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Prevention of Soccer Injuries: A Prospective Intervention Study in Youth Amateur Players

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Background: Risk factors for soccer injuries and possibilities for prevention have been discussed by several authors, but only a few have investigated the effectiveness of preventive interventions.
Purpose: The aim of the present study was to evaluate the effects of a prevention program on the incidence of soccer injuries in male youth amateur players.
Study Design: Prospective controlled intervention study.
Methods: Seven soccer teams took part in a prevention program that focused on education and supervision of coaches and players, while seven other teams were instructed to train and play soccer as usual. Over 1 year all injuries were documented weekly by physicians. Complete weekly injury reports were available for 194 players.
Results: The incidence of injury per 1000 hours of training and playing soccer was 6.7 in the intervention group and 8.5 in the control group, which equates to 21% fewer injuries in the intervention group. The greatest effects were observed for mild injuries, overuse injuries, and injuries incurred during training. The prevention program had greater effects in low-skill than in high-skill teams.
Conclusions: The incidence of soccer injuries can be reduced by preventive interventions, especially in low skill level youth teams. Coaches and players need better education regarding injury prevention strategies and should include such interventions as part of their regular training.

Soccer is the most popular sport in the world, with approximately 200,000 professional and 240 million amateur players. The incidence of soccer injury has been investigated in several studies (for review see references 8 and 21) and varies substantially depending on the definition of injury, the characteristics of the investigated players, and the research design. It has been reported that the incidence of injury for male outdoor players (≥16 years) is 12 to 35 injuries per 1000 match-hours and 1.5 to 7.6 injuries per 1000 training-hours.[8] The majority of soccer injuries are caused by trauma; overuse injuries account for between 9% and 34% of all injuries.[2,26] Soccer injuries predominantly affect the ankle and knee as well as the muscles of the thigh and calf.[16,20]

Numerous authors have described risk factors for soccer injuries[8,15,21,33] and discussed possibilities for prevention such as warm-up with more emphasis on stretching,[1,3,5,9–13,15,17] regular cooldown,[3,9,10,12,13,15,17] adequate rehabilitation with sufficient recovery time,[3,5,9–12,16,17] proprioceptive training,[3,6,15,35] protective equipment,[3–5,7,10–12,15,32] good playing field conditions,[5,10] and adherence to the existing rules.[3,5,9–12,15] However, only a few authors have reported results of prevention interventions in soccer players.[6,12,19,32,35]

Ekstrand et al.[12] evaluated an injury prevention program in a randomized trial with 12 male senior division

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teams. The program included 1) the correction of training, 2) provision of optimum equipment, 3) prophylactic ankle taping in players with clinical instability or history of previous strain, 4) controlled rehabilitation, 5) exclusion of players with serious knee instability, 6) information about the importance of disciplined play and the increased risk of injury at training camps, and 7) correction and supervision of physicians and physiotherapists. The intervention and the control teams were followed up for 6 months. The rate of injury (calculated as injuries per team per month) was 75% lower in the intervention teams than in the control teams. However, exposure-related incidence of injury was not reported, and thus the results of the study might have been biased by different numbers of matches and different amounts of training in the intervention and control groups. The exclusion and replacement of players with serious knee instability in the intervention group can be discussed regarding the prophylactic aspect, but from a methodologic point of view, it has to be criticized.[21] Nonetheless, the study of Ekstrand et al.[12] that was conducted about 20 years ago must be regarded as a pioneering work in the area of prevention of sports injury. Because quality and use of equipment (for example, shin guards are now compulsory in all matches) and also training methods have improved within the past few years, future prevention programs will probably not have such impressive results.

Heidt et al.[19] studied the effects of a preseason conditioning program on the occurrence of soccer injuries in female players. Of 300 female high school players, 42 were randomly selected to participate in a 7-week training program that combined sport-specific cardiovascular conditioning, plyometric work, sport cords drills, strength training, and flexibility exercises to improve speed and agility. The trainers recorded all injuries during 1 year of competitive soccer. Significantly fewer of the athletes who had participated in the preseason training program were injured (14%) compared with the control group (33.7%). The players in the intervention and control groups were not compared regarding age, skill level, or performance variables, and no exposure-related incidence of injury was reported. Thus, differences in the characteristics of the players or exposure time between the intervention and the control group might have biased the results of this study.

