury costs, significant differences were observed between different levels of leagues ($F(5,336) = 2.483$, $p = 0.032$) (see Figure 5.1). In particular, players in 30+/40+ leagues, which are composed as a function of age, caused higher average total costs (€ 8190, BCa 95%-CI 5036-11,645) than players in the other leagues (€ 4214, BCa 95%-CI 3313-5140, $t(55.6) = -2.150$, $p = 0.036$). They were responsible for 14.3% of all injuries during official amateur games and accounted for 24.5% of the corresponding costs. Other groups that incurred a high proportion of injury costs during amateur games

were players of the 4th to 5th amateur leagues (31.9%) and players of the 1st to 3rd amateur leagues (24.0%).

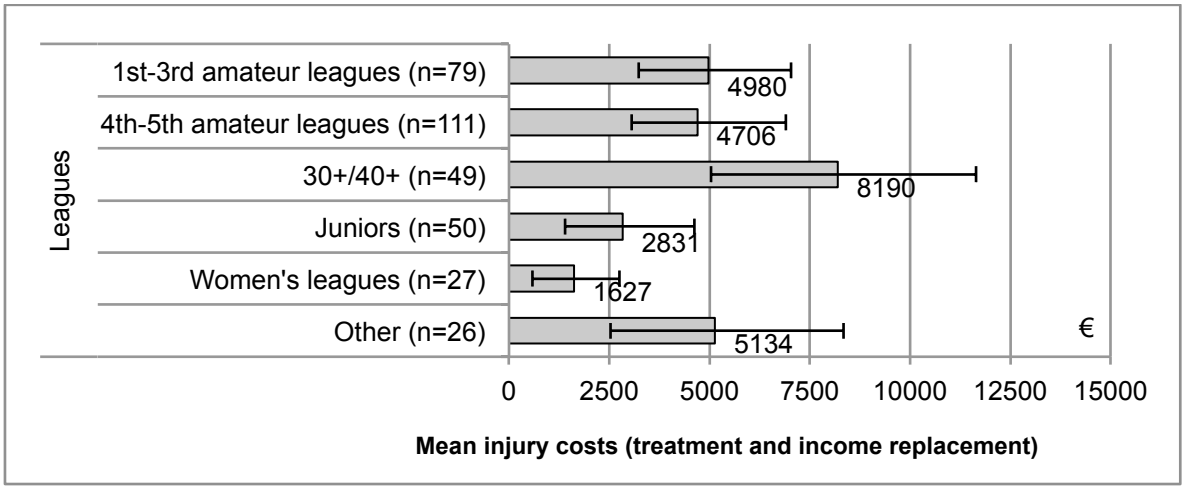

Figure 5.1. Mean injury costs and bias corrected and accelerated 95% confidence intervals by leagues (only game injuries, in Euros)

Which injuries are most costly?

Injury costs differed significantly by injured body region ($F(9,692) = 13.309$, $p < 0.001$) as presented in Figure 5.2. The highest average costs were associated with injuries that affected the lower leg, Achilles tendon or the knee. Although injuries to the lower leg or Achilles tendon represented only 11.3% of all costs, knee injuries were extremely costly and accounted for 24.8% of all injuries and for 53.2% of all costs. Ankle injuries accounted for 15.3% of all costs. Regarding injuries to the lower extremities, the average total costs for injuries affecting the dominant leg (€ 4173, BCa 95%-CI 3317-5093) did not differ significantly from injuries to the standing leg (€ 4566, BCa 95%-CI 3608-5637).

The total costs were also influenced by the injury type ($F(6,695) = 10.637$, $p < 0.001$) (see Figure 5.2). Ligament sprain or rupture was the most frequent injury type (44.6%) and represented 48.4% of all injury costs. Additionally, cartilage and meniscal damages led to high average costs per injury and were responsible for 17.2% of all injury costs, whereas bone fractures accounted for 15.8% of all costs. Tendon injuries were relatively rare and, therefore, accounted for only 6.9% of all injury costs.

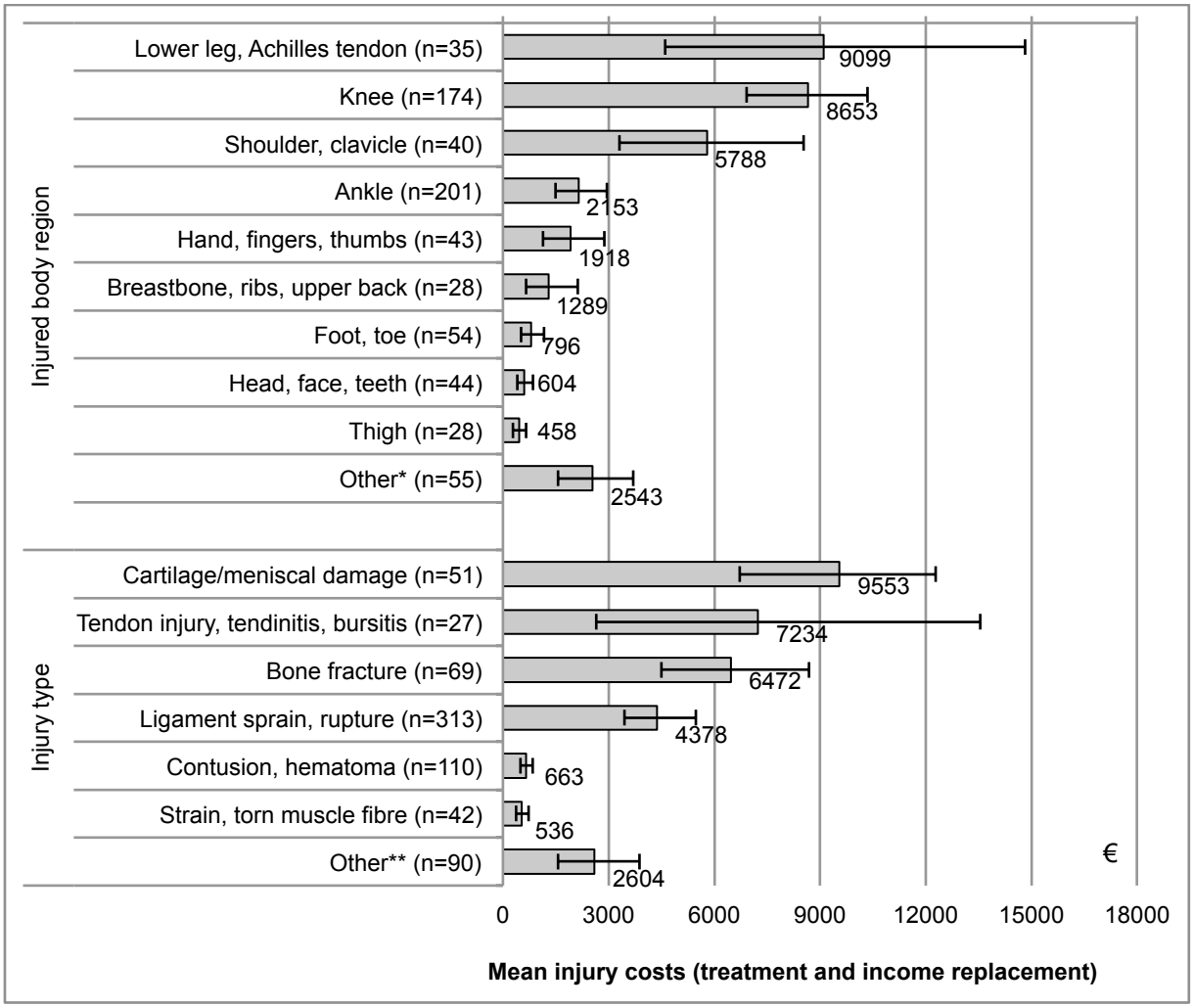

Figure 5.2. Mean injury costs and bias corrected and accelerated 95% confidence intervals by injured body region and injury type (in Euros)

* Body regions with <25 cases: Wrist; upper arm, elbow, forearm; hip, groin; lower back, sacrum, pelvis; neck, cervical spine; abdomen. **Injury types with <25 cases: Dislocation, luxation; other bone injury; concussion; abrasion, laceration; axonal injury; dental injury; other.

Which injury situations lead to high costs?

As Table 5.2 shows, contact injuries led to lower mean costs than non-contact injuries. Foul play did not influence injury costs significantly, although there was a tendency towards higher mean costs of game injuries that were not caused by foul play ($t(256.1) = -1.944$, $p = 0.053$). Additionally, foul play injuries accounted for a lower proportion of total costs. Concerning injury situations, twisting and turning injuries were responsible for higher average costs than all other injury situations combined ($t(62.1) = -2.997$, $p < 0.004$). Taken together, collisions, twisting and turning, and being tackled by an opponent accounted for 49.2% of all costs.

Table 5.2. Injury costs depending on injury cause and situation (in Euros)

	n (%)	Costs per injury				Total costs	% of total costs
		Median	Mean	BCa 95%-CI	*p*-value		
Contact with an opponent [a]					0.026		
Yes	369 (52.9)	626	3345	2612-4101		1234317	44.0
No	328 (47.1)	910	4796	3776-5916		1572930	56.0
Foul play (self-reporting) [a]					n.s.		
Yes	204 (29.6)	653	3529	2672-4371		719898	25.9
No	486 (70.4)	846	4243	5584-9709		2062048	74.1
Foul play (referee's decision) [a] *					n.s.		
Yes	90 (27.4)	804	3548	2423-4848		319348	19.9
No	239 (72.6)	901	5380	4199-6662		1285890	80.1
Injury situation					0.004		
Twisting/turning	56 (8.0)	1375	7710	5376-10466		431741	15.3
Running	50 (7.1)	814	5569	2646-9126		278471	9.8
Collision	103 (14.7)	1171	5272	3504-7116		543033	19.2
Falling	39 (5.6)	1005	4861	2354-8429		189562	6.7
Heading	54 (7.7)	609	4421	2119-7118		238729	8.4
Tackled	115 (16.4)	873	3627	2531-4806		417060	14.7
Other non contact	34 (4.8)	528	2792	1244-5024		94935	3.4
Other contact	71 (10.1)	796	2246	1254-3483		159484	5.6
Shooting	29 (4.1)	505	2234	874-3830		64791	2.3
Hit by the ball	38 (5.4)	557	1299	752-2075		49345	1.7
Other[§]	113 (16.1)	595	3204	1945-4893		362052	12.8

Note: The sum of respondents did not always correspond to 702 because individual questions were not answered by all respondents.

[a] A distinction was made between contact/non-contact injuries and foul play/non-foul play injuries. While foul play injuries always include a contact with an opponent, non-foul play injuries can occur with or without contact with an opponent.

* Only game injuries.

[§] Injury situations with <25 cases: kicking the ball simultaneously; tackling; kicked; dribbling; landing; use of elbow; passing; jumping; stretching; not specified.

Abbreviations: BCa 95%-CI= bias-corrected and accelerated 95% confidence intervals calculated by using non-parametric bootstrapping with 1000 replications; n.s.= not significant.

Discussion

In the present study, soccer-related injuries led to mean total costs (treatment and income replacement) of € 4030 and median costs of € 792. This difference can be explained by the very skewed distribution that is typical for injury cost data [141]. Dividing the annual costs of € 153 million by the number of soccer-related injuries suffered by working people in Switzerland (45,000) [117], mean costs of about € 3400 per soccer injury could be expected. Therefore, the sample of the present study included slightly more cost-intensive injuries and extrapolations tend to marginally overestimate the real costs. It is possible that those who sustained a severe injury were more willing to participate in the survey. Nevertheless, the data record allowed for separate analyses for different groups of non-professional soccer athletes, injury situations, and injury types and locations, some of which accounted for high costs related to health care and income replacement related.

One main finding of the present study was that soccer-related injuries of people aged ≥30 years were highly cost-relevant. A study focusing on netball also confirmed high total and mean costs for this age group [58]. However, an increased risk of sustaining a severe injury for older non-professional soccer players has only partially been confirmed by previous research [64, 68]. Because treatment costs did not differ between players ≥30 and <30 years of age in the present data record, increased average income replacement costs are the explanation for the high average injury costs of the older age group.

Based on previous research indicating that female amateur players are more frequently affected by severe injuries than men, higher average injury costs could be expected for women compared to men [20, 37, 74]. Nevertheless, in the present study, 97% of all costs were associated with injuries to men [55]. Although gender was unrelated to injury severity in the present sample, male soccer players were responsible for higher average costs because they generated substantially higher average income replacement costs than females. Higher income replacement costs among male athletes are attributable to the fact that on average, female players were four years younger than male players, which in turn is due to the fact that women stop playing soccer at a younger age than men [46]. Additionally, in Switzerland, men have slightly higher salaries than women [144].

Cost-effective injury prevention should generally focus on soccer club members, who accounted for 80% of all costs. In addition, participants of amateur games accounted for 58% of injury costs. Several previous studies have shown that injury incidence is higher during games than during training in amateur and professional soccer [37, 41, 68]. Additionally, previous research shows that a higher proportion of severe injuries occur during games [68, 145, 146], which might explain the high average costs of game injuries in the present study. With respect to amateur games, games in the 30+/40+ leagues are of particular interest

because injuries sustained by these players caused substantial costs. An increased injury risk in competitions involving veteran soccer players has been reported previously by Herrero et al., [64] and another study [19] identified players in veteran teams aged ≥32 years as a target group for injury prevention.

Knee injuries not only caused high average costs of nearly € 9000 per injury, but also accounted for 53% of all injury costs, which makes this injury type a priority regarding injury prevention. Previous research [56, 59] has also highlighted that knee injuries, beyond being cost-relevant, have serious health-related consequences for individuals, such as prolonged absence from physical activity [22, 68]. In their research on netball injuries, Otago and Peake [58] found that knee injuries accounted for 57% of the total costs, Achilles/calf injuries accounted for 12% of the total costs, and ankle injuries accounted for 13% of the total costs. These findings correspond remarkably well with the results of the present study in which lower leg and Achilles tendon injuries accounted for 11% of the total costs and ankle injuries accounted for 15%. This finding confirms that preventive measures should also focus on these two body regions. Because of their high probability of occurrence, even relatively minor injuries causing low average costs per claim, such as ankle injuries, result in significant costs to society [56, 58, 140].

The present study highlights the fact that contact and foul play injuries did not result in high average costs. On the contrary, non-contact injuries were more cost-intensive, and non-foul play injuries caused 74% of total costs. This finding is in line with recent research showing that most foul play injuries do not result in an absence from playing and that they are less likely to be severe [128].

Remarkably, in the present study, three injury situations (twisting/turning, collision and being tackled) accounted for nearly half of the total costs. According to van Beijsterveldt et al., [22] contact with another player (which includes collisions, and tackling) and twisting/turning are important contributing factors leading to injury. With respect to cost-effective prevention strategies, the decrease of twisting/turning injuries should be of great interest because such injuries led to average costs of nearly € 8000 in the present study. It seems likely that this kind of injury is associated with knee injuries. In line with this notion, de Loës et al. [57] identified high speed and quick changes of direction as being responsible for knee injuries in females.

From the perspective of cost-effective injury prevention, there is some evidence that the implementation of neuromuscular training programmes can lead to a decrease in injury costs [104, 105]. Because existing injury prevention programmes (such as FIFA “11+”, PEP, Harmonknee, etc.) already aim at reducing knee injuries, non-contact injuries, and injuries in twisting situations, future injury prevention strategies should focus on the implementation of

these programmes in different recreational soccer settings. Players in 30+/40+ leagues especially need to be convinced of the effectiveness of preventive exercises, as do young players who have yet to internalise injury prevention as an essential part of training.

Although injury insurance data are a useful basis for defining priorities in the process of creating injury prevention strategies [58], at least three limitations in the present study should be considered. First, treatment costs and income replacement costs were restricted to one year after the accident. As a result, costs for injuries with long-term consequences were likely underestimated. Second, the time period between the injury and the interview varied considerably in the present sample and may have caused recall bias. Nevertheless, retrospective data collection is considered to be a valid method for obtaining relevant information about an injury's context and characteristics [34]. In the present sample, for instance, 79% of the respondents stated that they remembered the accident very well or well. Moreover, a database check was carried out to improve the quality of our data. Thus, we thoroughly compared the information provided during the telephone interviews with the official Suva record. Third, we acknowledge that our sample was not representative regarding the complete age range of soccer players in that data were only available for players aged 15-64 years. Thus, although we argue that players in 30+/40+ leagues constitute an important target group for injury intervention, one could also argue that injury prevention should start earlier (e.g., before the players reach the age where particularly costly injuries occur). Presumably, the best scenario would be that players become accustomed to injury prevention programmes from an early age (e.g., from the time they begin playing children's soccer onwards).

Conclusions

The results from the present study show that non-professional soccer players aged ≥30 years, and particularly players in 30+/40+ leagues, accounted for above-average injury costs. These players, therefore, constitute an interesting target group for future injury prevention programmes. Injuries affecting the knee were responsible for more than one-half of all costs, whereas injuries caused by contact with an opponent and foul play injuries were not associated with high injury costs. Consequently, non-contact and non-foul play injuries should be a key target for cost-effective injury prevention, and a special emphasis should be placed on twisting/turning situations.

Acknowledgment: The present study was funded and supported by the Swiss National Accident Insurance Fund (Suva).

CHAPTER 6

PUBLICATION IV: CHANGES IN INJURY INCIDENCES AND CAUSES IN AMATEUR SOCCER BETWEEN THE YEARS 2004 AND 2015

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Accepted version*

Swiss Medical Weekly, 2018 (in press)

* Minor editorial modification have been made due to harmonisation of the thesis

Abstract

Background: Injury prevention in amateur soccer has been promoted in the past years but only a few studies have addressed the long-term development of injury incidence in amateur soccer. However, better knowledge of changes with respect to injury incidences and causes can make an important contribution to improving prevention strategies.

Purpose: The aim of this study was to investigate the long-term development of injury incidence in Swiss amateur soccer with respect to level of play, injury causes and injury characteristics.

Methods: A representative sample of about 1000 Swiss amateur soccer coaches was interviewed by telephone in 2004, 2008 and 2015. They were instructed to recall their last game, and were asked to report details on all injuries. For every injury, the coaches had to remember injury characteristics and causes. The same procedure was repeated for all games that took place during the previous four weeks. Additionally, all training injuries of the previous four weeks were recorded in detail.

Results: The incidence of game injuries decreased between the years 2004 and 2008 from 15.1 (95%-CI 14.2-16.0) to 13.3 (95%-CI 12.4-14.2) injuries per 1000 hours and increased between the years 2008 and 2015 to 16.5 (95%-CI 15.5-17.4) injuries per 1000 hours. When comparing the years 2004 and 2015, the rate of contact injuries during games increased by 19.1%. The incidence of foul play injuries in games showed an increase of 25.5% between the years 2008 and 2015. Regarding total training injury incidence, the rise between the years 2004 (2.4, 95%-CI 2.2-2.7) and 2015 (2.9, 95%-CI 2.6-3.1) was caused by a 22.2% higher rate of non-contact injuries. During the same period, game and training injury incidence increased across all amateur soccer leagues without exception, but these changes did not reach statistical significance. In 2015, the incidence of medical attention injuries was higher than 2004 (game 20.0%, training 37.5%).

Conclusion: There is evidence that injury incidence in Swiss amateur soccer has increased in the past years.

Keywords: amateur soccer, injury incidence, level of play, contact

Introduction

The overall injury incidence in amateur soccer typically ranges from 5.2 to 12.4 per 1000 hours of play [18-20, 32] and is higher during games than in training [21, 22, 95]. Accordingly, previous studies of amateur soccer have reported injury incidences of 2.0 to 4.5 per 1000 hours for training and 12.3 to 24.7 per 1000 hours for match play [18, 19, 28, 32].

To our knowledge, studies addressing to the long-term development of injury incidence in amateur soccer are scarce. Esquivel et al. [36] observed the estimated number of soccer-related injuries of people aged 5 to 49 years in the USA from 2000 to 2012. They concluded that the injury rate in youth soccer was increasing, despite a decline in participation. With respect to adult soccer, they reported an increase in the number of injuries that was higher than the increase in participation. In contrast, a decreased number of injuries per 100 players was found when comparing data obtained by the Belgian Football Association from the seasons 1999/00 and 2009/10 [37], while there was a higher percentage of severe injuries in the season 2009/10. However, no injury incidences were provided in the two above-mentioned studies. In contrast, Junge et al. [28] compared injury incidences of Swiss amateur players between 2004 and 2008. They reported that teams performing the prevention programme „The 11“ reduced the incidence of all game injuries by 17%, of non-contact game injuries by 27%, and of training injuries by 19% during this period. For other teams, injury rates during games remained stable while injury rates during training increased by 9%. Unfortunately, this study only covered a short time period.