Whereas these two studies were aimed at the reduction of soccer injuries in general, three other studies evaluated the prevention of specific types of injuries in soccer players, namely ACL injuries[6] and ankle sprains.[32,35] In a prospective, controlled study of 40 semiprofessional or amateur soccer teams observed over three seasons, Caraffa et al.[6] demonstrated that a proprioceptive training program significantly reduced the incidence of ACL injuries. In a large study with 55 male senior soccer teams followed up for 6 months, Tropp et al.[35] showed the preventive effect of ankle disk training and of orthosis use in players with previous ankle problems. Surve et al.,[32] over the course of 1 playing season, prospectively investigated the incidence of ankle sprains in 258 senior soccer players who had previously sprained their ankles and in 246 players without such history. Players in both groups were randomly assigned to either a group prescribed to wear an ankle orthosis or a control group. In players with a previous history of ankle sprain, the incidence of reinjury was significantly lower for the orthosis group compared with the control group. No preventive effect was observed for players without previous ankle sprains.

Prospective controlled trials of injury prevention programs in other sports are also rare. Most such studies have focused on ankle sprains (for review see reference 34). A recent review of interventions for preventing ankle ligament injuries concluded from five randomized trials that external ankle support reduces the number of ankle sprains.[28] This reduction is greater for athletes who have had previous ankle sprains but is also evident in those without prior sprain.

In the scientific literature on prevention of sports injury, there seems to be good evidence for the effectiveness of prevention interventions. Because one of the most important risk factors for a sports injury is a previous injury (for review see references 8 and 21), prevention should begin as soon as players train or play on an organized level. To our knowledge, no study has ever evaluated the effects of an injury prevention program in youth soccer players. Even in professional players, an awareness of injury prevention strategies is somewhat lacking.[18] In consideration of the great number of amateur players, who presumably are less informed than professionals, a better instruction of players and coaches is needed, especially for recreational soccer.

The aim of the present study was to develop a prevention program for youth amateur soccer players and to evaluate its effects on the incidence of soccer injuries.

MATERIALS AND METHODS

This study was designed as a prospective cohort study. An initial baseline examination of players was conducted to ascertain the level of performance and potential risk factors for injury. Over a 1-year observation period, a physician visited each team weekly and documented all occurring injuries and physical complaints. The intervention group participated in an injury prevention program, while the control group was instructed to train and play soccer as usual.

The study was performed during two seasons in Switzerland (1999 and 2000). The intervention group and the control group were chosen from two different geographic regions (Zurich and Basel) to avoid transfer of information between the groups. Both groups consisted of three high skill level and four low skill level youth amateur teams. The teams were selected by the local soccer association. Only teams to which no physician or physiotherapist were attached and with male amateur players aged between 14 and 19 years were included in the study. Coaches and players of the control group were informed that they were taking part in an epidemiologic study on the incidence of soccer injuries in different countries. However, it was impossible to blind coaches and players of the intervention group about their participation in a prevention program.

After giving their informed consent, all players took part in a baseline examination that included a clinical examination of the spine, hip, knee, and ankle (for details of methods see reference 23); a soccer test of flexibility, speed, strength, and endurance (modified methods from reference 29); and a self-administered questionnaire concerning medical history, psychological characteristics, and aspects of training and playing soccer (for details of methods see references 23 and 24). During the 1-year study period, data on injuries and physical complaints were collected by physicians on a weekly basis. Each team had one responsible physician who visited the team once per week, asked the players about physical complaints, and examined their injuries. All injuries were described in relation to their type and location and the duration of subsequent limitation in performance. If a new injury was incurred, the player was asked about the circumstances under which it occurred. The amount of training and matches was recorded for each player individually by the coaches. All information was documented on specially designed documentation forms.