Only a few studies focusing on elite and professional club soccer provide more information about the long-term development of injury incidences [39-44]. Several studies analysing different periods between 1992 and 2010 found no changes with respect to the total injury incidence in professional soccer teams [39-43]. Training and game injury rates as well as the incidence of severe injuries and muscle injuries were also stable for top European male teams between 2001 and 2008 [41], but Dauty and Collon [40] concluded that the rate for muscle injuries had increased continuously in a French professional team between the seasons 1995/96 and 2009/10. Contrary to expectations, another study showed a decreasing tendency with regard to injury rates between 1993 and 2007 for professional soccer games in Japan [43].

Finally, one further study analysed the trend of injury incidence of male and female players in different world soccer tournaments between 1998 and 2012 [147]. The results suggest that the average number of injuries per game decreased in both men’s FIFA World Cups and the tournaments of the Olympic Games during this period, but increased for the corresponding female tournaments. While the incidence of non-contact injuries remained stable, the trends mentioned above were mainly caused by changes in the frequency of contact injuries.

In Switzerland, 80,000 soccer-related injuries are counted annually [54]. Consequently, injury prevention has been promoted in the past years. Between the years 2004 and 2011, all soccer coaches were instructed during their basic education and during refresher courses to implement “The 11” in their soccer training. Since 2011, another prevention programme called “Sports Basics” has been promoted and implemented in the education of coaches. Additionally, in 2007, fair play measures were launched in low-level amateur soccer leagues and junior leagues. More specifically, a penalty point system for red and yellow cards was implemented which is of relevance for the final ranking position of a team.

Although detailed information about changes of injury incidence with respect to level of play, injury causes and injury characteristics can make an important contribution to improve injury prevention, thus far little is known about the long-term development of injury incidences in amateur soccer. Therefore, the purpose of the present study was to compare injury incidences in Swiss amateur soccer between the years 2004, 2008, and 2015. More specifically, the present article focuses on the following three research questions: (1) How has injury incidence changed in amateur soccer? (2) How has injury incidence changed in different amateur soccer leagues? (3) How have injury characteristics and injury causes changed in amateur soccer?

Methods

Sample and study design

In May 2004, May 2008 and May 2015, three representative samples of Swiss amateur soccer coaches were interviewed about the frequency and characteristics of injuries in their teams. Detailed information about study design and samples of 2004 and 2008 was provided by Junge et al. [28]. In 2004, 1029 amateur coaches were interviewed, whereas 1015 coaches participated in the 2008 survey.

For the latest survey, a random sample of 1260 coaches was contacted by telephone. The sample was drawn from a complete list provided by the Swiss Football Association (SFV) of 5719 coaches who were engaged either in male amateur leagues (including 2nd-5th amateur leagues, juniors 14-20 years, and 30+/40+ leagues) or in female leagues (all levels). Of the selected coaches, 1008 were willing to take part in the survey (80.0% response rate). The 252 (20.0%) non-responses were due to the following reasons: no longer coaching a soccer team (n = 64), not coaching an amateur team (n = 22), could not be contacted due to unavailability (did not answer the telephone call repeatedly) (n = 50), incorrect telephone numbers (n = 37), and other reasons (n = 21) such as language problems. Additionally, 58 coaches refused to be interviewed.

The computer-assisted, fully structured telephone interviews were conducted by the LINK Institute, which specializes in this kind of survey. On average, an interview took 21 minutes to complete. In Switzerland, the ethical committee's approval is not mandatory for anonymised surveys as documented by Art. 2 HRA (Human Research Act) and Art. 25 HRO (Human Research Ordinance). Nevertheless, the study followed the ethical principles described in the Declaration of Helsinki.

Questionnaire and definition of injury incidence

The content of the 2015 telephone interviews was almost identical to the survey carried out in 2008 which was developed by Junge et al. [28] and followed the consensus statement of Fuller et al. [119] (the survey used in the 2015 telephone interviews is available on request in German and French language from the corresponding author). First, the coaches had to answer some questions about their team (league, team size, training frequency, etc.). Second, they had to report the number of games played by their team during the previous four weeks and to describe all injuries which happened during these games. To achieve the highest level of accuracy with respect to the injury reports, the interviewers strictly guided the coaches. The coaches were instructed to remember the last game and the opposing team. Then, they were asked to report the injuries which occurred (for their players) during this

specific game. For each injury mentioned, the coaches were asked to provide detailed information (body region, type, contact, foul play, severity, medical attention). This procedure was repeated for all games that took place during the previous four weeks. Third, the coaches had to report the number of training injuries that had occurred during the previous four weeks, and were invited to provide detailed information about each injury. Finally, the coaches were asked to respond to some questions about their personal background (age, gender, experience as a coach).

Based on the answers of the coaches, injury incidences were calculated as injuries per 1000 hours of game play and as injuries per 1000 hours of training. For the calculation of injury incidence during games, a maximum of five games was considered in order to reduce recall bias. With respect to games, total exposure time was defined as multiplication of the number of games, the duration of a game (1.5 hours), and the number of players (11 players) while for training exposure, time was calculated as multiplication of the average number of training sessions per week, the average duration of a training session, the average number of players per training session, the number of weeks for this study period (4 weeks), and the number of teams involved.

Statistical analysis

Data analysis was conducted using the Statistical Package for the Social Sciences software (version 22.0; SPSS Inc). Descriptive data are presented as percentages, means (M) including standard deviations (SD), and means including bias corrected and accelerated 95% confidence intervals (BCa 95%-CI) calculated by using bootstrapping with 1000 replications [142]. Differences between the three surveys with respect to the distribution of coaches by league and with respect to team characteristics were tested by χ^2 statistics and by t-tests, respectively. To avoid alpha error inflation, Bonferroni correction was performed. Thus, differences were considered significant at $p < 0.017$. Injury incidence was calculated with Excel 2011 for Mac (Microsoft, Redmond, WA, USA) and defined as the number of injuries divided by the total person-time at risk. To establish the significance of the difference between injury incidences, 95% confidence intervals (95%-CI) were calculated with the following formula [148]:

Incidence rate ± 1.96 * √(number of injuries) / (person-time at risk)

The criterion for statistical significance was set according to Field (p. 71) [142] who states that a moderate overlap between the bars of the 95% confidence intervals (no more than half of each bar) represents a p-value of ≈0.05.

Results

Characteristics of the coaches and their teams

In 2004, 2008 and 2015 almost all interviewed coaches were male (99%). On average, they were about 40 years old (2004: M = 40.3, SD = 9.2; 2008: M = 41.6, SD = 9.6; 2015: M = 40.6, SD = 10.7) and had more than 10 years of experience as soccer coaches (2004: M = 10.4, SD = 7.8; 2008: M = 11.9, SD = 7.9; 2015: M = 11.0, SD = 8.9). A majority of all coaches was responsible for a male soccer team. However, the percentage of respondents coaching female teams increased from 3.3% in 2004 to 9.8% in 2015 (χ^2[1,2035] = 35.302, p < 0.001). The representation of the other leagues did not differ significantly between the years 2004 and 2015 and the years 2008 and 2015.

There were only some slight changes from 2004 to 2015 with respect to team characteristics (see Table 6.1). However, due to the large sample sizes, all team characteristics significantly differed (with the exception of training duration). In 2015, the average number of players per team consisted of 1.4 players more than in 2004, whereas the average number of players participating per training has increased by nearly one player. By contrast, the average number of reported games played during the previous four weeks was slightly lower in 2015, while training load (number of training sessions per week and training duration) remained relatively stable across the examined time period.

Table 6.1. Team and exposure characteristics (arithmetic mean and BCa 95%-CI)

	2004	2008	2015
Team size	18.6 (18.4-18.9)	19.3 (19.0-19.5) [c]	20.0 (19.7-20.2) [a b]
No. of games (previous 4 weeks)	4.3 (4.2-4.3)	4.4 (4.3-4.4)	4.0 (4.0-4.1) [a b]
No. of training sessions per week	2.0 (2.0-2.0)	2.1 (2.0-2.1) [c]	2.1 (2.0-2.1) [a]
Duration of training (in minutes)	92.0 (91.2-92.9)	91.0 (90.4-91.5)	91.0 (90.1-91.5)
No. of players per training session	13.6 (13.4-13.8)	14.1 (13.9-14.2) [c]	14.4 (14.2-14.6) [a b]
No. of interviewed coaches	*1028*	*1015*	*1007*

Significant difference (t-test, p < 0.017): [a] between 2015 and 2004, [b] between 2015 and 2008, [c] between 2008 and 2004.

Injury incidence in amateur soccer

The survey of 2015 referred to 1076 injuries which happened during 3964 amateur soccer games and to 525 injuries which occurred during 8338 training sessions. Additionally, an exposure time of 182,961 training hours was considered for the calculations. As illustrated in Figure 6.1, the number of injuries per 1000 hours of competitive playing significantly decreased from 2004 to 2008 by 11.9%. However, from 2008 to 2015, an increase in injury incidence of 3.2 injuries per 1000 hours was observed during competitive games. The incidence of training injuries increased by 20.8% from 2004 to 2015 and by 31.8% from 2008 to 2015.

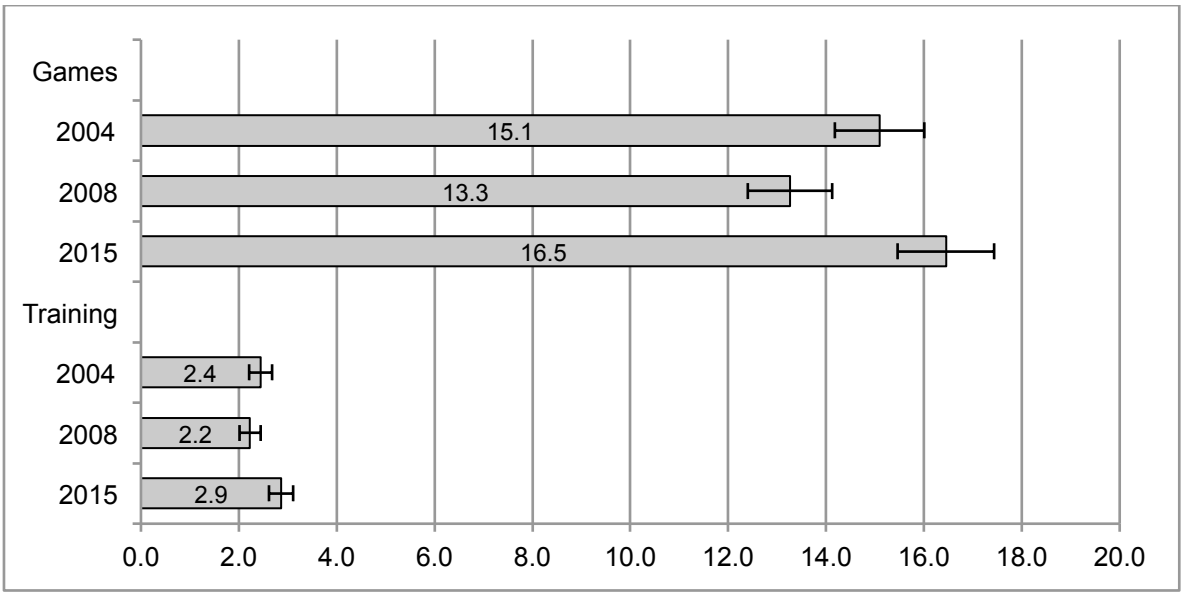

Figure 6.1. Injury incidence in amateur soccer per 1000 hours of play during the previous four weeks (including 95%-CI).

Injury incidence in different amateur soccer leagues

Considering the incidence of game injuries, the reported trend highlighting a decrease between the years 2004 and 2008, followed by an increase between the years 2008 and 2015, was observable across all leagues (see Table 6.2). On a descriptive level, in each league, the incidence of game and training injuries was higher in 2015 compared to 2004. Nevertheless, differences across time rarely reached statistical significance in the various subgroups.

Comparing the years 2004 and 2015, a considerable increase of 109.1% was observed for training injury incidence among female players. However, this change was not statistically significant due to a limited number of injuries. With regard to injury incidence during competitive games, a significant increase occurred from 2008 to 2015 for 14- to 15-year-old males (47.1%) and males playing in the 30+/40+ leagues (34.4%), and there was a significant decrease of injury incidence in male 30+/40+ league players from 2004 to 2008. Regarding training injuries, a 42.1% increase was found in young male players (14-15 years), and a 61.5% increase among 16- to 20-year-old male players.

Furthermore, a remarkably high injury incidence was observed during games of male 30+/40+ leagues. Across all three time points, this group had the highest injury incidence rates, during both competitive games and training.

Table 6.2. Injury incidence during amateur soccer games and training per 1000 hours of playing during the previous four weeks, by leagues (including 95% confidence intervals)

	2004	2008	2015
Games			
Male 2nd-3rd amateur leagues	16.3 (13.9-18.7)	14.0 (11.8-16.2)	17.2 (14.5-19.9)
Male 4th-5th amateur leagues	17.1 (15.1-19.0)	16.5 (14.4-18.6)	19.0 (16.8-21.3)
Male 16-20 years	12.2 (10.4-13.9)	12.1 (10.5-13.8)	14.4 (12.4-16.4)
Male 14-15 years	10.1 (8.4-11.7)	8.5 (7.0-10.1)	12.5 (10.7-14.3) [a]
Male 30+/40+ leagues	22.7 (19.7-25.6)	18.0 (14.9-21.1) [b]	24.2 (20.5-27.8) [a]
Female all levels	13.8 (9.0-18.5)	11.9 (8.6-15.2)	14.3 (11.4-17.2)
Training			
Male 2nd-3rd amateur leagues	2.6 (2.1-3.2)	2.1 (1.6-2.6)	2.8 (2.2-3.4)
Male 4th-5th amateur leagues	2.7 (2.2-3.2)	3.1 (2.6-3.7)	3.5 (2.9-4.1)
Male 16-20 years	2.3 (1.8-2.7)	1.9 (1.5-2.3)	2.7 (2.2-3.2) [a]
Male 14-15 years	1.7 (1.3-2.0)	1.3 (1.0-1.7)	2.1 (1.7-2.5) [a]
Male 30+/40+ leagues	4.9 (3.6-6.3)	6.0 (4.3-7.7)	5.0 (3.6-6.4)
Female all levels	1.1 (0.3-2.0)	1.6 (0.8-2.3)	2.3 (1.6-3.0)

Significant difference (95% confidence intervals, $p \leq 0.05$): [a] between 2015 and 2008, [b] between 2008 and 2004.

Injury causes and characteristics

With regard to injury severity, there were no significant differences in game (see Table 6.3) and training (see Table 6.4) injury incidence between the years 2004 and 2015. Only the incidence of medical attention injuries significantly increased from 2004 to 2015 (game 20.0%, training 37.5%). However, comparing the years 2008 and 2015, a higher incidence for light (1-7 days lay-off, 40.6%) and severe (>28 days lay-off, 29.2%) game injuries and a higher incidence for moderate (8-28 days lay-off, 33.3%) training injuries were found.

Focusing on injury situations during competitive games, the incidence of contact injuries increased by 19.1% from 2004 to 2015, while the incidence of non-contact injuries and foul play injuries did not vary significantly between these years. The increase of game injury incidence from 2008 to 2015 can be explained by both a higher frequency of contact and non-contact injuries. Comparing the years 2008 and 2015, the incidence of foul play injuries in games increased by 25.0%. With regard to training injuries, the total increase from 2004 to 2015 was mainly due to a 22.2% higher rate of non-contact injuries.

There were also significant differences across time with respect to injury characteristics. More injuries to the knee (38.1% higher injury incidence), to the upper limb (83.3%), sprains (28.1%) and bone fractures (80.0%) were observed during competitive games in 2015 compared to 2004. The incidence of injuries such as strains and contusions was significantly reduced in 2008. With a view to training injuries, the changes of injury characteristics between the years 2004, 2008 and 2015 were of less relevance.

Table 6.3. Injury incidence in amateur soccer games per 1000 hours of playing during the previous four weeks, by causes and characteristics (including 95% confidence intervals)

Games	2004	2008	2015
Time loss*			
No days	1.8 (1.5-2.1)	1.2 (0.9-1.4) [c]	1.5 (1.2-1.8)
1-7 days	4.2 (3.7-4.6)	3.2 (2.8-3.6) [c]	4.5 (4.0-5.0) [b]
8-28 days	5.9 (5.3-6.5)	5.8 (5.2-6.4)	6.7 (6.0-7.3)
> 28 days	2.6 (2.2-3.0)	2.4 (2.1-2.8)	3.1 (2.6-3.5) [b]
Had to stop soccer	0.1 (0.0-0.2)	0.1 (0.0-0.2)	0.1 (0.0-0.2)
Medical attention	6.0 (5.4-6.5)	5.8 (5.3-6.4)	7.2 (6.5-7.8) [a b]
Injury situation			
Contact	4.7 (4.2-5.2)	4.4 (3.9-4.9)	5.6 (5.0-6.2) [a b]
Non-contact	10.3 (9.6-11.1)	8.6 (7.9-9.3) [c]	10.7 (9.9-11.5) [b]
Foul play†	3.1 (2.6-3.5)	2.8 (2.4-3.2)	3.5 (3.0-4.0) [b]
Body region			
Ankle	3.5 (3.1-3.9)	3.6 (3.2-4.1)	3.9 (3.4-4.4)
Thigh	3.5 (3.1-4.0)	2.9 (2.5-3.3) [c]	3.7 (3.3-4.2) [b]
Knee	2.1 (1.8-2.5)	1.9 (1.6-2.2)	2.9 (2.4-3.3) [a b]
Lower leg, Achilles tendon	1.3 (1.1-1.6)	1.1 (0.9-1.4)	1.3 (1.0-1.6)
Upper limb	0.6 (0.4-0.8)	0.9 (0.7-1.1)	1.1 (0.9-1.4) [a]
Other, don't know	4.0 (3.5-4.5)	2.8 (2.4-3.2) [c]	3.5 (3.1-4.0)
Injury type			
Strain, muscle rupture, tear	4.5 (4.0-5.0)	3.0 (2.6-3.4) [c]	4.3 (3.8-4.8) [b]
Ligament injury, sprain	3.2 (2.8-3.6)	3.4 (3.0-3.8)	4.1 (3.6-4.6) [a b]
Contusion, hematoma	4.1 (3.6-4.5)	3.1 (2.7-3.5) [c]	3.8 (3.3-4.2) [b]
Bone fracture, bone injury	0.5 (0.3-0.7)	0.6 (0.4-0.8)	0.9 (0.7-1.1) [a]
Other, don't know	2.8 (2.4-3.2)	3.1 (2.7-3.5)	3.3 (2.9-3.8)
No. of injuries	*1049*	*914*	*1076*

Significant difference (95% confidence intervals, $p \leq 0.05$): [a] between 2015 and 2004, [b] between 2015 and 2008, [c] between 2008 and 2004.

*The information is based on the medical diagnosis (provided that the player consulted a physician) and on the assessment of the player and the coach.

†Foul play was determined as a combination of the referee's and the coach's opinion for game injuries and of the coach's opinion for training injuries. Foul play is a sub-category of contact injuries. Even in training, (unintentional) foul play can occur, for example, when duels are practiced or when two teams play against each other.