Prevention Program

The prevention program was developed on the basis of the scientific literature concerning risk factors and prevention of soccer injuries (for details see "Introduction"). An additional factor we considered during program development was the situation of youth amateur players in the socioeconomic environment of Switzerland. The program was designed to reduce the incidence of soccer injuries in general, without emphasis on a special type of injury. The interventions were focused on improving the structure and content of the training by educating and supervising the coaches and players. Other factors, such as the amount of training and number of matches, time schedule, players' equipment, and playing surface were not addressed.

The prevention program included general interventions such as improvement of warm-up, regular cooldown, taping of unstable ankles, adequate rehabilitation, and promotion of the spirit of fair play as well as specially designed "F-MARC Bricks." F-MARC Bricks are 10 sets of exercises designed to improve the stability of ankle and knee joints, the flexibility and strength of the trunk, hip, and leg muscles, as well as to improve coordination, reaction time, and endurance. The main emphasis of the interventions was tailored for the particular situation of each team, that is, amount and quality of training, and the physical performance of the players.

The intervention strategy was aimed first at raising the coaches' and players' motivation for and awareness of injury prevention strategies, and then at imparting the necessary knowledge and techniques to carry these strategies through. The coaches took part in courses, practical demonstrations, and individual consultations given by a sports scientist (DR). Additionally, each player was informed of the results of his baseline examination and was instructed on how to improve his individual weaknesses. During the study period, each team was taken care of by a physiotherapist who attended one training session per week and supervised the warm-up, cooldown, performance of F-MARC Bricks, and the rehabilitation of injured players.

Definition of Injury

An injury was defined as any physical complaint caused by soccer that lasted for more than 2 weeks or resulted in absence from a subsequent match or training session. The severity of injury was classified in three categories according to the duration of complaints and absence from matches and training sessions. An injury was classified as mild if there was absence up to 1 week or complaints for more than 2 weeks; moderate, if there was absence for more than 1 week but less than 4 weeks; and severe if there was absence for at least 4 weeks or severe tissue damage, such as fracture or dislocation. An injury was categorized as overuse if it was caused by repetitive microtrauma with no identifiable traumatic event. The classification of an injury as caused with or without contact with another player was based on information about the circumstances of the injury given by the player.

Calculation of Incidence

The incidence of injury was calculated per player per year as well as per 1000 hours of exposure (sum of training and match-playing hours). To analyze the effects of the intervention in more detail, two additional indexes were computed: 1) the number of match injuries in relation to the time spent in matches and 2) the number of overuse injuries and injuries during training in relation to the time spent in training.

Statistical Analysis

All data were processed on a Macintosh computer (Apple Computers, Cupertino, California) with Microsoft Office software (Microsoft Corp., Redmond, Washington). The statistical procedures were performed with StatView (version 4.5; SAS Institute, Cary, North Carolina). Only players with complete weekly follow-ups for the entire study period were included in the analysis of effects of the prevention program. Players who could not be followed for the entire season (dropouts) were compared with the study group for potential bias. Methods applied were descriptives, frequencies, and cross-tabulations. Differences between groups were examined by using *t*-tests or the chi-square test; incidences of injury were compared by calculating z-values.[25] Significance was accepted at the 5% level.

Analysis of Dropouts

Of the 263 players who participated in the baseline examination, 69 (26%) dropped out of the cohort study. In the majority of cases, players dropped out because they stopped playing soccer or changed teams or clubs. Players with complete weekly follow-ups and dropouts did not

differ in skill level of their teams, but the dropouts were significantly older because several players had to leave for military service. There was no significant difference in the rate of dropout between the intervention group ($N = 31$; 23%) and the control group ($N = 38$; 29%).

Study Group

Complete weekly injury reports were available in 194 players, of whom 87 (45%) were high-skill players and 107 (55%) were low-skill players. On average, the players were 16.5 years of age (SD, 1.2) and had played soccer for 7.7 years (SD, 2.9) in an organized club. Most of the players were midfield players ($N = 59$; 31%) or defenders ($N = 57$; 30%); attackers ($N = 38$; 20%) were less numerous. Twenty-nine players (15%) stated that they played in more than one position. Only nine goalkeepers (5%) participated in the study. The positions of two players were not recorded.