Table 6.4. Injury incidence in amateur soccer training per 1000 hours of playing during the previous four weeks, by causes and characteristics (including 95% confidence intervals)

Training	2004	2008	2015
Time loss*			
No days	0.3 (0.2-0.3)	0.2 (0.2-0.3)	0.3 (0.2-0.3)
1-7 days	0.7 (0.6-0.9)	0.6 (0.5-0.8)	0.8 (0.7-1.0)
8-28 days	1.0 (0.9-1.2)	0.9 (0.7-1.0)	1.2 (1.1-1.4) [b]
> 28 days	0.4 (0.3- 0.5)	0.4 (0.3-0.4)	0.4 (0.3-0.5)
Had to stop soccer	0.0	0.0	0.0
Medical attention	0.8 (0.7-1.0)	0.8 (0.7-1.0)	1.1 (1.0-1.3) [a b]
Injury situation			
Contact	0.6 (0.4-0.7)	0.5 (0.4-0.6)	0.6 (0.5-0.7)
Non-contact	1.8 (1.6-2.0)	1.7 (1.5-1.9)	2.2 (2.0-2.4) [a b]
Body region			
Ankle	0.6 (0.5-0.8)	0.7 (0.5-0.8)	0.8 (0.6-0.9)
Thigh	0.6 (0.5-0.7)	0.5 (0.4-0.7)	0.6 (0.5-0.7)
Knee	0.3 (0.2-0.4)	0.3 (0.2-0.4)	0.4 (0.3-0.5)
Lower leg, Achilles tendon	0.2 (0.1-0.2)	0.2 (0.1-0.2)	0.2 (0.1-0.2)
Upper limb	0.2 (0.1-0.2)	0.1 (0.0-0.1)	0.2 (0.1-0.3)
Other, don't know	0.6 (0.5-0.7)	0.5 (0.4-0.6)	0.7 (0.6-0.8) [b]
Injury type			
Strain, muscle rupture, tear	0.7 (0.5-0.8)	0.7 (0.5-0.8)	0.7 (0.6-0.8)
Ligament injury, sprain	0.7 (0.6-0.8)	0.6 (0.5-0.7)	0.8 (0.7-1.0) [b]
Contusion, hematoma	0.5 (0.4-0.6)	0.4 (0.3-0.5)	0.5 (0.4-0.6)
Other, don't know	0.6 (0.5-0.7)	0.5 (0.4-0.7)	0.8 (0.7-1.0) [a b]
No. of injuries	*417*	*403*	*525*

Significant difference (95% confidence intervals, $p \leq 0.05$): [a] between 2015 and 2004, [b] between 2015 and 2008.

*The information is based on the medical diagnosis (provided that the player consulted a physician) and on the assessment of the player and the coach.

Discussion

The aim of the present study was to compare injury incidences in Swiss amateur soccer between the years 2004, 2008, and 2015 with respect to leagues, injury causes, and characteristics. One main finding was that the rate of training injuries increased significantly from 2004 to 2015, whereas the injury rate during competitive games increased significantly from 2008 to 2015. On this basis, it can be concluded that the injury incidence in Swiss amateur soccer has increased in the past years. This finding is in line with a previous study analysing soccer-related injuries of children and adults in the USA [36].

A more detailed analysis of the injury situations showed that the above-mentioned changes of injury incidence may be attributable to various causes. Compared to 2004, the incidence of contact injuries during games was higher in 2015. Additionally, the incidence of foul play injuries during games increased from 2008 to 2015. These findings suggest that competitive amateur soccer in Switzerland may have become more physical. In contrast, the higher incidence of training injuries in 2015 was mainly due to an increased rate of non-contact injuries. This indicates that the intensity of playing may have increased during amateur soccer training.

The long-term development of injury incidence with respect to different amateur soccer leagues provides important insights for the improvement of prevention strategies. A comparison of the 2004 and 2015 data points towards a tendency for injury incidence to increase across all leagues. From 2008 to 2015, significant increases were observed among junior (both training and game) [36] and veteran soccer players (only game). Although not statistically significant, the increased injury incidence during female soccer training is worth noting. As Junge and Dvorak [147] concluded, the playing style of women has become more intense in top tournaments. Although speculative, it can be assumed that this trend also pertains to female soccer trainings, and both to youth and veteran soccer.

Furthermore, in line with previous research [64], remarkably high levels of injury incidences were identified during competitive games and trainings among male 30+/40+ leagues. Our data supports previous research showing that injury risk increases with age [34, 78, 132]. As a consequence, male 30+/40+ league players should be a main target group for injury prevention. While Hammes et al. [95] were unable to find a preventive effect of FIFA “11+“ among veteran soccer players, this might be due to the low frequency of training sessions. Thus, more concerted efforts are needed to find out how injury prevention can be implemented successfully among older amateur players.

During both games and training, incidence of medical attention injuries increased significantly between 2004 and 2015. This may be related to the fact that players more frequently consulted a physician. It might also be an indication that injuries in Swiss amateur soccer

have become more severe. The latter assumption is supported by the fact that on a descriptive level moderate (time loss of 8-28 days) and severe (time loss of >28 days) game injuries increased between 2004 and 2015. The development of severe injuries sustained during competitive games between 2008 and 2015 is also of particular concern. Furthermore, significant differences regarding injury characteristics were in line with the assumption that injury severity may has increased over time. Compared to 2004, injuries to the knee, to the upper limb, sprains, and bone fractures were more frequently observed during competitive games in 2015. The changes in injury severity and injury characteristics corroborate the notion that amateur soccer in Switzerland may have become more intensive, including higher speeds and forces, which leads to a higher number of serious falls and severe injuries such as bone fractures.

Possible limitations of the present study design such as memory effects and reporting bias have been discussed previously by Junge et al. [28]. Since these effects were similar across all three years the data should be comparable and changes in injury incidence should be conclusive. However, the generalisability of the calculated injury incidences is limited due to the study design. In general, injury data collected by sports coaches are likely to underestimate injury incidence [149]. Nevertheless, the incidences of game and training injuries were comparable to those reported for amateur players in other studies [18, 19, 32]. Additionally, a game duration of 90 minutes and a number of 11 players was used as a basic assumption when calculating the total exposure time. However, for a few junior teams (male and female 14-15 years) as well as for a few veteran teams, play time was shorter (e.g. 80 minutes) and fewer players are engaged on the field (7 or 9 players). As a consequence, injury incidence may have been underestimated in these leagues. All in all, we assume that these few cases should not have an impact on our data. Furthermore, we acknowledge that our study does not provide real longitudinal data, in which same individuals are followed-up over time. Rather, changes observed over time are based on potentially different individuals (that is, different coaches who may refer to different players). Finally, as described in the method section, the coaches were asked to report injuries with regard to games when they were present. With regard to the training sessions the question was formulated in a more general way. That is, coaches were asked about the number of training injuries that had occurred during the previous four weeks. Moreover, coaches were invited to provide details about each injury. Since coaches might not have been present in each single training session, it is plausible that coaches may not be aware of some minor injuries that have occurred during training. Accordingly, it is possible that we underestimated the incidence of minor injury during training sessions in the current study.

Conclusions

During the past years, injury prevention programmes and fair play measures have been successfully implemented in Swiss amateur soccer [28]. Additionally, the international literature supports a positive effect of prevention programmes in youth soccer [150-152], female soccer [90, 153, 154], and amateur soccer in general [90, 92, 155]. Nevertheless, the present study shows that despite these measures, an increase of incidence was observed from 2004 to 2015 with respect to contact injuries during games, non-contact injuries during training and medical attention injuries. We therefore claim that the development, scientific evaluation, and implementation of appropriate preventive strategies in amateur soccer need to remain a top priority for policy makers. Furthermore, there is a continued need for studies monitoring the development of injury incidence in amateur soccer across time.

CHAPTER 7

PUBLICATION V: INJURY PREVENTION IN AMATEUR SOCCER: A NATION-WIDE STUDY ON IMPLEMENTATION AND ASSOCIATIONS WITH INJURY INCIDENCE

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Submission date: 18 September, 2018

* Minor editorial modification have been made due to harmonisation of the thesis

Abstract

We examined the implementation of injury prevention in Swiss amateur soccer and the association between injury incidence and the implementation of prevention programmes. In 2004 (n = 1029), 2008 (n = 705) and 2015 (n = 1008), a representative sample of Swiss amateur soccer coaches was interviewed by telephone about the frequency of injuries in their teams, the implementation of preventive measures, and the use of two injury prevention programmes. Injury incidences were compared between teams that did and did not perform a prevention programme according to minimal standards (at least three exercises of a programme per session, at least once per week over at least six months). In the 2015 survey, 86.1% of amateur coaches stated that injury prevention is important and 85.3% of amateur coaches reported that they would implement some kind of preventive measures. The proportion of teams which performed a prevention programme according to minimal standards, remained unchanged between 2008 (21.7%) and 2015 (21.9%), although a second prevention programme was made available in 2011. Only 8.6% of 30+/40+ league teams implemented a programme. Teams performing a prevention programme had a 37.5% lower incidence of training injuries, whereas no difference was found for game injuries. Overall, the level of implementation of prevention programmes in a real-world context is still unsatisfactory. Offering an additional programme did not lead to a higher willingness to implement such programmes among the coaches. Concerted efforts are needed to remove barriers that hinder the use of such programmes, particularly among coaches of 30+/40+ league teams.

Keywords: injury prevention, preventive measures, prevention programmes, amateur soccer

Introduction

Soccer is the most popular team sport in Switzerland [49]. Out of 6.2 million Swiss citizens aged between 15 and 74 years, about 480,000 were involved in playing soccer in 2013 [49]. While soccer is considered as a meaningful leisure time activity that can enhance health [6, 10], as a contact sport, it is also associated with an increased injury risk and therefore has a high socioeconomic impact [53, 55]. The incidence of injury in amateur soccer ranges from 2.7 to 4.5 per 1000 hours of training and from 12.3 to 24.7 per 1000 hours of game play [18, 19, 22]. In order to reduce the injury risk, the Swiss Football Association (SFV) has promoted injury prevention strategies since 2004 [28]. More specifically, as part of their basic education and refresher courses, all Swiss soccer coaches are instructed to implement prevention programmes in their training plans. Furthermore, fair play measures were launched in 2007 by the SFV [113]. For instance, in low-level and junior leagues, a ranking-relevant penalty point system was introduced for red and yellow cards.

There is empirical evidence that prevention programmes can reduce injury risk in both amateur [86, 89, 90, 92] and youth soccer [150, 152, 154]. However, not all studies were able to detect a significant reduction of injury risk in the intervention group [95, 96]. Hammes et al. [95] attributed the lack of significant results to the low number of training sessions of some amateur soccer teams, which does not allow for neuromuscular adaptations. Alternatively, Steffen et al. [96] assumed that the low compliance of teams and players may have reduced the positive impact of the prevention programme. Generally, a high compliance of players with preventive measures is identified as being a key factor for the successful implementation of preventive strategies in soccer, and sports in general [102, 103]. Furthermore, previous studies highlighted the key role played by coaches in the promotion of preventive strategies [109, 154, 156].

A substantial limitation of existing research consists in the fact that most evidence is based on randomized controlled trials (RCTs), in which the programme implementation was prescribed and monitored by the researchers [92, 116]. There is no doubt that RCTs should be seen as “gold standard” in order to document programme efficacy, but studies with alternative study designs might provide valuable information to obtain insights in the generalisability of the findings in a real-world context, when preventive measures are carried out voluntarily and under less controlled circumstances [157]. For instance, Junge et al. [28] showed that the prevention programme „The 11“ was successfully implemented in Swiss amateur soccer, and that this programme is associated with a reduced injury incidence rate.

Given this background, the aim of the present study was to extend the study by Junge et al. [28] by exploring the current state and the development of injury prevention in Swiss amateur soccer by comparing retrospective survey data from 2004, 2008, and 2015. Moreover, we

aimed at examining the association between the injury incidence of a team and the implementation of a prevention programme. In this manuscript the following research questions will be addressed: (1) How well are preventive measures implemented in Swiss amateur soccer, and are there any differences between leagues? (2) To what extent are prevention programmes implemented in Swiss amateur soccer, and are there any differences between leagues? (3) Is the implementation of prevention programmes by Swiss soccer coaches associated with a lower injury incidence rate among players?

Methods

Prevention programmes

Since 2004, three prevention programmes have been launched in Swiss amateur soccer. “The 11“ prevention programme was developed by the FIFA as warm-up programme to reduce the most common soccer injuries and was integrated into the coach education from 2004 onwards [28, 107]. “The 11“ includes ten exercises focusing on core and hamstring strength, balance, and dynamic stabilisation as well as a fair play rule. “11+“ is a revised version of “The 11“ launched in 2009 and comprises 15 exercises, which are grouped into three parts [108]. Part one focuses on low speed running exercises and active stretching, while part two includes core and leg strength exercises, and part three consists of moderate and high speed exercises combined with planting and cutting movements. Additionally, all exercises of part two are provided in three levels with increasing difficulty. There is evidence that “11+” is efficacious [89, 90, 92]. Since it is not obvious for coaches to make a distinction between “The 11“ and “11+“, these programmes were recorded together as 11/11+. In addition, Suva “Sport Basics“ (SSB) is a prevention programme developed for all ball sports, promoted by Suva (the Swiss National Insurance Fund) and launched in 2011 [110]. This programme was integrated into the coach education instead of “The 11”. It consists of six basic exercises, which focus on strengthening of the core and stabilisation of the axis of the leg. Additionally, four exercises with a higher difficulty level are provided for advanced athletes. “Sport Basics” has not been evaluated in a randomised controlled trial or interventional study.

Study design

In May 2015, a retrospective survey was carried out with a representative sample of 1008 Swiss amateur soccer coaches about their use of injury prevention strategies and the frequency of injuries in their teams. Only coaches of amateur teams, which consisted of players older than 14 years, were included. In order to explore the development of coaches’ self-reported use of prevention strategies, data of two further surveys of Swiss amateur soccer coaches carried out in May 2008 (n = 705) and May 2004 (n = 1029) by Junge et al. [28] were included. Methods of the 2004 and 2008 surveys were described in detail by Junge et al. [28] and the 2015 survey used the same methods as in 2008, however, questions on SSB were added. The telephone interviews were computer-assisted and fully structured. On average, an interview took 12 minutes in 2004, 20 minutes in 2008, and 21 minutes in 2015. As stated by Art. 2 HRA (Human Research Act) and Art. 25 HRO (Human Research Ordinance), the ethical committee’s approval is not required for anonymised surveys. All

procedures performed in this study were in accordance with the ethical principles stated in the Declaration of Helsinki.

Questionnaire

The questionnaire was developed by Junge et al. [28] in lights of the well-established consensus statement of Fuller et al. [119]. First, the coaches had to answer some basic questions about their teams (league, team size) and their training (frequency, level of attendance).

Second, the questionnaire included some questions about injury prevention. With respect to preventive measures, coaches who stated that they would implement such measures were asked to name all (unprompted questioning). These answers were categorised by the interviewers. Furthermore, the coaches were asked whether they knew and used the prevention programmes 11/11+ and SSB and how frequently they taught these programmes or some exercises from them. For the more in-depth analyses, teams were divided into four groups: Those that implement SSB according to minimal standards, those that implement 11/11+ according to minimal standards, those that implement both programmes according to minimal standards, and those that implement parts of a programme (but not according to minimal standards) or have never performed a programme. For the purpose of the present study, implementation of a programme according to minimal standards was accomplished if the coach used at least three exercises of a programme per session, at least once per week over at least six months. With respect to specific types of exercises, all coaches had to mention how frequently they performed one-legged coordination and balance exercises, core strength exercises, hamstring strength exercises, and jumping power exercises with their teams. In the analyses, a distinction was made between coaches who regularly (frequently, each training) and not regularly (never, rarely, sometimes) implemented a specific type of exercise.

Third, the procedure for the recording of injuries was strictly predetermined, in order to improve the accuracy of injury reports. The coaches were asked about the number of games played in the previous four weeks, and they were then asked to remember the last game by mentioning the opponent and reporting all related injuries sustained by their players. For each injury mentioned detailed information about body region, type, contact, foul play, severity, and medical attention was recorded. The same procedure was repeated back in time for each game played during the four weeks before the interview. Moreover, the coaches had to report the number of training injuries which occurred during the four weeks before the interview, and had to provide detailed information about each.

Statistical analysis

Descriptive data were presented as means including standard deviations (SD) and as percentages with 95% confidence intervals (95%-CI). Statistical methods applied were χ^2 statistics and the significance level was set to 5%. Injury incidences were calculated as injuries per 1000 hours of training and injuries per 1000 hours of game play. For the calculation of game injury incidence five games were considered at most in order to reduce recall bias. Following Knowles et al. [148], 95%-CI were provided for injury incidences calculated as:

Incidence rate ± 1.96 * √(number of injuries) / (person-time at risk)

Moderate overlap between the bars of the 95%-CI (no more than half of each bar) was the criterion for statistically significant differences of injury incidences at a p-value of 0.05 [142]. The statistical analysis was performed using SPSS 24.0 for Mac (SPSS, Chicago, Illinois, USA) and Excel 2001 for Mac (Microsoft, Redmond, WA, USA).

Results

Injury prevention in Swiss amateur soccer

In the 2015 survey, a majority of coaches confirmed that injury prevention plays an important role in their training plans (86.1%, 95%-CI 84.0-88.3). However, the number of affirmative answers was slightly higher in the previous surveys (2008: 90.9%, 95%-CI 88.7-93.0; 2004: 89.3%, 95%-CI 87.4-91.2). In accordance with this, a high percentage of coaches reported that they would implement specific measures to prevent injuries of their players (85.3%, 95%-CI 81.9-86.3). In 2008, this percentage was slightly higher (89.8%, 95%-CI 87.6-92.0), while in 2004 it was similar (84.1%, 95%-CI 81.9-86.3). There were significant differences by leagues ($\chi^2[5,1006] = 64.261$, $p < 0.001$), indicating that preventive measures were less frequently implemented in 30+/40+ league teams (64.7%, 95%-CI 56.0-73.4) compared to other teams (male 2nd and 3rd amateur leagues 85.3%, 95%-CI 79.2-91.4; male 4th and 5th amateur leagues 79.9%, 95%-CI 74.7-85.2; male 16-20 years 93.0%, 95%-CI 89.5-96.4; male 14-15 years 92.0%, 95%-CI 88.5-95.5; female all levels 89.9%, 95%-CI 84.0-95.8).

Furthermore, Table 7.1 shows which preventive measures the coaches implemented. In the 2015 survey, the most commonly reported measures were warm-up, stretching, general strength training, and core strength training, whereas specific prevention programmes were rarely mentioned. 11/11+ was less frequently mentioned in 2015 compared to 2008, but the percentage of coaches who implemented general strength training and core strength training had increased significantly. Warm-up and stretching were less frequently reported in the 2015 survey compared to the 2004 survey.

Table 7.1. Implementation of preventive measures: Preventive measures reported by the coaches (unprompted questioning), by percentage of coaches who reported taking preventive measures (including 95%-CI)

	2004 % (95%-CI)	**2008** % (95%-CI)	**2015** % (95%-CI)
Suva Sport Basics	-	-	5.7 (4.2-7.3)
The 11/ 11+	-	25.6 (22.2-29.0)	6.5 (4.9-8.2)
Warm-up	80.7 (78.0-83.3)	72.4 (68.9-75.8)	67.4 (64.2-70.5)
Stretching	74.9 (72.0-77.8)	48.0 (44.1-51.9)	47.8 (44.4-51.1)
Cool down	35.1 (31.9-38.3)	12.0 (9.5-14.5)	12.9 (10.7-15.2)
Wearing shin guards	21.6 (18.9-24.4)	13.4 (10.8-16.1)	9.8 (7.8-11.8)
General strength training	16.2 (13.7-18.7)	13.3 (10.6-15.9)	24.2 (21.4-27.1)
Massage	11.5 (9.3-13.6)	6.2 (4.3-8.0)	4.4 (3.1-5.8)
Information	11.0 (8.9-13.1)	3.3 (1.9-4.7)	3.4 (2.2-4.6)
Core strength training	10.0 (8.0-11.9)	7.4 (5.4-9.5)	20.9 (18.1-23.6)
Cardiorespiratory fitness training	10.0 (8.0-11.9)	4.4 (2.8-6.0)	10.1 (8.1-12.2)
Rehabilitation and complete recovery	5.3 (3.8-6.8)	1.7 (0.7-2.8)	3.3 (2.1-4.5)
Fair play	4.5 (3.1-5.9)	2.1 (0.9-3.2)	3.6 (2.4-4.9)
Adjusting footwear	4.2 (2.8-5.5)	1.3 (0.4-2.1)	1.9 (1.0-2.8)
Other measures	14.1 (11.8-16.4)	11.2 (8.8-13.7)	18.1 (15.5-20.6)
Number of coaches	*864*	*633*	*858*

Implementation of prevention programmes

When the coaches were asked whether they knew SSB or 11/11+, 43.0% (95%-CI 39.9-46.0) stated that they knew SSB and 48.4% (95%-CI 45.3-51.5) stated that they knew 11/11+. All in all, 33.2% (95%-CI 30.3-36.1) of coaches stated that they knew both programmes. The percentage of coaches who knew 11/11+ did not differ from 2008 (46.2%, 95%-CI 42.5-29.9). 16.3% (95%-CI 14.0-18.5) of the coaches reported that they would implement SSB or at least a selection of exercises with their team and 21.8% (95%-CI 19.3-24.4) of the coaches reported that they would implement 11/11+ or at least a selection of exercises with their team. Moreover, 18.2% (95%-CI 15.8-20.5) reported that they would implement both programmes or at least particular exercises of them.

Coaches who implemented a prevention programme reported that on average they instruct 3.9 (SD = 1.9) exercises per session, for a mean duration of 13.7 minutes (SD = 7.8). Furthermore, 56.9% (95%-CI 53.0-60.8) of them reported that they would implement this

prevention programme at least once a week. Taken together, the programme implementation differed not significantly from 2008 (3.7 exercises, 13.5 minutes, 60.4% once per week).

As shown in Figure 7.1, the percentage of teams, in which a prevention programme was carried out according to minimal standards did not change between 2008 (21.7%, 95%-CI 18.6-24.8) and 2015 (21.9%, 95%-CI 19.3-24.5) despite the fact that in 2015 an additional programme (SSB) was available. Coaches of 30+/40+ teams less frequently implemented prevention programmes according to minimal standards (8.6%, 95%-CI 3.5-13.7) compared to coaches of other teams (male 2nd and 3rd leagues 32.3%, 95%-CI 24.3-40.3; male 4th and 5th leagues 16.5%, 95%-CI 11.6-21.4; male 16-20 years 25.2%, 95%-CI 19.4-31.0; male 14-15 years 20.4%, 95%-CI 15.1-25.7; female all levels 32.3%, 95%-CI 23.1-41.5).

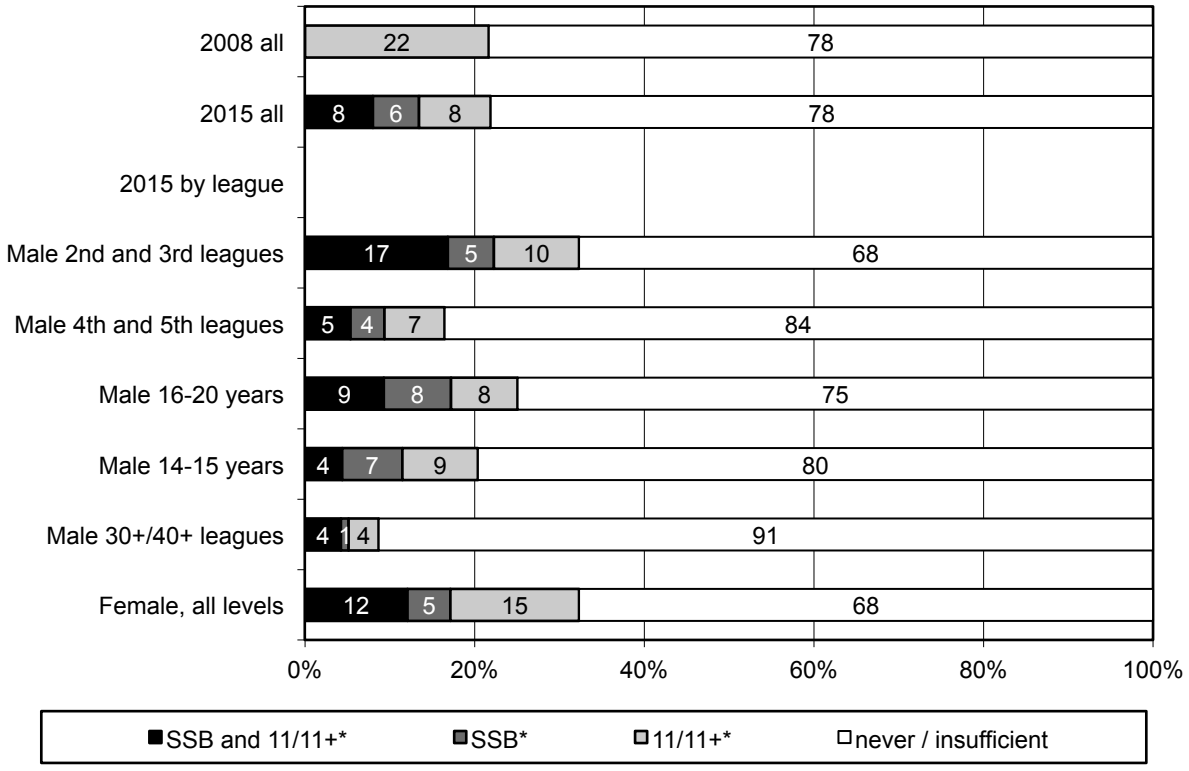

Figure 7.1. Implementation of prevention programmes according to minimal standards in Swiss amateur soccer by leagues (in percent)

* Implementation according to minimal standards: At least three exercises of a programme per session, at least once per week over at least six months.

Association between injury incidence and the implementation of a prevention programme

In 2015, the coaches reported 1076 injuries which happened during nearly 4000 amateur soccer games, and 525 injuries which occurred during about 180,000 hours of training. The overall injury incidence was 16.5 (95%-CI 15.5-17.4) injuries per 1000 hours of competitive playing and 2.9 (95%-CI 2.6-3.1) injuries per 1000 training hours.

Implementing a prevention programme according to minimal standards was not associated with a lower injury incidence during games, but minimal implementation of 11/11+ or of both programmes was significantly associated with a 37.5% lower injury incidence during training (see Figure 7.2).

Regarding the association between injury incidence and specific exercises, one-legged coordination and balance training was significantly associated with a lower injury rate. Teams which regularly performed one-legged coordination and balance exercises had an 18.0% lower game injury incidence (15.0, 95%-CI 13.8-16.3 vs. 18.3, 95%-CI 16.7-19.9) and a 28.6% lower training injury incidence (2.5, 95%-CI 2.2-2.8 vs. 3.5, 95%-CI 3.0-3.9). However, with regard to exercises focusing on core strength, strengthening of the hamstrings, and jumping power, no significant associations with injury incidence were found.

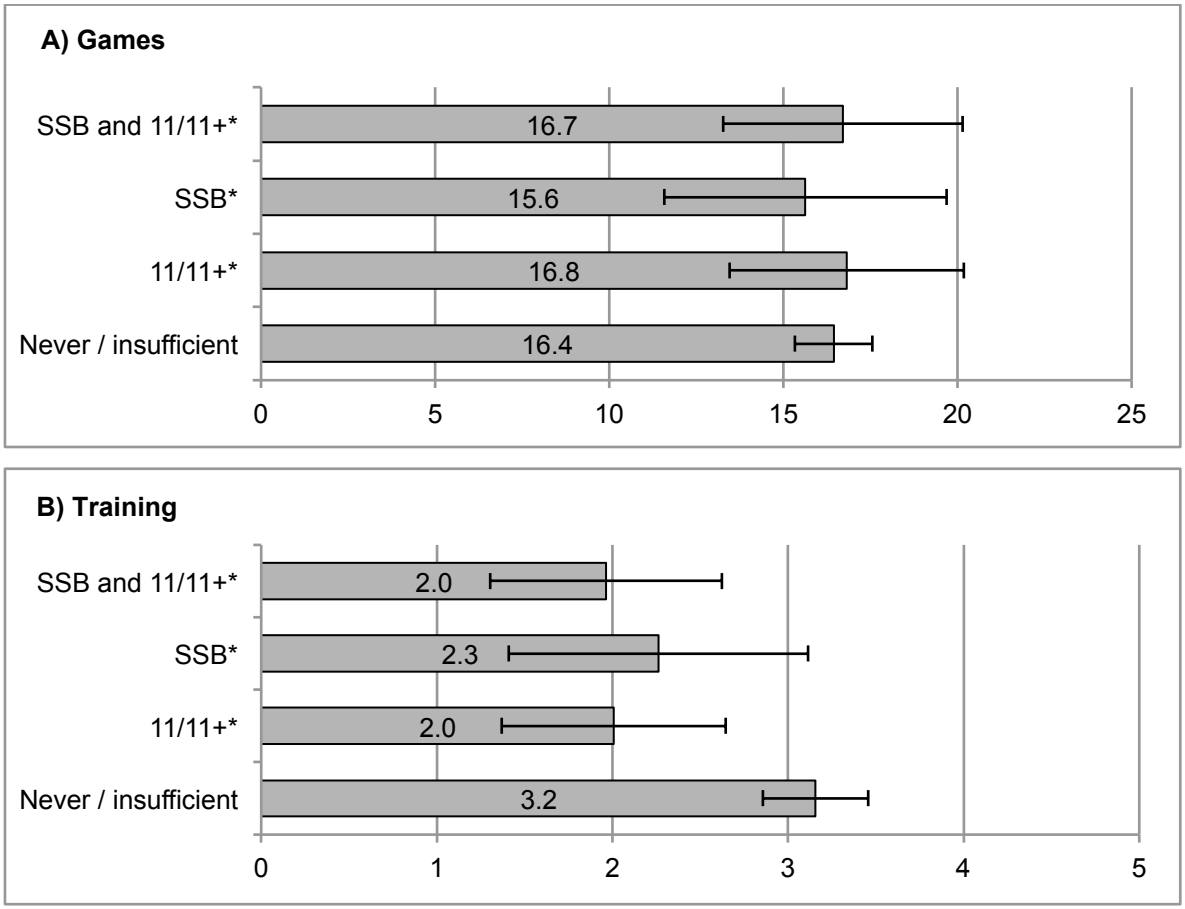

Figure 7.2. Injury incidence per 1000 hours of game play (A) and training (B) by implementation of a prevention programme according to minimal standards in 2015 (including 95%-CI)

* Implementation according to minimal standards: At least three exercises of a programme per session, at least once per week over at least six months.

Discussion

The present study analysed the implementation of injury prevention in amateur soccer based on three surveys (2004, 2008, and 2015) conducted with representative samples of Swiss amateur soccer coaches. Furthermore, the association between injury incidence and the implementation of prevention programmes was examined. The principal finding was that 22% of amateur soccer coaches implemented a prevention programme according to minimal standards, if they have learned it in the course of their coaches' education. Although various prevention programmes have been available for several years, the percentage of soccer coaches who have implemented a prevention programme did not differ between the 2008 and 2015 surveys. This result suggests that a wider range of programmes does not automatically lead to a higher willingness to implement them. Bogardus et al. [158] identified motivation, time and skill requirements, compliance, and costs as barriers to the implementation of anterior cruciate ligament injury prevention programmes. Consequently, further measures are needed to reduce such barriers and to convince coaches of the importance of consistent implementation of prevention programmes.

Nevertheless, 86% of coaches actually confirmed in the 2015 survey that including injury prevention in the training programme is important [28]. Several studies highlight coaches' high levels of compliance with injury prevention [103, 159]. It can be assumed that a coach influences the compliance of his players [103] which represents an important factor in the effectiveness of injury prevention programmes [102, 154, 159, 160]. Interestingly, coaches of 30+/40+ teams were less willing to implement preventive measures and prevention programmes than coaches of other teams. This finding is alarming, as research shows that the risk of injury increases with age [34].

In the 2015 survey, the most frequently mentioned preventive measures were warm-up, stretching, general strength training and core strength training. While warm-up and stretching were less frequently reported compared to the 2004 survey, the coaches more frequently mentioned general strength training and core strength training. We assume that warm-up is still implemented by (nearly) all coaches, but has become so established in everyday training that the coaches decreasingly associate this measure with prevention [118]. Even if there is no evidence for a preventive effect of stretching, this measure is often used by coaches and soccer players [161]. The fact that strength training (general and core) was more frequently mentioned as a preventive measure in the survey 2015 suggests a positive development. However, the results also indicate that coaches were less reminiscent of specific prevention programmes in 2015 than they were in 2008.

Based on the results of the present study no causal effects of prevention programmes on injury incidence can be deduced. We could show that teams which implemented 11/11+

according to minimal standards had a 38% lower training injury incidence than teams which did not implement a prevention programme. This result was even more pronounced than in 2008 [28] and well in line with the results of a meta-analysis by Thorborg et al. [92], who found that FIFA “11+” induced a reduction of soccer injuries by 39%. On the other hand, injury incidence during games did not differ between teams performing a prevention programme and teams not performing a programme. In the 2008 survey, the reduction by 12% of game injuries attributable to the implementation of “The 11” was rather low as well [28]. One possible explanation for this finding is that coaches of injury-prone teams are more likely to seriously implement a prevention programme. Another conclusion could be that performing a programme once a week may not be enough to cause substantial preventive effects with respect to game injuries [92, 95, 97]. Furthermore, the results of the present study indicate that regularly performing one-legged coordination and balance exercises may be more effective in preventing both training and game injuries than other exercises. Further research is needed in this respect.

The design of the present study is associated with some methodological weaknesses which were also discussed previously by Junge et al. [28]. A considerable limitation is that the injury data was collected by interviews with coaches, which might cause memory effects and reporting bias. Ekegren et al. [149] concluded that sports coaches are likely to underestimate injury rates. However, injury incidences calculated in the present study accorded well with previous research [18, 19, 22]. Additionally, implementing a prevention programme according to minimal standards required that a team had performed the programme for at least six months, at least once per week, and with at least 3 exercises per session. This lower limit was chosen to account for the fact that many low-level amateur soccer teams only train once per week. Setting the limit to an implementation of two or three times per week could have strengthened the association between injury incidence and the implementation of prevention programmes [92, 97], but would have disregarded real conditions and systematically eliminated many teams.

Perspective

The results of the present study have practical significance with regard to the development of preventive strategies in Swiss amateur soccer. It could be shown that Swiss amateur soccer coaches have a positive attitude towards injury prevention. However, the implementation rate of prevention programmes needs to be further optimised. Therefore, a main objective must be to systematically remove barriers that impede the implementation of prevention programmes, especially in teams of 30+/40+ leagues.

CHAPTER 8

DISCUSSION AND CONCLUSIONS

8.1 Outline of the PhD thesis

In Switzerland, 480,000 people from the 15- to 74-year-old population play soccer [49]. In combination with the high risk of injury during soccer play [18-22] this results in a high number of soccer-related accidents and a high psychosocial and economic burden for our society [53]. In addition, the costs incurred by soccer-related injuries have been constantly increasing in recent years [53]. Thus, appropriate preventive measures and effective prevention strategies are needed to counteract this development. To define effective prevention strategies, it is crucial to have appropriate knowledge about injury characteristics, causes, mechanisms and risk factors [72, 86-88]. Therefore, the overall aim of this thesis is to provide detailed information about injuries in Swiss non-professional soccer. Improved knowledge about soccer-related accidents will help to identify appropriate preventive measures and as a result to reduce accident rates in Swiss non-professional soccer.

Based on the background described in Chapter 1 and the aims of this thesis (Chapter 2), the second section of this chapter summarises the main results, which have been outlined in detail in Chapters 3 to 7. Subsequently, these results and their relevance for the prevention of soccer injuries in Switzerland are discussed in a broader context in the section “general discussion. Further, some methodological considerations and limitations are described, since the standards of peer reviewed articles often do not allow a full discussion of all potential limitations and methodological issues. Finally, the thesis ends with a short “conclusions and outlook” section.

8.2 Summary of the main results

8.2.1 Publication I (Suva study)

The aim of Publication I was to provide an overview of injury events in Swiss non-professional soccer. 30% of non-professional soccer injuries occurred during informal soccer play, such as playing with family and friends or in fun tournaments; 21% occurred during formal soccer training and 49% during formal soccer games. 29% of injuries affected the ankle and 25% the knee, but the knee injuries were associated with more severe injury. Additionally, the proportion of severe injuries was generally higher among older players and during games of the 30+/40+ leagues. 53% of injuries were caused by contact with an opponent, of which the most frequent injury mechanisms were tackling of an opponent and collision, while twisting and turning was the most common cause for non-contact injuries. Additionally, injury severity was associated with injury mechanisms such as twisting and

turning, and being tackled by an opponent. According to the respondents, about 30% of all injuries involved foul play. However, foul play was not associated with increased likelihood of reporting a severe injury.

8.2.2 Publication II (Suva study)

Publication II aimed at comparing injury events in different formal and informal non-professional soccer settings. The main finding was that key differences between non-professional soccer settings exist with regard to injury characteristics, causes and injury incidence. With 18.7 injuries per 1000 hours of exposure, the injury incidence amongst 30+/40+ league players was significantly higher than in all other leagues. In addition, this group showed notably little interest in preventive measures such as strength training. Only 47% performed core strength training and only 44% performed general strength training. In contrast, the 1st to 3rd amateur league players were more used to undertaking preventive measures (86% core and 83% general strength training). Further differences were found with respect to injury causes. Being tackled by an opponent and heading the ball or aerial duels were more frequent injury causes during formal games than during formal training or informal soccer. Additionally, a significantly higher proportion of contact (69%) and foul play (subjective appraisal: 41%) injuries was observed in formal games. During formal games, 27% of injuries were caused by foul play according to the referee's assessment. With respect to injury characteristics, injuries affecting the knee and the head were observed more frequently in formal games than in informal soccer.

8.2.3 Publication III (Suva study)

Publication III aimed at providing detailed information about the costs of injuries in non-professional soccer. An injury sustained in non-professional soccer led to average total costs of CHF 4741 (€ 4030), of which CHF 2459 (€ 2090) was associated with treatment and CHF 2282 (€ 1940) was associated with income replacement. Players aged 30 years and older accounted for 35% of injuries, but drew 49% of all costs. This was due to significantly higher income replacement costs compared to the younger age group. Injuries which happened during official amateur games accounted for a considerable proportion, namely 58%, of all costs. An injury of a 30+/40+ league player sustained during an official game led to average costs of CHF 9636 (€ 8190). Injuries affecting the knee were extremely cost-relevant. They caused average costs of CHF 10,180 (€ 8653) and accounted for 25% of all injuries and for 53% of all costs. Non-contact injuries were responsible for 56% of all costs. However, injuries caused by contact with an opponent and foul play injuries were not associated with above-average injury costs. Nevertheless, foul play injuries caused 26% of all costs. Concerning

specific injury situations, twisting and turning injuries were associated with high average costs of CHF 9070 (€ 7710). Taken together, collisions, twisting and turning, and being tackled by an opponent accounted for 49% of all costs.

8.2.4 Publication IV (coaches study)

The aim of Publication IV was to show how injury incidences in Swiss amateur soccer changed over the years 2004, 2008 and 2015 with respect to leagues, injury causes and injury characteristics. Training injury incidence increased by 21% between 2004 and 2015 and game injury incidence decreased by 12% from 2004 to 2008, although it then increased by 24% from 2008 to 2015. Compared to 2004, injury incidence during training and during games was higher in each league but the differences were not statistically significant. Between 2008 and 2015 injury incidence increased significantly for 14- to 15-year-old males (game and training), for 16- to 20-year-old males (training), and for 30+/40+ league players (games). Injury incidences amongst 30+/40+ league players were extremely high during games in the 2015 survey (24.2 injuries per 1000 hours of play). During games the incidence of contact injuries significantly increased by 19% between 2004 and 2015 and the incidence of foul play injuries significantly increased by 25% between 2008 and 2015, while during training the incidence of non-contact injuries increased by 22% from 2004 to 2015. Additionally, the incidence of injuries requiring medical attention increased during both training and games. More injuries affecting the knee (38%) and the upper limb (83%) as well as more sprains (28%) and bone fractures (80%) were observed during games in 2015 compared to 2004.

8.2.5 Publication V (coaches study)

Publication V aimed at assessing the implementation of injury prevention in Swiss amateur soccer and examining the association between the implementation of prevention programmes and the injury incidence in soccer teams. 86% of coaches stated that injury prevention is important and 85% of coaches implemented preventive measures. The most commonly implemented measures were warm-up, stretching, general strength training, and core strength training. While the prevention programmes “The 11” and “11+” were less frequently mentioned by unprompted questioning in 2015 compared to 2008, general strength training and core strength training were mentioned more often. 22% of amateur soccer coaches were willing to implement a prevention programme according to minimal standards. This percentage did not change between 2008 and 2015, even though an additional prevention programme was available in 2015. Coaches of 30+/40+ league teams (9%) and coaches of 4th and 5th league teams (17%) implemented a prevention programme

less frequently, while coaches of 2nd and 3rd league teams (32%) and coaches of female teams (32%) were more used to implementing a prevention programme. The implementation of “The 11” or “11+” according to minimal standards was associated with a 38% lower injury incidence during training. No association was found between the implementation of prevention programmes and the injury incidence during games. However, teams which regularly performed one-legged coordination and balance exercises had an 18% lower game injury incidence and a 29% lower training injury incidence.

8.3 Overall discussion

Since the results of the publications have already been discussed in detail in the corresponding chapters, the following sections concentrate on a comprehensive and more in-depth discussion of the main findings. A further intention is to address the results with regard to their relevance for injury prevention in Swiss non-professional soccer.