The players in the intervention group ($N = 101$) and control group ($N = 93$) were comparable regarding the skill levels of their teams, potential risk factors for injury (such as number of previous injuries, pathologic findings, quality of warm-up, reaction time), and almost all performance tests assessed at baseline. The intervention group was older than the control group (mean 16.7 versus 16.3 years; $P < 0.05$); this difference was significant in high-skill players but not in low-skill players (see Table 3).

RESULTS

We first describe the frequency and characteristics of injury in the control group to illustrate the initial conditions in Swiss youth amateur teams without prevention intervention. The results of the comparison of injuries rates for the intervention and control groups are then reported. Finally, the effects of the prevention program are analyzed for high- and low-skill teams separately, because baseline characteristics and incidence of injury differed substantially between these groups. Both the information on injuries in the control group as well as the analysis of the effects in different skill-level groups are meaningful for understanding and interpreting the results of the study.

Incidence of Injury in the Control Group

During the study period, the 93 players of the control group reported 111 injuries, which is equivalent to 1.2 injuries per player per year. The incidence of injury per 1000 hours of soccer was 8.5 (7.6 when analyzing only injuries that resulted in a subsequent absence from match and training).

Two-thirds of the injuries were mild ($N = 74$), 20% were moderate ($N = 22$), and 14% were severe ($N = 15$). The majority of injuries affected the lower extremities, predominantly the thigh ($N = 24$ or 22%), ankle ($N = 18$ or 16%), and knee ($N = 18$ or 16%). Injuries in other locations were less frequent. Approximately half of all injuries ($N = 51$ or 46%) were incurred during a match, 17% ($N = 19$) were incurred during training sessions, and 37% ($N = 41$) were overuse injuries. Almost 38% of all injuries ($N = 42$) were caused by contact with another player, and half of these cases were associated with foul play ($N = 20$ or 18% of all injuries). There was no relationship between the circumstances and severity of injury. The number of injuries varied during the course of the year, with a higher frequency at the beginning of the season, especially the spring season.

The incidence of injury per 1000 hours of soccer was significantly higher ($P < 0.05$) in low-skill teams than in high-skill teams (see Table 3). This result was even more pronounced if only overuse injuries and injuries incurred during training were analyzed. In the control group, the incidence of these injuries in low-skill teams was twice as high as in high-skill teams. The difference in match injuries was less marked (see Table 3).

General Effects of the Prevention Program

Comparison of the intervention and control groups revealed that significantly fewer injuries occurred in the intervention group (Tables 1 and 2); the number of injured players was 20% lower, and the rate of injury per player was 36% lower. When the incidence of injuries per player per year was analyzed with regard to different grades of severity, circumstances, and location of injury, specific

TABLE 1
Comparison of the Average Number of Injuries per Player per Year Regarding Severity, Circumstances, and Location of Injury

Injuries per player per year	Intervention group ($N = 101$)	Control group ($N = 93$)
	Mean (SD)	Mean (SD)
Total	0.76 (0.89)	1.18 (1.04)[b]
Severity		
Mild	0.46 (0.71)	0.80 (0.93)[b]
Moderate	0.17 (0.40)	0.24 (0.50)
Severe	0.14 (0.38)	0.16 (0.40)
Circumstances		
Overuse	0.26 (0.48)	0.44 (0.65)[c]
Training	0.09 (0.32)	0.20 (0.48)[c]
Match	0.42 (0.62)	0.55 (0.73)
Contact		
No	0.43 (0.65)	0.74 (0.88)[b]
Yes	0.34 (0.55)	0.45 (0.63)
Location of injury		
Head	0.02 (0.14)	0.01 (0.10)
Upper extremity	0.05 (0.22)	0.07 (0.25)
Lumbar spine	0.06 (0.24)	0.12 (0.33)
Trunk	0.01 (0.10)	0.05 (0.23)
Groin	0.02 (0.14)	0.10 (0.30)[c]
Thigh	0.15 (0.38)	0.26 (0.55)
Knee	0.11 (0.31)	0.19 (0.47)
Lower leg	0.09 (0.29)	0.06 (0.25)
Ankle	0.18 (0.41)	0.19 (0.42)
Foot	0.08 (0.27)	0.14 (0.41)

For tables in this article, the footnotes are arranged by level of significance so not all letters appear in each table.