8.3.1 Injuries in different non-professional soccer settings

Our data showed the existence of key differences between non-professional soccer settings with regard to injury characteristics, causes and incidence. It can thus be assumed that a more context-specific approach to injury prevention may have positive effects [87, 95]. A focus on the distinctions between the main settings of play (formal training, formal games, informal soccer) in the Suva study revealed that, at 70%, a majority of soccer accidents occurred during formal soccer. Thus, preventive strategies aimed at amateur soccer clubs and their players should be given highest priority in Switzerland [22, 30, 64].

A strong focus should be put on preventing injuries during amateur games because this setting is responsible for 49% of injuries and 58% of injury costs. Additionally, injury incidence was several times higher during games compared to training [18, 19, 21, 23-27, 29-32, 64] and game injury incidence significantly increased between 2008 and 2015. Overall, this situation seems to have been recognised because policy makers and the relevant authorities have been investing in the prevention of injuries in Swiss amateur soccer for several years [28, 110, 111, 113]. Nevertheless, it cannot be ignored that 30% of accidents happened during informal play (of which 83% of the affected persons were not members of a soccer club), which justifies including preventive measures in informal soccer settings as well [35]. In recent years, Suva has been active in this regard and has developed an entertaining online test to determine the risk of injury which is accessible to the general

public [115]. Furthermore, injury prevention at fun tournaments is supported by Suva [115]. Thus, the field of informal soccer is becoming well covered.

In the course of the analyses in both the Suva study and the coaches study, we found indications that 30+/40+ league players should be a central target group for injury prevention [64, 95]. First, their overall injury incidence was extremely high compared to other leagues [64]. This could be attributed to the fact that the ratio of training to game play is lower than in other leagues [19, 78]. However, this argument is not convincing since both training injury incidence and game injury incidence were much higher than in other leagues. Second, game injury incidence amongst 30+/40+ league players significantly increased between 2008 and 2015. Third, the proportion of severe injuries was substantially higher during games in the 30+/40+ leagues as compared to other leagues and the injuries of 30+/40+ league players led to extremely high costs. Finally, our results suggested that 30+/40+ league players less frequently perform preventive exercises such as strength training and less frequently implement prevention programmes. Taken together, these findings are alarming. Obviously, barriers exist which hinder the implementation of preventive measures. Possible reasons for this could be structural problems like the low frequency of training sessions [95] or the lack of a (well-educated) coach [28]. It is indisputable that coach education plays an important role in implementing a prevention programme and in delivering preventive exercises to soccer teams and players [154, 156]. Moreover, it is also conceivable that 30+/40+ league teams wish to use the little training time they have at their disposal in a more attractive manner or that they do not feel addressed by the available prevention programmes. Since attractiveness to the target population is an important point in the development of prevention strategies, adjustments in the programmes could be useful [87]. For example, a do-it-yourself segment could be offered to 30+/40+ league players [95]. However, future research is needed to investigate the attitudes and motivations of these players in order to improve preventive strategies. Furthermore, additional measures such as rule adjustments [79, 116, 147] and the promotion of appropriate forms of play should be considered in this setting. Another reason why injury prevention amongst 30+/40+ league players should be an important concern for the future is that this segment has shown continuous growth in recent years [51]. Between 2004 and 2018, the number of 30+/40+ league players increased by 41% and they currently account for 51% of all male adult amateur players. Due to an ongoing sports boom in all age categories [49], further growth in 30+/40+ league sector can be expected in the next few years.

8.3.2 Changes in injury incidence and prevention in Swiss amateur soccer

According to the coaches study, the incidence of game injuries significantly decreased between 2004 and 2008. A possible explanation for this shift might be the systematic implementation of the prevention programme “The 11” [28], although other factors could also have influenced this change. However, injury incidence during games rose again significantly between 2008 and 2015 and injury incidence during training also increased during this timeframe. This is not in line with the finding that the proportion of coaches who considered preventive measures in their training plans remained similar and the proportion of coaches implementing a prevention programme according to minimal standards was exactly the same in 2008 and 2015. Additional factors must have affected injury incidence in amateur soccer during this period. One explanation could be that the programmes “The 11” and “11+” were implemented less frequently while the prevention programme “Sport Basics” was also used instead. Another explanation could be that soccer at amateur level has increased in intensity. There is some evidence in our data that this might be the case. First, the incidence of contact injuries during games and of non-contact injuries during training significantly increased between 2004 and 2015. Second, during training and during games a higher incidence of injuries requiring medical attention was observed in 2015 as compared to 2004. This finding is also confirmed by the Swiss Accident Insurance Database of the working population (see Figure 1.3) [53]. Finally, the changes reported in Publication IV with respect to injury characteristics, such as an increased incidence of bone fractures and sprains as well as knee and upper limb injuries, also indicate that in amateur soccer there were greater forces of impact and higher speeds involved in 2015. A similar trend was observed at top tournaments in women’s soccer, in which contact game injuries increased significantly between 2003 and 2011 [147]. As a consequence, injury incidence with an emphasis on injury causes and characteristics should be further monitored in Swiss amateur soccer in the future. Additionally, amateur players must be prepared and trained to meet the demands of a more intense and more physical game. This could be achieved, for example, through the consistent implementation of prevention programmes [86].

In the coaches study, we were able to research the implementation of injury prevention in a real-world context, which is not possible in randomised controlled trials. We found that Swiss amateur soccer coaches are generally willing to include preventive measures in their normal training plans. This is an extremely positive finding because the compliance of coaches and players is fundamental to the successful implementation of preventive measures [86, 96, 102, 103, 162, 163]. However, despite a positive attitude towards injury prevention in general and even though the positive effect of various prevention programmes has been proven [86, 90, 92, 150-155], only 22% of coaches implemented an existing prevention programme according to minimal standards. This proportion has remained constant since 2008 and was

not increased by the availability of an additional prevention programme. In a recent survey of German amateur soccer coaches, 31% of coaches reported that they implemented “11+” at least once per week [164]. This is a considerably higher proportion than in our coaches study, which found that 16% of Swiss amateur coaches implemented “The 11” or “11+” according to minimal standards. Consequently, there are some barriers, such as time and skill requirements or motivation and compliance [158], that prevent Swiss amateur soccer coaches and teams from using the existing prevention programmes. Prevention programmes cannot prevent injuries unless they are accepted and implemented in an appropriate manner by coaches and their teams [86]. The most recent implementation research demonstrates that a strategic evidence-based approach to implementing sports injury prevention interventions would help maximise their impact in a real-world context [157, 165]. In addition to improved implementation strategies [164], we also see a need to better understand the challenges and situations of coaches and teams in order to adapt and optimise existing prevention programmes to their needs.

Finally, associations between the implementation of prevention programmes and injury incidence need to be discussed. However, it must be stated that, based on the results of the coaches study, no direct causal effects of prevention programmes and preventive exercises on injury incidence can be deduced.

In 2015, teams utilising the prevention programme “The 11” or “11+” according to minimal standards had a 38% lower training injury incidence as compared to teams not utilising a prevention programme. It is plausible that the implementation of a prevention programme during training has led to a reduction of injury incidence, since during the performance of the exercises no injuries happen. Assuming that performing a prevention programme takes 13.7 minutes per training (see Publication V) and that a training session lasts 91 minutes (see Publication IV), this would correspond to an automatic reduction of injuries of about 15%. However, this extrapolation does not explain the entire difference in the training injury incidence between teams performing “The 11” or “11+” and teams not performing a prevention programme.

Game injury incidence did not differ between teams utilising any prevention programme and teams not implementing a programme, even though the positive effect of “11+” is well documented by research [89, 90, 92]. Two explanations come to mind, aside from the fact that the effect of “The 11” is scientifically disputed [28, 89, 92, 96, 97] and “Sport Basics” has not been evaluated in a randomised controlled trial or intervention study. On the one hand, it can be assumed that the repeated occurrence of injuries during games leads coaches to incorporate a prevention programme into the training and to take it seriously. Thus, coaches of injury-prone teams are possibly more likely to implement a prevention programme. On the other hand, a stricter definition of "minimal standards" might have produced stronger

indications of a relationship between prevention programmes and injury reduction, since there is evidence that the more frequently and the longer a prevention programme is performed, the greater is its effect [101, 153, 154, 166]. In the coaches study the implementation of a programme according to minimal standards was defined as consisting of at least three exercises from a programme per session, at least once per week over at least six months. It can be assumed that raising the minimal standards to the performance of a prevention programme to two or three times per week or to at least five exercises from a programme could have strengthened the association between injury incidence and the utilisation of prevention programmes [92]. However, this would have required disregarding real conditions, since teams that practiced only once a week would have been systematically eliminated.

8.3.3 Knee injuries are of high relevance in non-professional soccer

A severe knee injury can have serious consequences for any athlete regardless of the level of competition. Our findings confirm, as does previous research, that knee injuries are an important aspect of amateur soccer [22, 24, 36, 64-66, 68]. Knee injuries accounted for 25% of all injures in Swiss non-professional soccer, were classified as severe more frequently than injuries to other regions of the body, and were responsible for 53% of all costs. The high significance of knee injuries in terms of severity and costs is also confirmed by other studies [20, 22, 56]. In an investigation focussing on Dutch male amateur players, knee injuries had the most serious consequences as measured by the days of absence from soccer play [22] and a Belgian study found that anterior cruciate ligament injuries and other knee injuries accounted for the highest medical costs in Flemish sports federations [56].

In addition, we were able to show a worrying trend in the incidence of knee injuries during amateur soccer games, which increased by 38% between 2004 and 2015. Generally, more knee injuries occurred during formal games than during informal play. This finding could be related to the higher speed of formal play and the correspondingly quick changes of direction [57]. Furthermore, knee injuries often occur without contact with an opponent [68, 85]. This fact should be taken into account when developing preventive strategies and argues in favour of continuing the implementation of neuromuscular and proprioceptive prevention programmes.

Knee injuries can be reduced by appropriate modifications to training [167-171]. Donnel-Fink et al. [168] found in their meta-analysis that neuromuscular and proprioceptive prevention programmes were able to reduce knee injuries by 27% and anterior cruciate ligament injuries by 51% in various sports. According to Mehl et al. [167], a prevention programme which aims to successfully reduce knee injuries should take five aspects into consideration: Information

about injury mechanisms, jumping exercises (muscle strengthening and correction of movement patterns), balance training, strength training, and running/flexibility exercises. They recommended combining these aspects with sport-specific exercises and integrating the whole into the warm-up in order to improve compliance. Both the prevention programme "11+" and the prevention programme "Sport Basics" conform to most of these specifications.

Another important key point is the information on knee injuries mentioned above. Previous research found that substantial knowledge gaps exist in the female youth soccer community with respect to injury risk factors, prevention strategies and in particular knee injury prevention [127, 172]. There may be similar knowledge gaps in all non-professional soccer settings, since limited injury awareness was observed among amateur athletes and coaches in other sports [173-175]. In sum, it is important to make athletes and coaches aware of knee injuries, their causes and their serious consequences [22, 125, 127, 167, 172], and to convince them to take the implementation of prevention programmes seriously.

8.3.4 Injury mechanisms related to contact and non-contact situations

The findings of this thesis enable a better understanding of injury causes and of the situations leading to injuries in non-professional soccer; such knowledge is needed to improve injury prevention [72]. A soccer-related injury can occur with or without contact with an opponent. Our results indicate that both contact and non-contact causes of injury must be considered when it comes to the prevention of non-professional soccer injuries [22, 30, 68, 69]. While contact causes of injury such as player contact and foul play have been considered by various studies of amateur soccer [20, 21, 24, 28, 64-69, 71, 151, 153, 155], more detailed information about the situations leading to an injury were provided in only a few studies [20, 22, 71]. Furthermore, information about the association between injury situations and the severity of injury is missing. In conclusion, future research is needed to investigate injury mechanisms in different amateur soccer settings in a more precise way.

In the Suva study, we found that more than half of all injuries in non-professional soccer were caused by contact with an opponent [30, 66]. The proportion of injuries caused by contact with an opponent (69%) and by foul play reported by the player (41%) was significantly higher in competitive situations than during training [21, 24, 30, 69] and informal soccer. Additionally, 27% of injuries were caused by foul play, according to the referee's assessment at the time [30]. In contrast, the coaches study showed that game injuries caused by contact with an opponent only accounted for one third and foul play injuries for one fifth of all injuries. We assume that coaches perceive the situation differently because they are less close to the injury event than the player and the referee. Nonetheless, alarming changes over time were noted. The incidence of contact and foul play injuries has increased in recent years [147]. A

further issue is that our detailed analysis of contact injury events showed that being tackled by an opponent was a frequent cause of injury [71] and that it was associated with injury severity, while the majority of other contact situations, such as collisions, heading the ball and aerial duels, were not. However, foul play also was not associated with a higher likelihood of reporting a severe injury.

Nevertheless, the above-mentioned findings call for increased measures to support fair play in order to reduce borderline tackles and fouls [30, 68, 79]. There is evidence, however, that fair play education in soccer has had little effect [129]. Consequently, a greater effort would be needed in order to motivate players, coaches, referees and club officials to instantiate a cooperative and fair game. A reduction of the number of contact injuries in general and of injuries caused by tackles (irrespective of foul play) in particular might also be realised by implementing stricter rule enforcement by the referees or by changing the rules [22, 24, 79, 81]. In amateur leagues in particular fun and physical health should be the highest priority.

The Suva study also showed that non-contact injuries happened more frequently during formal training [24, 69] and during informal soccer, and were associated with higher average costs than contact injuries. A special focus should be placed on the prevention of injuries caused by twisting and turning [22], since these injuries were associated with high average costs and with a higher likelihood of reporting a severe injury. Research also confirms that in women's soccer non-contact injuries are more likely to be severe than contact injuries [20, 69]. In order to reduce injuries caused by twisting and turning, the implementation of appropriate prevention programmes is again recommended [22, 28, 86, 92, 155].

8.4 Limitations and methodological considerations

To our knowledge, this PhD thesis is the first study to examine non-professional soccer injuries in such a comprehensive framework. With the data provided by Suva and the statements from representative samples of Swiss amateur soccer coaches from the years 2004, 2008 and 2015, a unique and broad database was at our disposal. In order to collect the most detailed and comprehensive information on injury events in Swiss non-professional soccer, a compromise was made by choosing a retrospective study design, as otherwise it would not have been possible to examine such large cohorts. The disadvantages of the retrospective study design were taken into account and various measures were developed to optimise the data. Overall, we believe that these two datasets deliver valuable information to improve injury prevention in Swiss non-professional soccer.

Since various limitations of the two studies have already been discussed in Chapters 3 to 7, the following section only includes the most important limitations that concern the overall approach of this thesis and affect our ability to generalise the results.

8.4.1 The Suva study

In the Suva study, persons who were injured while playing soccer and who reported this accident to Suva were retrospectively interviewed. Therefore, first of all, recall bias must be considered. Research confirms that retrospective reporting of injuries is associated with a memory effect, which suggests advantages to a prospective study design for epidemiological studies of soccer injuries [120, 134, 176]. However, Junge and Dvorak [134] also concluded that retrospective data collection appears to be valid enough to record injury type and injury causes. They were able to show that injuries were more frequently forgotten if the period of symptoms was short or if the accident occurrence was further in the past. These two points need to be discussed in more detail. Injuries reported to Suva, by definition, required medical attention and caused corresponding costs. Since the person concerned consulted a physician, we assume that it was not trivial. This in turn increases the probability that this person remembers the injury. Nevertheless, the interviews were conducted on average six moths after the injury, which is in fact a long period. On the one hand, this is due to the fact that it takes some time before an injury is reported to and registered by Suva. On the other hand, it was a major concern of the research design to draw a random sample of injuries from a full year. Since this would have resulted in extremely long periods between injury and interview, we decided to draw an initial random sample after the first half-year and a second random sample after the second half-year. In addition, further measures were taken in order to reduce recall bias. The respondents were asked about a specific soccer accident and the date of the accident was mentioned at the beginning of the interview. Furthermore, extensive data screening was carried out by comparing the information about injury location, type and cause provided during the interview with the official Suva records. 111 people with non-corresponding information were excluded from the analyses (see Figure 3.1), since they had not reported about the randomly selected injury. If the Suva study was repeated, measures would have to be taken to reduce this number of excluded cases.

Second, in the Suva study only injuries requiring medical attention amongst the working population were recorded. Consequently, a higher percentage of moderate and severe injuries was included in the analysis and the percentage of mild injuries was underestimated as compared to other studies focusing on amateur soccer [19-22, 30, 64, 68, 151]. Nonetheless, ultimately only those injuries requiring medical attention are associated with serious consequences for the players and with a high economic burden for society.

Third, exposure time and the number of injuries in the past year were also recorded during the Suva study interviews in order to calculate injury incidences. In this regard, one could assume that the "real" injury incidence was substantially underestimated [134]. Unexpectedly, the overall injury incidence of amateur players in the Suva study was 10.7 per 1000 hours of soccer participation, which corresponded surprisingly well with previous research on amateur soccer [18-22]. The fact that we interviewed only those people who had suffered at least one injury during the past year may have prevented an underestimation of injury incidence. In sum, injury incidences in the Suva study should be interpreted with caution.

Overall, we believe that the information on injury characteristics, causes and costs in the Suva study is valid, provided that the focus on injuries requiring medical attention is taken into consideration. For injury incidences at large, generalisability is limited. Nevertheless, the differences in injury incidences amongst the various amateur leagues should be taken seriously.

8.4.2 The coaches study

The effectiveness of prevention programmes and preventive strategies in a real-world context has been examined very rarely, since these studies are very difficult to carry out [116]. Thanks to the coaches study, an instrument is available to record changes in the injury incidence related to amateur soccer and to observe the implementation of preventive measures in Switzerland. However, the use of coaches as a source of information is associated with certain limitations.

It can be expected that coaches are likely to underestimate injury rates [149]. We were conscious of this fact when we developed the questionnaire. As a consequence, the coaches were not simply asked to report all injuries in the previous four weeks; rather the questioning technique was much more complex [28]. The coaches were instructed to remember the last game as well as the opposing team. Further, they had to report the number of injuries which affected their players during this specific game. For all injuries mentioned, the coaches had to provide detailed information about body region, type, contact, foul play, severity, and medical attention. For all games that took place during the four weeks before the interview this procedure was repeated. Detailed analyses pointed out that there was a moderate memory effect (decreasing number of injuries with increasing number of games). Therefore, only the previous five games were taken into consideration to calculate injury incidence. With respect to training injuries, not every training session was surveyed separately, since training injuries occur less frequently [22]. Taking into account that injury incidences in the coaches study corresponded well with previous research [18, 19, 24, 26, 28] and that all effects of the

survey method were similar in 2004, 2008 and 2015, we come to the conclusion that with respect to injury incidence the differences between leagues and the changes over time, which were determined in our study, should be regarded as significant. We assume that the injury situation in Swiss amateur soccer is well projected.

Additionally, it could be claimed that coach interviews have a large information bias and that information quality is not precise enough to allow for major conclusions. This limitation primarily concerns the detailed information on the individual injury such as injury severity as well as injury type. However, to judge the implementation of preventative measures, the coach is a very valuable and reliable source. Moreover, the prevention programmes “The 11” and “11+” were surveyed together, since we had to assume that the coaches did not know the exact difference. Thus, no statements can be made with respect to the individual programmes.

A further limitation is that, with respect to the association between the implementation of prevention programmes and injury incidence, it is not possible to draw causal relationships because the coach decides on the implementation of preventive measures for each team. For example, many injuries in the team can motivate a coach to become more involved in injury prevention. It would thus be possible that teams with a high risk of injury use preventive measures whereas teams with a low risk do not. In contrast, Junge et al. [28] were able to draw causal conclusions, as in the 2008 survey a panel was available. However, because the panel mortality was relatively high (many coaches had changed the team) and a team after a few years no longer consists of the same players (especially in the area of youth sports), it was impossible to maintain the panel in the 2015 survey.

In conclusion, the findings regarding the changes in injury incidences over time and the implementation of preventive measures and prevention programmes provide important information for improving injury prevention strategies in Swiss amateur soccer.

8.5 Conclusions and outlook

The fact that soccer accidents are a major problem does not need repeating at this point. This PhD thesis draws a highly differentiated picture of injuries in non-professional soccer in Switzerland. We have been able to show in which settings and situations injuries occurred and who was affected by these injuries. Furthermore, we have identified which injuries occurred more frequently, which had serious consequences, and which caused high costs. How injury incidence and the implementation of preventive measures have changed in recent

years has also been described in detail. This information will be useful in providing a basis for the further development and improvement of injury prevention in Swiss non-professional soccer. Even if there is no ideal solution which will fully prevent injury in non-professional soccer, we want to make evidence-based suggestions to show where prevention can start.