[b] Significance of difference between the intervention and control groups ($P < 0.01$).

[c] Significance of difference between the intervention and control groups ($P < 0.05$).

TABLE 2
Comparison of Exposure Time and Incidence of Injury in the Intervention and the Control Groups

Variable	Intervention group (N = 101)	Control group (N = 93)
	N (%)	N (%)
Injuries	77 (100)	111 (100)
Injured players	53 (52.5)	67 (72.0)[b]
	Mean (SD)	Mean (SD)
Training hours	87.4 (29.9)	113.4 (40.4)[a]
Match hours	26.2 (8.89)	27.4 (11.6)
	Injuries in relation to exposure time	
All injuries per 1000 hours of exposure	6.71	8.48
Overuse or training injuries per 1000 training hours	3.96	5.69
Matches injuries per 1000 match hours	15.9	20.0

For tables in this article, the footnotes are arranged by level of significance so not all letters appear in each table.
[a] Significance of difference between the intervention and control groups ($P < 0.001$).
[b] Significance of difference between the intervention and control groups ($P < 0.01$).

effects of the prevention program could be demonstrated (Table 1). Almost all types of injuries were less frequent in the intervention group compared with the control group. The differences were statistically significant for mild injuries, overuse injuries, noncontact injuries, injuries incurred during training, and injuries of the groin.

These results might be biased by the fact that the intervention and control groups differed significantly in the amount of training during the study year (Table 2). However, even when the incidence of injury was calculated per 1000 hours of training and matches, the intervention group still demonstrated 21% fewer injuries than the control group. The incidence of overuse injuries and injuries during training as related to the amount of time spent in training was 30% lower in the intervention group, and the incidence of match injuries related to the time spent in matches was 20% lower in the intervention group than in the control group (Table 2).

Specific Effects of the Prevention Program in High- and Low-Skill Teams

Because the incidence of injury was significantly different in the high- and low-skill teams, specific effects of the prevention program were analyzed separately for both skill levels (Table 3). The differences in age and exposure time between the intervention and control groups were significant only for high-skill teams. Low-skill teams of the intervention and control groups were comparable in age and in exposure to soccer during the year of study.

When we analyzed the incidence of injuries per 1000 hours of soccer, low-skill teams seemed to profit much more from the intervention than did high-skill teams. In the low-skill intervention group there were 37% fewer injuries, but in the high-skill intervention group there were only 6% fewer injuries than in the corresponding control group.

When only match injuries in relation to the time spent in matches were analyzed, the intervention group showed a lower incidence of injury than did the control group for both skill levels (Table 3). In the high-skill intervention group, match injuries were 30% fewer, and in the low-skill intervention group, match injuries were 18% fewer compared with the corresponding control group. For overuse injuries and injuries during training per 1000 training hours, no effect of the prevention program was observed in high-skill teams. However, in the low-skill teams the incidence of these types of injury was 54% lower for the intervention group than for the corresponding control group.

To further analyze the effects of the prevention program, the incidence in relation to exposure time was calculated regarding different degrees of severity of injury (Table 3). In both skill-level groups, the incidence of mild injuries was lower in the intervention group than in the corresponding control group. For the low-skill intervention group, the incidence of mild injuries was only about 60% that of the control group, and the incidence of moderate injury was only half as high as in the corresponding control group. No effect on severe injuries was observed for either of the skill-level groups. Prevention effects on specific types of injury (for example, ankle sprain) could not be statistically demonstrated.

Although in the control group the incidence of injury in low-skill teams was significantly higher than in high-skill teams ($P < 0.01$), this difference was not observed in the intervention group. The incidence of injury in the low-skill intervention group was similar to that in the high-skill control group (Table 3). This was the result of the lower incidence of mild and moderate injuries, overuse injuries, and injuries during training sessions in the low-skill intervention group.