The results of this PhD thesis suggest that in Swiss amateur soccer great emphasis should be placed on the future implementation of exercise-based injury prevention. Swiss amateur soccer coaches are generally willing to take measures regarding injury prevention and their education includes discussion of such measures. Nevertheless, the proportion of coaches who implement an injury prevention programme according to minimal standards is not satisfactory, and offering an additional prevention programme did not lead to a higher willingness to implement such programmes. Accordingly, new approaches rather than additional prevention programmes are needed in order to optimise the implementation rate. These approaches should aim to adapt the existing prevention programmes to individual risk groups (such as 30+/40+ league players) and their needs. In addition to increased efforts in the education of coaches, awareness-raising work amongst amateur soccer players with respect to severe injuries and their serious consequences should be strengthened.

We found that a high percentage of game injuries were caused by contact with an opponent and that at least one in four game injuries involved foul play. Additionally, being tackled by an opponent was the only contact situation which was associated with a higher likelihood of reporting a severe injury. In particular, the increase over recent years with respect to the incidence of contact and foul play injuries during games indicates that there is a need for action in this area. Moreover, the question arises, why in every amateur soccer league the injury incidence during game play is not closer to injury incidence in training, since fun, exercise and health should be at the heart of this activity. Based on these findings we propose two measures. On the one hand, a strict application of the rules of the game is indispensable and referees should be made aware of their influence on the risk of injury. Furthermore, rule changes (e.g. restricting duels, prohibiting sliding tackles) should be considered in amateur soccer. On the other hand, more weight should be given to fair play in amateur soccer and new, less competitive ways of playing (e.g., no reporting of results, random team selection, dispensing with a referee) should be offered and promoted in specific subgroups.

Various aspects which were addressed in the course of this PhD thesis need further investigation in order to reduce injuries in Swiss non-professional soccer. First, we have been able to show that considerable differences exist between various non-professional soccer settings with respect to injury incidence, injury cause, injury characteristics, and the implementation of preventive measures. Nonetheless, more research is needed regarding

particular non-professional soccer populations and different skill levels. Second, it will be important to analyse the needs of individual groups of players and coaches with regard to injury prevention programmes. A special focus should be put on players and coaches of 30+/40+ league teams. Knowledge about their needs and perceptions could be fundamental to adapting prevention programmes optimally and thus increasing the willingness to implement them. Third, the development of injury incidence and of the implementation of injury prevention should be further monitored. This requires data collection at regular intervals. We therefore recommend carrying out the coaches study again in a few years, as the ability to spot trends enables the early initiation of appropriate measures. Finally, a further step would be to examine how rule adjustments, stricter rule enforcement by referees, and adapted forms of play influence the incidence of injury. Well-proven approaches should be promoted further.

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APPENDIX A: CONTRIBUTION TO THE PHD THESIS

PhD student: Angela Gebert (AG)

Contributors: Markus Lamprecht (ML), Hanspeter Stamm (HS), Philippe Gassmann (PG), Astrid Junge (AJ), Flora Colledge (FC), Rahel Bürgi (RB)
Link Institute (Link), Swiss Football Association (SFV)

Process	Execution	Support
Suva study		
Planning of the study	**AG**, ML	
Overall study coordination	**AG**	
Systematic literature review	**AG**	
Creation of the questionnaire	**AG**	ML
Pre-testing, evaluation, improvement of the questionnaire	**AG**	master student
Preparation of information letters	PG	**AG**
Sampling procedure and making contact	PG	**AG**
Interviewer training, quality control	**AG**	
Evaluation of the second pre-test	**AG**	
Conducting the survey	Link	**AG**
Data cleansing and data control	**AG**	
Detailed comparison between every injury reported in the survey with the Suva record	**AG**	
Classification of injury situation of every injury reported	**AG**	RB
Data analysis	**AG**	
Writing a detailed report for Suva	**AG**	
Presentation of the results	**AG**	
Writing of two publications as first author	**AG**	
Proofreading of publications	FC, co-authors	
Preparation of injury costs	PG	**AG**

Matching of datasets (survey and injury costs)	**AG**	
Data cleansing and data control	**AG**	
Data analysis	**AG**	
Writing a short report for Suva	**AG**	
Writing one publication as first author	**AG**	
Proofreading of the publication	FC, co-authors	

coaches study		
Planning of the study	**AG,** ML	
Overall study coordination	**AG**	
Creation of the questionnaire (in 2004)	AJ, ML	
Adaption of the questionnaire	**AG**	
Adaption of information letters	**AG**	
Sampling procedure and making contact	**AG,** SFV	ML
Interviewer training, quality control	**AG**	
Conducting the survey	Link	**AG**
Preparing of the dataset identical to 2004 and 2008	**AG,** HS	
Data cleansing and data control	**AG**	
Matching datasets of 2004, 2008, 2015	**AG**	
Data analysis 2004, 2008, and 2015	**AG**	
Writing a detailed report for Suva	**AG**	
Presentation of the results	**AG**	
Writing of two publications as first author	**AG**	
Proofreading of publications	FC, co-authors	

APPENDIX B: QUESTIONNAIRE SUVA STUDY

The questionnaire was optimised so that the questions could be asked in Swiss German.

The French version of the questionnaire is available on request.

	Fragen
	Grüezi, mein Name ist ... vom Forschungsinstitut LINK. Im Auftrag der SUVA führen wir eine breit angelegte, wissenschaftliche Umfrage zum Verletzungsgeschehen beim Fussballspielen durch. Sie haben sich schriftlich oder mündlich dazu bereit erklärt, zu Ihrer kürzlich erlittenen Verletzung Auskunft zu geben.
	Im Interview geht es jetzt nur um den Unfall, wo sie am TT.MM.JJJJ beim Fussballspielen gehabt haben. (*das Unfalldatum wird von der Suva zur Verfügung gestellt*)
A1	Welches ist Ihr Geburtsjahr? *(Geburtsjahr: JJJJ)*
A2	Wie gut können Sie sich an den Unfall erinnern? *(Int: vorlesen)* sehr gut — weiter bei B1 gut — weiter bei B1 mittel — weiter bei B1 schlecht — weiter bei A3 sehr schlecht — weiter bei A3 weiss nicht/keine Angabe
A3	Auch wenn Sie sich nicht mehr sehr gut daran erinnern können, werde ich Ihnen jetzt ein paar Fragen zu Ihrem Unfall stellen. Falls Sie etwas nicht mehr wissen, können Sie mit "weiss nicht" antworten.
	Verletzungscharakteristiken
B1	An welchem Körperteil haben Sie sich verletzt? *(Int.: nicht vorlesen – beim Zuordnen helfen. Bei mehreren verletzen Körperteilen nur die schwerste Verletzung angeben und darauf hinweisen, dass in Zukunft nur von dieser gesprochen wird)* Kopf/Gesicht, Zähne — weiter bei Frage B3 Nacken, Halswirbelsäule — weiter bei Frage B3 Brustbein, Rippen, oberer Rücken — weiter bei Frage B3 Unterleib, Bauch — weiter bei Frage B3 unterer Rücken, Kreuzbein, Becken — weiter bei Frage B3 Schulter, Schlüsselbein — weiter bei Frage B2 Oberarm, Ellenbogen, Unterarm — weiter bei Frage B2 Handgelenk — weiter bei Frage B2 Hand, Finger, Daumen — weiter bei Frage B2 Hüfte, Leiste — weiter bei Frage B2 Oberschenkel — weiter bei Frage B2 Knie, Kniescheibe — weiter bei Frage B2 Unterschenkel, Achillessehne — weiter bei Frage B2 Fussgelenk — weiter bei Frage B2 Fuss, Zehen — weiter bei Frage B2

B2	Auf welcher Körperseite war die Verletzung? rechts links weiss nicht / keine Angabe
B3	Was war das für eine Verletzung? *(Int.: nicht vorlesen – beim Zuordnen helfen, Mehrfachantworten möglich)* Hirnerschütterung mit oder ohne Verlust des Bewusstseins Knochenbruch andere Knochenverletzung Verrenkung, Luxation Verstauchung, Bandverletzung Meniskusläsion oder Knorpelschaden Muskelfaserriss, Zerrung, Krämpfe Sehnenverletzung, Sehnenriss, Sehnenscheidenentzündung, Schleimbeutelentzündung Bluterguss, Hämatom, Prellung, Quetschung Schürfwunde, Risswunde, Schnittwunde Nervenverletzung Zahnverletzung anderes
B4	*(Frage nur stellen wenn: B1=Knie und B3=Verstauchung, Bandverletzung)* Hat es sich um einen Kreuzbandriss gehandelt? ja nein weiss nicht / keine Angabe
B5	Wie lange haben Sie nach der Verletzung nicht mehr so trainieren und Sport treiben können wie vorher? *(Int.: nicht vorlesen – beim Zuordnen helfen. Falls jemand noch immer verletzt ist, soll dieser Aufgrund des Arztbescheids eine Annahme treffen. Bei Nachfrage: Zeitrechnung ab dem Zeitpunkt der Verletzung und nicht ab OP)* weniger als 7 Tage 1-2 Wochen 3-4 Wochen 1-2 Monate 3-4 Monate 5-6 Monate über 6 Monate nie mehr weiss nicht / keine Angabe
B6	Wie sehr sind Sie mit dem allgemeinen Heilungsverlauf Ihrer Verletzung zufrieden? *(Int.: nicht vorlesen – beim Zuordnen helfen)* sehr zufrieden zufrieden teilweise zufrieden unzufrieden völlig unzufrieden weiss nicht / keine Angabe
B7	Wie gut haben Sie sich bei der Heilung durch den Arzt und/oder Physiotherapeuten betreut gefühlt? *(Int.: nicht vorlesen – beim Zuordnen helfen)* sehr gut gut genügend ungenügend schlecht

B8	Bitte beantworten Sie die folgenden Fragen zum Heilungsverlauf mit ja oder nein! a) Sind Sie mehrmals beim Arzt gewesen? b) Haben Sie Physiotherapie gehabt? c) Haben Sie eine Operation gehabt? ja = weiter bei B8d1 und B8e, nein = weiter bei B8d2 und B8e d1) Hat es Komplikationen gegeben? d2) Ist eine Operation geplant? e) Haben Sie schon einmal eine ähnliche Verletzung auf der gleichen Seite gehabt? ja = weiter bei B9, nein = weiter bei C1 ja nein weiss nicht / keine Angabe
B9	Wie viele Monate vor der aktuellen Verletzung ist das gewesen? *(Int.: nicht vorlesen – beim Zuordnen helfen)* in den 2 Monaten vor der Verletzung 3 bis 12 Monate vor der Verletzung über 12 Monate vor der Verletzung weiss nicht / keine Angabe
	Verletzungsursache
C1	Bei welchem Anlass ist es zu dieser Verletzung gekommen? *(Int.: nicht vorlesen – beim Zuordnen helfen)* im Fussballverein während dem Spiel — weiter bei C4 im Fussballverein während dem Training — weiter bei C4 in einem anderen Verein, Sportverein (z.B. Turnverein) — weiter bei C3 in der Freizeit mit Freunden/Familie — weiter bei C3 in einer Alternativliga (z.B. Firmenfussball — weiter bei C3 an einem Grümpel- oder Plauschturnier — weiter bei C2 im Schulsport — weiter bei C3 anderes — weiter bei C3 weiss nicht / keine Angabe
C2	In welcher Kategorie haben Sie teilgenommen? *(Int.: nicht vorlesen – beim Zuordnen helfen)* Fussballer Nichtfussballer (Fun) Mixed Damen Firmen und Vereine anderes weiss nicht / keine Angabe
C3	Haben sie zum Zeitpunkt der Verletzung auch in einem Verein Fussball gespielt? ja — weiter bei C4 nein — weiter bei C5 weiss nicht / keine Angabe
C4	In welcher Liga hat Ihr Team zum Zeitpunkt der Verletzung gespielt? *(Int.: nicht vorlesen – beim Zuordnen helfen)* Herren: Super und Challenge League 1. Liga (Promotion oder Classic) 2. Liga interregional 2. Liga regional 3. Liga 4. Liga 5. Liga Senioren Veteranen

	Junioren A Junioren U18 Junioren B Junioren U16 Frauen: NLA NLB 1. Liga 2. Liga 3. Liga 4. Liga Seniorinnen Juniorinnen U23 Juniorinnen A Juniorinnen U18 Juniorinnen B Juniorinnen U16 anderes weiss nicht / keine Angabe
C5a	Ist die Verletzung durch einen Gegenspieler verursacht worden? ja weiter bei C6 nein weiter bei C5b weiss nicht / keine Angabe
C5b	Ist ein Zusammenprall mit einem Mitspieler oder etwas Anderem die Verletzungsursache gewesen oder sind Sie von einem Ball getroffen worden? *(Int.: nicht vorlesen – beim Zuordnen helfen. Keine Mehrfachantwort möglich, wenn ein Gegenspieler Auslöser der Situation war, bitte dieser Kategorie Priorität geben.)* mit einem Mitspieler weiter bei C6 mit einem anderen Objekt (z.B. Torpfosten, Hallenwand) weiter bei C6 und C10 von Ball getroffen weiter bei C6 und C10 andere Ursache (z.B. selbst verschuldet) weiter bei C6 und C10 weiss nicht / keine Angabe
C6	Beschreiben Sie mir bitte kurz, in welcher Situation bzw. bei welcher Bewegung es zu ihrer Verletzung gekommen ist? *(Int.: in Stichworten erfassen. Bei Unklarheiten nachfragen. Wenn die Antwort eine der folgenden Aussagen enthält: „gestrecktes Bein“, beidbeinig“, „zweibeinig“, „reinrutschen“, „grätschen“, „tackling“, „sliding tackling“, dann bitte erfassen aus welcher Richtung der Angriff des Gegenspielers kam – von vorne – von der Seite – von hinten)* *(Stichworte)* *weiss nicht / keine Angabe*
C7	Handelte es sich Ihrer Meinung nach um ein Foulspiel des Gegenspielers? *(Int.: nicht vorlesen – beim Zuordnen helfen)* ja, sicher weiter bei C8 eher ja weiter bei C8 eher nein weiter bei C8, danach C10 nein, sicher nicht weiter bei C8, danach C10 weiss nicht / keine Angabe
C8	Wie hat der Schiedsrichter entschieden? (*Int.: nicht vorlesen – beim Zuordnen helfen)* kein Foul Freistoss/Penalty (für mein Team) Freistoss/Penalty (für mein Team) und gelbe Karte (für meinen Gegenspieler) Freistoss/Penalty (für mein Team) und rote Karte (für meinen Gegenspieler) Freistoss/Penalty gegen mein Team Es gab keinen Schiedsrichter weiss nicht / keine Angabe

C9	Denken Sie, es hat einen Grund für das Foulspiel gegeben? *(Int: vorlesen)* normales Foulspiel taktisches Foulspiel Notbremse Aggression vom Gegenspieler anderes weiss nicht / keine Angabe
C10	Wie war die Stimmung im Spiel/Training/Turnier kurz vor Ihrer Verletzung? *(Int: vorlesen)* freundschaftlich und entspannt normal etwas gereizt aggressiv weiss nicht / keine Angabe
	Verletzungsgeschichte
D1	Haben Sie, abgesehen von der aktuellen Verletzung, in den letzten 12 Monaten eine oder mehrere Verletzungen beim Fussballspielen erlitten, wo Sie für mindestens einen Tag von Ihren normalen sportlichen Aktivitäten abgehalten haben? ja weiter bei D2 nein weiter bei D3 weiss nicht / keine Angabe
D2	Bei wie vielen von diesen Verletzungen haben Sie *(Int: Falls notwendig Sportausfall beschreiben als Tage, an denen man nicht normal Trainieren oder Sporttreiben konnte)* a) ... 1-7 Tage Sportausfall gehabt? *(Anzahl notieren)* b) ... 8-28 Tage Sportausfall gehabt? *(Anzahl notieren)* c) ... über 28 Tage Sportausfall gehabt? *(Anzahl notieren)* weiss nicht / keine Angabe
D3	Halten Sie sich generell für verletzungsanfällig? *(Int: vorlesen)* sehr eher eher nicht gar nicht weiss nicht / keine Angabe
	Expositionszeit
E1	*(Frage nur für Vereinsfussballer: C1 = Fussballverein (Spiel oder Training) oder C3 = ja)* Wie viele Trainings mit Ball haben Sie zum Zeitpunkt der Verletzung pro Woche mit ihrem Team absolviert? *(Angabe in Anzahl Trainings)* weiss nicht / keine Angabe

E2	*(Frage nur für Vereinsfussballer: C1 = Fussballverein (Spiel oder Training) oder C3 = ja)* Wie viele Stunden pro Woche haben Sie zum Zeitpunkt der Verletzung ungefähr Fussball gespielt? Bitte rechnen Sie das Vereinstraining auch mit ein. *(Angabe in Stunden)* weiss nicht / keine Angabe
	Verhalten und Verletzungsprävention
F1	Es folgen ein paar Fragen zu Ihrem Befinden und Verhalten unmittelbar vor dem Unfall. Bitte beantworten Sie die folgenden Fragen mit ja oder nein. Falls Sie sich nicht mehr genau erinnern können, dürfen Sie dies sagen. a) Haben Sie sich am Tag der Verletzung fit und ausgeruht gefühlt? b) Haben Sie in der Nacht vor der Verletzung genügend geschlafen? c) Haben Sie am Abend vor der Verletzung Alkohol konsumiert? nein= weiter bei F1e d) Haben Sie mit einem Kater/Hangover Fussball gespielt? e) Haben Sie unmittelbar vor oder während des Fussballspielens Alkohol konsumiert? f) Haben Sie sich vor dem Fussballspielen aufgewärmt? nein= weiter bei F4 ja nein weiss nicht / keine Angabe
F2	Wie lange haben Sie sich aufgewärmt? *(Int.: nicht vorlesen – beim Zuordnen helfen)* bis zu 10 Minuten 11 bis 20 Minuten 21 bis 30 Minuten 31 bis 40 Minuten mehr als 40 Minuten weiss nicht / keine Angabe
F3	Was haben Sie zum Aufwärmen alles gemacht? Bitte antworten Sie mit ja oder nein! *(Int: vorlesen – Mehrfachantworten möglich)* a) normales Joggen b) Laufübungen (z.B. Lauf ABC) c) Sprints b) Stretching/Dehnen d) Stabilisations- und Kräftigungsübungen e) Ballarbeit/Kurzpasspiel) f) Spielformen g) Flanken/Torschuss ja nein weiss nicht / keine Angabe
F4	An wie vielen Tagen pro Woche haben sie sich zum Zeitpunkt der Verletzung sportlich betätigt, abgesehen vom Fussballspielen? *(Angabe in Tagen)* *(bei 0 Tagen: weiter bei F7)* weiss nicht / keine Angabe
F5	Wie viele Stunden pro Woche haben Sie damals in sportliche Aktivitäten investiert, abgesehen vom Fussballspielen? *(Angabe in Stunden)* weiss nicht / keine Angabe

F6	Welche Sportarten sind das gewesen? (*Sportartenliste aus Sport Schweiz 2014, nur die wichtigsten 3 Sportarten erfassen*) 1. Sportart *(Suche in der Datenbank)* 2. Sportart *(Suche in der Datenbank)* 3. Sportart *(Suche in der Datenbank)* weiss nicht / keine Angabe
F7	Ich lese Ihnen jetzt Massnahmen für die Verletzungsprävention vor. Bitte sagen Sie mir jeweils, ob Sie die zum Zeitpunkt von der Verletzung regelmässig gemacht haben oder nicht. *(Int: vorlesen – Mehrfachantworten möglich)* a) Einlaufen/ Warm-Up b) Auslaufen/ Cool down c) Stretching/ Dehnen d) gezieltes Rumpfkraft-/Bauchmuskel-/Rückenmuskeltraining e) allgemeines Krafttraining f) Konditions-/Fitnesstraining g) Massagen ja nein weiss nicht / keine Angabe
F8	Welche von den folgenden Präventionsprogrammen kennen Sie? a) „Sport Basics“ ja= weiter bei F9, nein= weiter bei F11 b) „Die 11“ oder „Die 11+“ ja= weiter bei F10, nein= weiter bei F11 ja nein weiss nicht / keine Angabe
F9	Wie häufig haben Sie damals „Sport Basics“ gemacht? *(Int: vorlesen)* häufig ab und zu selten nie weiss nicht / keine Angabe
F10	Wie häufig haben Sie damals „Die11“ oder „Die 11+“ gemacht? *(Int: vorlesen)* häufig ab und zu selten nie weiss nicht / keine Angabe
F11	*(Frage nur stellen wenn: C1 = Fussballverein (Spiel))* Zu welchem Zeitpunkt des Spiels haben Sie sich verletzt? *(Int.: nicht vorlesen – beim Zuordnen helfen)* Einlaufen/ Warm-Up 1.-15. Minute 16.-30. Minute 31.-45. Minute 46.-60. Minute 61.-75. Minute 76.-90. Minute Nachspielzeit Auslaufen/ Cool down oder später weiss nicht / keine Angabe

F12	(*Frage nur stellen wenn: C1 ≠ Fussballverein (Spiel))* Zu welchem Zeitpunkt vom Training oder Spiel haben Sie sich verletzt? Ist das eher am Anfang, am Ende oder mittendrin gewesen? *(Int.: nicht vorlesen – beim Zuordnen helfen)* (eher) am Anfang mittendrin (eher) am Ende weiss nicht / keine Angabe
F13	Sind Sie konditionell am Limit gewesen, wo Sie sich verletzt haben? *(Int: vorlesen)* ja eher ja eher nein nein, gar nicht weiss nicht / keine Angabe
	Spielweise
G1	Welches ist Ihr bevorzugtes Spielbein (zum Passen, Schiessen etc.)? rechts links keines weiss nicht / keine Angabe
G2	Haben Sie als Kind, das Fussballspielen im Verein erlernt? ja weiter bei G3 nein weiter bei G4 weiss nicht / keine Angabe
G3	Wie viele Jahre haben Sie im Alter von 7 bis 13 Jahren im Verein Fussball gespielt? *(Int.: das Maximum sind 7 Jahre)* *(Angabe in Jahr(e))* weiss nicht / keine Angabe
G4	Ich lese Ihnen jetzt ein paar Aussagen zu Ihren fussballerischen Fertigkeiten und zu Ihrem Verhalten auf dem Platz vor. Bitte sagen mir jeweils wie sehr diesen Aussagen in der Zeit vor Ihrer Verletzung auf Sie zugetroffen haben? Sagen Sie mir das auf einer Skala von 5 "trifft voll und ganz zu" bis 1 "trifft überhaupt nicht zu". *(Int.: allenfalls Skala wiederholt erklären. Zwischendurch wiederholen, dass das Verhalten zum Zeitpunkt der Verletzung zählt.)* a) Im Vergleich zu meinen Mitspielern bin ich technisch sehr gut gewesen. b) Im Vergleich zu meinen Mitspielern bin ich taktisch sehr gut gewesen. c) Ich hätte mich als Kämpfer bezeichnet. d) Ich habe meine Emotionen immer unter Kontrolle gehabt. e) Ich habe es im Spiel öfters riskiert, nicht nur den Ball sondern auch den Gegner zu treffen. f) Wenn es um einen wichtigen Sieg gegangen ist, dann habe ich auch eine Verletzung in Kauf genommen. g) Ich habe die korrekte Ausführung eines Tacklings gelernt und geübt. 5 (trifft voll und ganz zu) 4 3 2 1 (trifft überhaupt nicht zu) weiss nicht / keine Angabe

	Bedingungen, Material
H1	Auf welcher Unterlage ist Ihre Verletzung passiert? *(Int.: nicht vorlesen – beim Zuordnen helfen)* Rasen — weiter bei H2 a, b, c, d, e Kunstrasen mit — weiter bei H2 a, b, d, f Kunstrasen ohne Granulat — weiter bei H2 a, b, d, f ganz alter Kunstrasen (Teppich) — weiter bei H2 a, b, d, f Hartplatz — weiter bei H2 a, b, d Turnhalle — weiter bei H2 a, d Sandplatz/ im Sand — weiter bei H3 weiss nicht / keine Angabe
H2	In der nächsten Frage geht es um den Zustand der Unterlage, wo Sie sich verletzt haben. War die Unterlage... *(Int: vorlesen – pro Buchstabe eine Antwort möglich)* a) gut bespielbar - eher gut bespielbar - eher schlecht bespielbar - schlecht bespielbar - weiss nicht b) trocken – eher trocken – eher nass – nass – weiss nicht c) eben – eher eben – eher holprig/löchrig – holprig/löchrig – weiss nicht d) griffig – eher griffig – eher rutschig – rutschig – weiss nicht e) hart – eher hart – eher weich und tief – weich und tief – weiss nicht f) hart – eher hart – eher weich – weich – weiss nicht
H3	Haben Sie zum Zeitpunkt der Verletzung regelmässig zwischen verschiedenen Unterlagen gewechselt? *(Int: nicht vorlesen – beim Zuordnen helfen. Erklärung falls nötig: Zum Beispiel zwischen Rasen und Kunstrasen)* mehrmals pro Woche (etwa) einmal pro Woche alle zwei Wochen seltener weiss nicht / keine Angabe
H4	Haben Sie damals Ihre Schuhe bewusst der Unterlage entsprechend gewählt? ja nein weiss nicht / keine Angabe
H5	Was für Schuhe haben Sie zum Zeitpunkt der Verletzung getragen? *(Int.: nicht vorlesen – beim Zuordnen helfen)* keine, barfuss normale Turnschuhe Joggingschuhe Hallenschuhe Tausendfüssler Kunstrasenschuhe (neue Generation) Nockenschuhe (mit runden Nocken) Nockenschuhe (mit länglichen Nocken) Nockenschuhe (mit eckigen Nocken) Stollenschuhe anderes weiss nicht / keine Angabe
H6	Haben Sie Schienbeinschoner getragen? *(Int: vorlesen)* ja, mit Knöchelschutz ja, normale Grösse, ohne Knöchelschutz ja, möglichst kleine nein, keine
	Damit sind wir am Ende vom Interview. Wir danken Ihnen für Ihre wertvollen Auskünfte und wünschen Ihnen noch einen schönen Abend/Tag.

APPENDIX C: QUESTIONNAIRE COACHES STUDY

The questionnaire was optimised so that the questions could be asked in Swiss German.

The French version of the questionnaire is available on request.

	Fragen	***Kommentare dazu:***
	Grüezi, mein Name ist ... vom Forschungsinstitut LINK. Im Auftrag vom Schweizerischen Fussballverbandes und von der SUVA führen wir zur Zeit eine Befragung bei den Fussballtrainern durch. Es geht dabei um Verletzungen und Fairplay. Sie haben dazu vor ein paar Tagen eine E-Mail bekommen, wo man Sie um Ihre Teilnahme an der Studie gebeten hat. Kann ich bitte mit #bX sprechen oder sind Sie das selber? *Wenn ausgewählte Person am Telefon:* Wir hätten Ihnen dazu gerne ein paar Fragen gestellt.	*„Die11" oder „Sport Basics" sollen bewusst nicht erwähnt werden. (Text leicht angepasst: kein Panel, Ankündigungsmail)*
A1	Sind Sie zur Zeit als Fussballtrainer tätig? (*Intervieweranweisung: Bitte bei Frauen immer von "Fussbaltrainerin" sprechen*) ja nein → Interview abbrechen keine Angabe → Interview abbrechen	*2004/08 (wörtlich)*
A2	Was für eine Mannschaft trainieren Sie in dieser Saison? Wenn Sie mehrere Mannschaften trainieren, geben Sie bitte nur das Team an, wo Ihnen das Training wichtigsten ist bzw. wo Sie hauptsächlich verantwortlich sind. Super League, Nationalliga A, Männer → weiter bei A3 Challenge League, Nationalliga B, Männer → weiter bei A3 1. Liga, Männer → weiter bei A3 2. Liga, Männer interregional → weiter bei A3 2. Liga, Männer regional → weiter bei A6K 3. Liga, Männer → weiter bei A6K 4. Liga, Männer → weiter bei A6K 5. Liga, Männer → weiter bei A6K Junioren A, U18, U19, Männer → weiter bei A6K Junioren B, U16, U17, Männer → weiter bei A6K Junioren C, U14, U15, Männer → weiter bei A6K Senioren, 30+, 40+, 50+, Veteranen → weiter bei A6K Frauen Nationalliga A → weiter bei A6K Frauen Nationalliga B → weiter bei A6K 1. Liga Frauen → weiter bei A6K 2. Liga Frauen → weiter bei A6K 3. Liga Frauen → weiter bei A6K 4. Liga Frauen → weiter bei A6K Juniorinnen, U16, U18, U19, U20, Frauen → weiter bei A6K anderes (Junioren D, E etc.) → weiter bei A3	*2004/08 (fast identisch) Kategorien ganz leicht angepasst (inkl. U-Teams; neu 4. Liga Frauen, neue Bezeichnung Senioren, Veteranen aufgenommen).*

	Intervieweranweisung: Falls der/die Befragte eine Frauenmannschaft trainiert, soll in der Folge immer von Spielerinnen gesprochen werden.	
A3	Trainieren Sie in dieser Saison noch eine weitere Mannschaft? ja → weiter bei Frage A4 nein → Interview abbrechen	*2004/08 (wörtlich)*
A4	Um was für eine Mannschaft handelt es sich? 2. Liga, Männer regional → weiter bei A5K 3. Liga, Männer → weiter bei A5K 4. Liga, Männer → weiter bei A5K 5. Liga, Männer → weiter bei A5K Junioren A, U18, U19, Männer → weiter bei A5K Junioren B, U16, U17, Männer → weiter bei A5K Junioren C, U14, U15, Männer → weiter bei A5K Senioren, 30+, 40+, 50+, Veteranen → weiter bei A5K Frauen Nationalliga A → weiter bei A5K Frauen Nationalliga B → weiter bei A5K 1. Liga Frauen → weiter bei A5K 2. Liga Frauen → weiter bei A5K 3. Liga Frauen → weiter bei A5K 4. Liga Frauen → weiter bei A5K Juniorinnen A, B, C, U16, U18, U19, U20 → weiter bei A5K alle anderen Mannschaft (Kinder usw.) → Interview abbrechen	*2004/08 (fast identisch) Kategorien ganz leicht angepasst (inkl. U-Teams; neu 4. Liga Frauen, neue Bezeichnung Senioren, Veteranen aufgenommen).*
A5K	Bitte beachten Sie, dass alle weiteren Fragen sich ausschliesslich auf die letztgenannte Mannschaft beziehen.	*2004/08 (wörtlich)*
A6K	Bitte beachten Sie, dass alle weiteren Fragen sich ausschliesslich auf diese Mannschaft beziehen.	*2004/08 (wörtlich)*
A8	Wie viele Spieler gehören zu der von Ihnen trainierten Mannschaft? *Damit sind die Personen gemeint, die tatsächlich die Meisterschaft bestreiten, d.h. ohne möglicherweise zusätzliche Personen, die nur mittrainieren.* _____ Anzahl Spieler/innen eintragen weiss nicht / keine Angabe	*2004/08 (wörtlich)*
A11	Seit wie vielen Saisons trainieren Sie die genannte Mannschaft? __ Anzahl Saisons eintragen weiss nicht / keine Angabe	*2004/08 (wörtlich)*
A12	Trainieren Sie das genannte Team allein oder zusammen mit jemand anderem? allein → weiter bei A14 je nachdem, teilweise gemeinsam bzw. allein → weiter bei A13 gemeinsam mit jemand anderem → weiter bei A13 weiss nicht / keine Angabe	*2004/08 (wörtlich)*
A13	Um was für eine Person handelt es sich? Cheftrainer Assistenztrainer Spieler Physiotherapeut/Arzt Coach andere Person: _____ (*notieren*) weiss nicht / keine Angabe	*2004/08 (wörtlich)*

A14	Wie viele Trainings pro Woche absolviert das von Ihnen trainierte Team während der Meisterschaft? Es geht hier also um die Anzahl Trainingseinheiten ohne die Spiele. ____ Anzahl Trainingseinheiten pro Woche eintragen *(Als Training zählen alle sportlichen Aktivitäten in der Gemeinschaft der Mannschaft z.B. auch Lauftraining, Kraft-Training, etc.)* weiss nicht	*2004/08 (wörtlich)*
A15	Wie lange dauert ein durchschnittliches Training ohne Umkleiden und Duschen? _____ Anzahl Minuten eintragen weiss nicht / keine Angabe	*2004/08 (wörtlich)*
A16	Wie viele Spieler nehmen durchschnittlich am Training teil? _____ Anzahl Spieler/innen eintragen weiss nicht / keine Angabe	*2004/08 (wörtlich)*
	Erfassung der Verletzungen erfolgt genau gleich wie 2004/2008	
B1K	Zuerst geht es um Verletzungen beim Fussballspielen: Dazu möchten wir mit Ihnen das Verletzungsgeschehen in den letzten vier Wochen etwas genauer durchgehen.	*2004/08 (leicht angepasst; da Fragen zur Prävention erst hinten folgen)*
B1	Darum möchte ich von Ihnen wissen, wie häufig Ihre Mannschaft in den letzten vier Wochen in der Meisterschaft oder im Cup einen Match gespielt hat? ___ Anzahl Spiele eingeben nie → weiter bei Frage B7 weiss nicht	*2004/08 (wörtlich)*
B2	Denken Sie jetzt zunächst an das letzte der xy Spiele. Gegen wen haben Sie da gespielt? *(Gegnerische Mannschaft nicht erfassen- etwas Zeit zum Überlegen lassen)* Hat sich bei diesem Spiel einer Ihrer Spieler verletzt? ja -> Anzahl verletzte Spieler eingeben → weiter bei CX-C6, danach B3 nein → weiter bei B3 weiss nicht / keine Angabe	*2004/08 (wörtlich)*
B3	Denken Sie jetzt an das zweite der xy Spiele. Gegen wen haben Sie da gespielt? *(Gegnerische Mannschaft nicht erfassen- etwas Zeit zum Überlegen lassen)* Hat sich bei diesem Spiel einer Ihrer Spieler verletzt? ja -> Anzahl verletzte Spieler eingeben → weiter bei CX-C6, danach B4 nein → weiter bei B4 weiss nicht / keine Angabe	*2004/08 (wörtlich)*
B4	Denken Sie jetzt an das Spiel davor. Gegen wen haben Sie da gespielt? *(Gegnerische Mannschaft nicht erfassen- etwas Zeit zum Überlegen lassen)* Hat sich bei diesem Spiel einer Ihrer Spieler verletzt? ja -> Anzahl verletzte Spieler eingeben → weiter bei CX-C6, danach B5 nein → weiter bei B5 weiss nicht / keine Angabe	*2004/08 (wörtlich)*

B5	Denken Sie jetzt an das Spiel davor. Gegen wen haben Sie da gespielt? *(Gegnerische Mannschaft nicht erfassen- etwas Zeit zum Überlegen lassen)* Hat sich bei diesem Spiel einer Ihrer Spieler verletzt? ja -> Anzahl verletzte Spieler eingeben → weiter bei CX-C6, danach B6 nein → weiter bei B6 weiss nicht / keine Angabe	*2004/08 (wörtlich)*
B6	Denken Sie jetzt an das Spiel davor. Gegen wen haben Sie da gespielt? (Gegnerische Mannschaft nicht eingeben) *(Gegnerische Mannschaft nicht erfassen- etwas Zeit zum Überlegen lassen)* Hat sich bei diesem Spiel einer Ihrer Spieler verletzt? ja -> Anzahl verletzte Spieler eingeben → weiter bei CX-C6, danach B7 nein → weiter bei B7 weiss nicht / keine Angabe	*2004/08 (wörtlich)*
B7	Wenn Sie jetzt an die Trainings in den letzten vier Wochen denken? Wie viele Ihrer Spieler haben sich im Training in dieser Zeit verletzt? Anzahl verletzte Spieler eingeben → weiter bei CX-C5 (**ohne C6)**, danach D1 niemand → weiter bei D1 weiss nicht / keine Angabe	*2004/08 (wörtlich)*
CX	*(Intervieweranweisung: Falls sich jeweils mehrere Spieler/innen verletzt haben, in der Folge alle verletzten Spieler/innen einzeln durchgehen)* Denken Sie jetzt an den ersten (zweiten usw.) Spieler, der sich in diesem Spiel verletzt hat.	*2004/08 (wörtlich)*
C0	Auf welcher Unterlage ist diese Verletzung passiert? Rasen Kunstrasen mit Granulat Kunstrasen ohne Granulat anderes weiss nicht / keine Angabe	*neu*
C1	An welchem Körperteil hat sich der Spieler verletzt? (*Intervieweranweisung: Kategorien nicht vorlesen, es können mehrere Antworten kodiert werden*) Kopf/Gesicht Nacken/Halswirbelsäule Rumpf: Rücken (Brustwirbelsäule, Lendenwirbelsäule) Rumpf ohne Rücken (Brustbein, Rippen, Unterleib/Bauch, Becken/Steissbein) Obere Extremität (Schulter, Oberarm Ellenbogen, Unterarm, Handgelenk Hand, Finger, Daumen Hüftgelenk Leiste Oberschenkel Knie Unterschenkel/ Achillessehne Fuss: Knöchel, Fussgelenk, Sprunggelenk Fuss ohne Gelenk / mit Zehen anderes, nämlich: _____ (*notieren*) weiss nicht / keine Angabe	*2004/08 (wörtlich)*

C2	Um welche Art der Verletzung handelt es sich? (*Intervieweranweisung: Kategorien nicht vorlesen, es können mehrere Antworten kodiert werden*) Prellung / Quetschung, Kontusion, Hämatom, Bluterguss (Pferdekuss) Verstauchung, Distorsion, („Vertrampen“) Muskelzerrung, Muskelriss, Muskelfaserriss, Muskelabriss Bandverletzung, Bänderzerrung, Bänderriss Sehnenriss Knochenbruch / Knochenriss Kapselriss / Kapselverletzung Ausrenkung / Luxation Verletzung der Haut, Abschürfung, Fleischwunde Gehirnerschütterung (mit / ohne Bewusstlosigkeit) Entzündung / Reizung Schmerzen ohne eindeutige Diagnose anderes, nämlich: _____ (*notieren*) weiss nicht / keine Angabe	*2004/08 (wörtlich)* *„Vertrampen“ dazu genommen*
C3	Hat der Spieler einen Arzt aufsuchen müssen? ja nein weiss nicht / keine Angabe	*2004/08 (wörtlich)*
C4	Wie lange hat bzw. wird der Spieler voraussichtlich wegen dieser Verletzung nicht am regulären Training oder Spiel teilnehmen können? ca. _____Tage kann nie mehr am regulären Training/Spiel teilnehmen. weiss nicht / keine Angabe	*2004/08 (wörtlich)*
C5	War ein anderer Spieler am Unfall beteiligt? ja → weiter bei C6 nein → weiter bei nächstem verletzen Spieler oder B3-B7 oderD1 weiss nicht / keine Angabe	*2004/08 (leichte Änderung)*
C6	War es ein Foul und ist es gepfiffen worden? ja, Foul wurde gepfiffen ja, Foul wurde aber nicht gepfiffen nein, kein Foul weiss nicht / keine Angabe	*2004/08 (wörtlich)*
	Erst weiter zu D1 wenn alle Spiele und alle verletzen Spieler abgefragt wurden	
D1	Wenn Sie jetzt nochmals Ihre ganze Mannschaft betrachten: Wie viele Spieler haben am letzten Training nicht normal teilnehmen können, weil sie sich beim Fussballspielen verletzt haben? ___ Anzahl verletzte Spieler eintragen. weiss nicht / keine Angabe	*2004/08 (wörtlich)*
D2	Wie viele Langzeitverletzte haben Sie in Ihrem Team? Langzeitverletzte sind Spieler, die wegen einer Verletzung die ganzen vier Wochen nicht am Training teilnehmen konnten. ___ Anzahl verletzte Spieler eintragen. weiss nicht / keine Angabe	*neu*
D3	Auf welcher Unterlage wurde in den vergangenen vier Wochen hauptsächlich trainiert? Rasen Kunstrasen mit Granulat Kunstrasen ohne Granulat andere Unterlage weiss nicht / keine Angabe	*neu*

	Fragen zu den Präventionsprogrammen Suva Sport Basics und "Die 11"	
E1	Führen Sie in Ihrer Mannschaft spezielle Massnahmen zur Vorbeugung von Verletzungen durch? ja → weiter bei E2 nein → weiter bei E3 weiss nicht / keine Angabe	*2004/08 (wörtlich)*
E2	Um was für Massnahmen handelt es sich? *(Intervieweranweisung: Kategorien nicht vorlesen, es können mehrere Antworten kodiert werden.)* (Suva) Sport Basics „Die 11“ oder „11+“ Massage/Masseur Einlaufen/Einwärmen Auslaufen/Abkühlen/Cool down Stretching/Dehnen Rumpfkrafttraining/Bauchmuskel-/Rückenmuskeltraining Kraft-Übungen/Kraft-Training allgemein Konditions-/Fitnesstraining richtige Schuhwahl (Nocken, Stollen etc.) Tragen von Schienbeinschonern Fairplay/Aggression dämpfen Ausheilen von Verletzungen/Rehabilitation Aufklärung/Theorie andere Massnahmen: _____ weiss nicht FILTER: Falls Die 11 und SSB nicht erwähnt werden → weiter E3 Falls SSB erwähnt wird → weiter E3 Falls Die 11 erwähnt wird → weiter E3 Falls Die 11 *und* SSB erwähnt werden → weiter E4b	*wie 2008* *ergänzt um:* *- Suva Sport Basics* *- 11+* *- richtige Schuhwahl*
E3	Kennen Sie das Programm mit Kräftigungübungen (Suva) Sport Basics oder das Übungsprogramm „Die 11“? *(falls eines der beiden Programme bereits genannt wurde, wird nur noch das andere Programm abgefragt und die passende Antwort vom Interviewer gewählt)* Ja, kenne beide Programme → weiter bei E4b Ja, kenne (nur) Suva Sport Basics → weiter bei E4 (mit Variante Suva Sport Basics) Ja, kenne (nur) „Die 11“ → weiter bei E4 (mit Variante Die 11) bin unsicher → weiter bei E3c Nein → weiter bei E15 → F1 ff weiss nicht / keine Angabe → weiter bei E15 → F1 ff	*E3 wurde neu formuliert, weil neu nach beiden Programmen gefragt wird.*
E3c	*Erklärung abgeben:* "Die 11" und (Suva) Sport Basics sind Trainingsprogramme gegen Verletzungen von der Suva, die aus verschiedenen Übungen bestehen. Haben Sie davon schon gehört? Ja, schon gehört → weiter bei E4 Nein, noch nie gehört → weiter bei E15 → F1 ff weiss nicht / keine Angabe	*wie 2008 leicht angepasst.*
E4	Führen Sie zur Zeit (Suva) Sport Basics / „Die 11“ oder einzelne Übungen daraus mit Ihrer Mannschaft durch? ja → weiter bei E9 nein → weiter bei E5 weiss nicht / keine Angabe	*wie 2008: allerdings mit zwei Varianten: Je nach Antwort in Frage E3 heisst es Suva Sport Basics oder Die 11.*

E4b	Führen Sie zur Zeit (Suva) Sport Basics oder „Die 11“ oder einzelne Übungen aus diesen beiden Programmen mit Ihrer Mannschaft durch? Ja, SSB bzw. Übungen aus „SSB“ → E9 (mit Variante Suva Sport Basics) Ja, „Die 11“ bzw. Übungen aus „Die 11“ → E9 (mit Variante „Die 11“) Ja, beides bzw. Übungen aus beidem → E9 (mit Variante Sport Basics und Die 11) Nein → E5b weiss nicht / keine Angabe	*Neu E4 für Personen, die beide Programme kennen*
E5	Haben Sie früher (Suva) Sport Basics / „Die 11“ oder einzelne Übungen daraus mit Ihrer Mannschaft durchgeführt? ja → weiter bei E7 (mit jeweiligen Varianten) nein → weiter bei E6 (mit jeweiligen Varianten) weiss nicht / keine Angabe	*wie 2008: allerdings mit zwei Varianten: Je nach Antwort in Frage E3 heisst es Suva Sport Basics oder Die 11.*
E5b	Haben Sie früher (Suva) Sport Basics oder „Die 11“ oder einzelne Übungen daraus mit Ihrer Mannschaft durchgeführt? Ja, SSB bzw. Übungen aus „SSB“ → E7 (mit Variante Suva Sport Basics) Ja, „Die 11“ bzw. Übungen aus „Die 11“ → E7 (mit Variante „Die 11“) Ja, beides bzw. Übungen aus beidem → E7 (mit Variante Sport Basics od. Die 11) Nein → E6 (mit Variante Sport Basics od. Die 11) weiss nicht / keine Angabe	*Neu E5 für Personen, die beide Programme kennen*
E6	Warum führen Sie (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics oder „Die 11“ nicht durch? *(Intervieweranweisung: Kategorien nicht vorlesen, es können mehrere Antworten kodiert werden.)* kenne das Programm zu wenig finde keine Zeit dafür im Training / muss die wenigen Trainings für anderes nutzen habe im Moment andere Prioritäten/Probleme im Training mache bereits ähnliche Übungen / ähnliches Programm glaube nicht an den Erfolg / finde Programm nicht gut / bringt nichts Programm ist für meine Mannschaft nicht geeignet (z.B. Kinder, Seniorenmannschaft etc.) Die Spieler machen nicht mit, keine Akzeptanz durch Spieler kann das nicht selber entscheiden / Cheftrainer, Cheftechniker etc. haben das so entschieden. andere Umstände (Training mit diesem Team erst begonnen etc.) anderes → alle weiter bei E14 → E15 → ohne E16 → E19a bzw. z bzw. ab→ F1 ff. weiss nicht / keine Angabe	*wie 2008: allerdings mit drei Varianten: Je nach Antwort in Frage E3 sowie E4, E4b, E5, E5b heisst es „Suva Sport Basics“ oder „Die 11“ oder „Suva Sport Basics und Die 11“*
E7	Warum führen Sie (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics und „Die 11“ nicht mehr durch? *(Intervieweranweisung: Kategorien nicht vorlesen, es können mehrere Antworten kodiert werden.)* kenne das Programm zu wenig finde keine Zeit dafür im Training / muss die wenigen Trainings für anderes nutzen habe im Moment andere Prioritäten/Probleme im Training mache es nur in bestimmter Phase (Vorwettkampf, Aufbau, Winter, Herbst etc.) mache jetzt ähnliche Übungen / ähnliches Programm glaube nicht an den Erfolg / finde Programm nicht gut Programm ist für meine Mannschaft nicht geeignet (z.B. Kinder, Seniorenmannschaft etc.) Die Spieler machten zu wenig mit, keine Akzeptanz durch Spieler Programm hat sich nicht bewährt. kann das nicht selber entscheiden / Cheftrainer, Cheftechniker etc. haben das so entschieden. andere Umstände (Wechsel von Mannschaft, viele Spielerwechsel etc.) anderes → alle weiter bei E8 ff. weiss nicht / keine Angabe	*wie 2008: allerdings mit drei Varianten: Je nach Antwort in Frage E3 sowie E4, E4b, E5, E5b heisst es „Suva Sport Basics“ oder „Die 11“ oder „Suva Sport Basics und Die 11“*

E8	Vor wie vielen Monaten haben Sie mit (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics und „Die 11“ aufgehört? _____ Anzahl Monate eintragen. weiss nicht / keine Angabe	*wie 2008: allerdings mit drei Varianten: Je nach Antwort in Frage E3 sowie E4, E4b, E5, E5b heisst es „Suva Sport Basics“ oder „Die 11“ oder „Suva Sport Basics und Die 11“*
E9	Wenn Sie die ganze Zeitspanne anschauen, in der Sie (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics und „Die 11“ (oder einzelne Übungen daraus) durchgeführt haben? Wie viele Monate haben Sie (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics und „Die 11“ mit ihrer Mannschaft wirklich durchgeführt? *Es sollen nur Monate angegeben werden, wo die Übungen wirklich durchgeführt werden. Trainingsunterbrüche sollen abgezählt werden. Also 3 Monate 2006 + 4 Monate 2007=7 Monate. Die Frage bezieht sich ausschliesslich auf die vom Trainer trainierte Mannschaft, von der bisher die Rede war.* _____ Anzahl Monate eintragen. weniger als ein Monat weiter bei → E14 ff. weiss nicht / keine Angabe	*wie 2008: allerdings mit drei Varianten: Je nach Antwort in Frage E3 sowie E4, E4b, E5, E5b heisst es „Suva Sport Basics“ oder „Die 11“ oder „Suva Sport Basics und Die 11“*
E10	In diesen Monaten, wo sie (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics und „Die 11“ (durchgeführt haben. Wie viele mal pro Woche haben Sie (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics und „Die 11“ mit ihrer Mannschaft normalerweise durchgeführt? *(Intervieweranweisung: Die Frage bezieht sich ausschliesslich auf die vom Trainer trainierte Mannschaft, von der bisher die Rede war)* weniger als einmal pro Woche ca. einmal pro Woche ca. zweimal pro Woche ca. dreimal pro Woche über dreimal pro Woche mal so mal so / sehr unterschiedlich weiss nicht / keine Angabe	*wie 2008: allerdings mit drei Varianten: Je nach Antwort in Frage E3 sowie E4, E4b, E5, E5b heisst es „Suva Sport Basics“ oder „Die 11“ oder „Suva Sport Basics und Die 11“*
E11	Wenn Sie jetzt an eine normale Trainingssequenz von (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics und „Die 11“ denken. Wie viele Übungen aus dem Programm/ diesen Programmen haben Sie durchschnittlich in einem Training durchgeführt? *Nur Originalübungen aus Suva Sport Basics / „Die 11“ notieren, keine zusätzlichen anderen Übungen.* _____ Anzahl Übungen weiss nicht / keine Angabe	*wie 2008: allerdings mit drei Varianten: Je nach Antwort in Frage E3 sowie E4, E4b, E5, E5b heisst es „Suva Sport Basics“ oder „Die 11“ oder „Suva Sport Basics und Die 11“*
E12	Haben Sie immer die gleichen Übungen durchgeführt oder haben Sie abgewechselt? immer die gleichen Übungen immer wieder andere Übungen meist die gleichen, mit etwas Abwechslung durch andere Übungen weiss nicht / keine Angabe	*wie 2004/2008*
E13	Wie lange hat die Durchführung von (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics und „Die 11“ normalerweise in Ihrem Training gedauert? ____ Anzahl Minuten eintragen. weiss nicht / keine Angabe	*wie 2008: allerdings mit drei Varianten: Je nach Antwort in Frage E3 sowie E4, E4b, E5, E5b heisst es „Suva Sport Basics“ oder „Die 11“ oder „Suva Sport Basics und Die 11“*

E14	Führen Sie (noch) andere Übungen im Training durch, die mit (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics und „Die 11“ vergleichbar sind? ja nein weiss nicht / keine Angabe	*wie 2008: allerdings mit drei Varianten: Je nach Antwort in Frage E3 sowie E4, E4b, E5, E5b heisst es „Suva Sport Basics“ oder „Die 11“ oder „Suva Sport Basics und Die 11“*
E15	Wenn Sie jetzt alle Übungen, die Sie im Training machen, betrachten. Wie häufig machen Sie gezielt ... *(Intervieweranweisung: Inklusive Suva Sport Basics und „Die 11“)* • ...Übungen zur Kräftigung der Rumpfmuskulatur? • ...Übungen zur Koordination und Balance auf einem Bein? • ...Übungen zur Kräftigung der hinteren Oberschenkelmuskulatur (Hamstrings)? • ...Übungen zur Sprungkraft? in jedem oder fast jedem Training häufig / regelmässig hie und da selten nie weiss nicht / keine Angabe	*wie 2008*
E16	Wenn Sie jetzt alle gezielten Übungen zur Kräftigung und Koordination, die Sie mit Ihrer Mannschaft machen, anschauen: Handelt es sich dabei mehr um Übungen aus (Suva) Sport Basics / „Die 11“ oder mehr um andere Übungen? (fast) alles Übungen aus Suva Sport Basics / „Die 11“ mehr Übungen aus Suva Sport Basics / „Die 11“ etwas halbe, halbe *(50% Übungen aus* Suva Sport Basics / „Die 11“ *50% andere Übungen)* mehr andere Übungen (fast) alles andere Übungen weiss nicht / keine Angabe	*wie 2008: allerdings mit zwei Varianten: Je nach Antwort in Frage E3 heisst es Suva Sport Basics oder Die 11.*
E16b	Wenn Sie jetzt alle gezielten Übungen zur Kräftigung und Koordination, die Sie mit Ihrer Mannschaft machen, anschauen: Handelt es sich dabei mehr um Übungen aus (Suva) Sport Basics oder aus „Die 11“ oder mehr um andere Übungen? hauptsächlich Übungen aus Suva Sport Basics hauptsächlich Übungen aus „Die 11“ hauptsächlich aus anderen Übungen gemischt Übungen aus Suva Sport Basics und „Die 11“ (aber fast ohne andere Übungen) gemischt aus Suva Sport Basics und „Die 11“ und anderen Übungen weiss nicht / keine Angabe	*neu anstelle von E16 für alle die „Suva Sport Basics und Die 11“ machen (vgl. Filterung weiter oben).*
E18	Ich lese Ihnen verschiedene Aussagen zu (Suva) Sport Basics / „Die 11“ / (Suva) Sport Basics und „Die 11“ vor. Sagen Sie bitte, inwieweit diese für Sie zutreffen: • Ich habe immer darauf geachtet, dass meine Spieler die Übungen korrekt machen. • Meine Spieler haben bei Suva Sport Basics / „Die 11“ / Suva Sport Basics und „Die 11“ motiviert mitgemacht. • Meine Spieler haben die Übungen aus Suva Sport Basics / „Die 11“ / Suva Sport Basics und „Die 11“ auch ausserhalb des Trainings gemacht. trifft voll zu trifft eher zu trifft eher nicht zu trifft überhaupt nicht zu - weiss nicht / kann ich nicht beurteilen - keine Angabe	*wie 2008: allerdings mit drei Varianten: Je nach Antwort in Frage E3 sowie E4, E4b, E5, E5b heisst es „Suva Sport Basics“ oder „Die 11“ oder „Suva Sport Basics und Die 11“* *Int: Skala bei Bedarf vorlesen.*

E19a	Wie beurteilen Sie das Präventionsprogamm "Die 11" in Bezug auf folgende Punkte • Idee des Präventionsprogramms • Die einzelnen Übungen • Durchführbarkeit im Training • Nutzen für Verletzungsprävention sehr gut gut genügend ungenügend schlecht weiss nicht / kann ich nicht beurteilen keine Angabe	*wie 2008 gekürzt für alle, welche „Die 11" kennen (inkl. diejenigen, welche beide Programme kennen).* *Int: Skala bei Bedarf vorlesen.*
E19z	Wie beurteilen Sie das Präventionsprogramm (Suva) Sport Basics in Bezug auf folgende Punkte • Idee des Präventionsprogramms • Die einzelnen Übungen • Durchführbarkeit im Training • den Nutzen für die Verletzungsprävention sehr gut gut genügend ungenügend schlecht weiss nicht / kann ich nicht beurteilen keine Angabe	*wie 2008 gekürzt für alle, welche Suva Sport Basics kennen (inkl. diejenigen, welche beide Programme kennen).* *Int: Skala bei Bedarf vorlesen.*
	Allgemeine Fragen zur Prävention und zum Fairplay	
F1	Wenn Sie an Ihre Mannschaft, Ihr Training denken: Wie sehr stimmen Sie den folgenden Aussagen zu? • Ein gutes Spiel ist uns wichtiger als der Sieg. • Verletzungen gehören zum Fussball. • Verletzungsprävention hat in meinem Training einen hohen Stellenwert. • Bei uns wird auch im Training "richtig zur Sache gegangen". • Beim Sport muss man auch über die Schmerzgrenze hinaus gehen. • Spieler, die gegen das Fairplay verstossen werden bei uns intern zurechtgewiesen und bestraft. • Meine Spieler haben ihre Emotionen immer unter Kontrolle. • Meine Spieler nehmen für einen wichtigen Sieg eine Verletzung in Kauf • Meine Spieler riskieren oft, im Spiel nicht nur den Ball sondern auch den Gegenspieler zu treffen. 1) trifft voll zu 2) trifft eher zu 3) trifft eher nicht zu 4) trifft überhaupt nicht zu weiss nicht / kann ich nicht beurteilen keine Angabe	*wie 2008 drei Items werden ersetzt* *Int: Skala bei Bedarf vorlesen.*
F4	Was würden Sie sagen: Kann Ihr Team gegen Ende eines Spiels nochmals zulegen und Druck machen oder läuft Ihr Team gegen Ende der Spiele eher konditionell am Limit? • kann noch zulegen • läuft am Limit • ist unterschiedlich, je nach Spiel weiss nicht / keine Angabe	*neu*

F5	Wie viele Ihrer Spieler tragen auch im Training Schienbeinschoner? *(Interviewanweisung: Es geht um Übungen oder Spielformen mit Körperkontakt.)* alle eine Mehrheit etwa die Hälfte eine Minderheit niemand weiss nicht / keine Angabe	*neu*
	Neue Fragen zum Fussballtest	
H1	Kennen Sie den Fussballtest der Suva, mit dem man online das Verletzungsrisiko bestimmen kann? ja → H2 nein → H5 (mit Erklärung) weiss nicht / keine Angabe → H5 (mit Erklärung)	*neu*
H2	Haben Sie mit den Spielern Ihres Teams über den Test gesprochen? ja → H3 nein → H4 weiss nicht / keine Angabe	*neu*
H3	Wie viele Spieler Ihres Teams haben den Test durchgeführt? alle eine Mehrheit etwa die Hälfte eine Minderheit niemand weiss nicht / keine Angabe	*neu*
H4	Wie beurteilen Sie... • ...die Idee des Fussballtests? • ...die einzelnen Fragen des Fussballtests? • ...die Antworten und Tipps des Fussballtests? • ...den Nutzen des Fussballtests für die Verletzungsprävention? sehr gut gut genügend ungenügend schlecht weiss nicht / kann ich nicht beurteilen keine Angabe → Alle weiter bei H5 (ohne Erklärung)	*neu analog zu E19* *Int: Skala bei Bedarf vorlesen.*
H5	Mit dem Fussballtest kann man online das persönliche Verletzungsrisiko beim Fussballspielen bestimmen. Würden Sie Ihre Spieler dazu motivieren, den Test durchzuführen, falls Sie in einem Trainerkurs nähere Informationen dazu erhalten würden? ja, sicher eher ja eher nicht sicher nicht weiss nicht / keine Angabe	*neu* *(obere Erklärung erscheint nur, wenn H1 = „nein“)*

	Zum Abschluss haben wir noch einige Fragen zu Ihrer Person.	
G1	Darf ich Sie fragen, wie alt Sie sind? _____ Alter in Jahren eintragen *Geschlecht eintragen: Mann/Frau*	*2004/08 (wörtlich)*
G1b	Seit wie vielen Jahren sind Sie als Fussballtrainer tätig? __ Anzahl Jahre eintragen keine Angabe	*2004/08 (wörtlich)*
G2	Was für eine Nationalität haben Sie? (*Intervieweranweisung: Kategorien nicht vorlesen, es können mehrere Antworten kodiert werden*) Schweiz Fürstentum Liechtenstein Deutschland Österreich Frankreich Italien Grossbritannien Spanien Portugal Ex-Jugoslawien: Kroatien/Serbien/Kosovo/Mazedonien/Slowenien/Bosnien/Montenegro Türkei Übriges Europa Nordamerika Südamerika/ Mittelamerika Afrika Asien Australien / Ozeanien Staatenlos keine Angabe	*2004/08 (wörtlich)*
G3	Welche Trainerausbildung haben Sie durchlaufen? Geben Sie bitte die höchste Ausbildungsstufe an, die Sie absolviert haben. Kinderfussball-Trainer-Diplom SFV C-Diplom / J+S-Leiterkurs SFV B-Diplom / UEFA - B-Lizenz SFV A-Diplom / UEFA - A -Lizenz J+S-Experte / SFV Instruktor NLA – Trainer – Diplom / UEFA – Pro – Lizenz anderes, nämlich: _____ keine Ausbildung weiss nicht / keine Angabe	*2004/08 (wörtlich)*
G4	Wann haben Sie das letzte Mal einen Trainer-Ausbildungs- oder einen Fortbildungskurs besucht? 2015 2014 2013 2012 2011 vor 5-10 Jahren vor über 10 Jahren weiss nicht / keine Angabe	*2004/08 (Jahre angepasst)*
	Damit sind wir schon am Schluss des Interviews. Ich danke Ihnen für Ihre wertvollen Auskünfte.	