DISCUSSION

The present study was a prospective controlled trial conducted to assess the effects of an injury prevention program in youth amateur soccer players. The prevention program focused on improvement of the structure and content of training through education and supervision of coaches and players. Other factors, such as the amount

TABLE 3
Comparison of Exposure Time and Incidence of Injury in the Intervention and the Control Groups Regarding Skill Level of the Team

Variable	High-skill group		Low-skill group	
	Intervention (N = 41)	Control (N = 46)	Intervention (N = 60)	Control (N = 47)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Injuries per player	0.71 (0.84)	1.15 (1.05)[c]	0.80 (0.92)	1.21 (1.04)[c]
Age	16.2 (1.18)	15.6 (0.86)[c]	17.0 (0.97)	17.0 (1.32)
Training hours	85.4 (23.5)	141.8 (31.8)[a]	88.7 (33.7)	85.7 (26.2)
Match hours	26.0 (8.36)	31.4 (11.6)[c]	26.4 (9.30)	23.6 (10.3)
Exposure (hours)	111.4 (28.4)	173.2 (40.6)[a]	115.2 (37.8)	109.3 (31.2)
	Injuries per 1000 hours of exposure			
All injuries	6.35	6.78	6.95	11.1[c]
Severity				
Mild	3.28	4.52	4.48	7.40[c]
Moderate	1.97	1.26	1.16	2.34
Severe	1.09	1.00	1.30	1.36
Circumstances				
Overuse	2.19	2.51	2.32	4.09
Training	1.09	0.88	0.58	2.34[b]
Match	3.07	3.39	4.05	4.67
Contact				
No	3.72	4.64	3.76	6.23
Yes	2.63	2.13	3.19	4.87
	Injuries in relation to exposure time			
Matches injuries per 1000 match hours	13.1	18.7	17.7	21.6
Overuse or training injuries per 1000 training hours	4.28	4.14	3.76	8.16[b]

[a] Significance of difference between the intervention and control groups ($P < 0.001$).
[b] Significance of difference between the intervention and control groups ($P < 0.01$).
[c] Significance of difference between the intervention and control groups ($P < 0.05$).

of training and number of matches, time schedule, type of equipment used, and playing surface were not addressed. The program was designed to reduce the incidence of soccer injuries in general, without emphasis on a special type of injury.

The intervention and control groups were similar in almost all baseline characteristics. Differences in age and exposure time were significant only in high-skill, but not in low-skill players for whom the greatest effects of the prevention program were observed. The conduction of the prevention program did not influence the numbers of players who stopped playing soccer or changed their team or club (dropouts). It was impossible to blind coaches and players of the intervention group about their participation in a prevention program. However, coaches and players of the control group were informed that they were taking part in an epidemiologic study of soccer injuries in different countries and were requested to train and play soccer as usual. To avoid a transfer of information between the groups, the intervention group and the control group were chosen from different geographic regions. The incidence and characteristics of injuries of the control group in the present study was almost the same as has been reported before for this age group.[20,22,27,30,31]

The results of the present study clearly indicate that the incidence of soccer injuries in youth amateur players can be reduced by a prevention program. This outcome is in agreement with results of previous studies in senior division teams[12] and female high school players.[19] The greatest effects were observed for mild injuries, overuse injuries, and injuries incurred during training. Most of the interventions were aimed at improving training or actually took place during the training sessions of the teams, and this might have directly resulted in a reduction of training and overuse injuries. Match injuries, which are predominantly caused by contact with another player,[21] are more difficult to prevent. From the data reported by Heidt et al.,[19] it can be calculated that only the frequency of injuries during training was lower in the players who participated in a preseason conditioning program versus the control group; the rate of match injuries per player per year was similar in both groups.

An effect of the prevention interventions on specific types of injury (as shown previously for ankle sprains[32,35] and ACL injuries[6]) was not the subject of the present study, and differences between the intervention and control groups were not statistically significant because of the relatively low incidence of these injuries and the sample size in the present study.

The injury prevention program had substantially different effects in high- and low-skill players. With respect to the total incidence of injury, significantly fewer injuries were observed only in low-skill teams. The same was true for overuse injuries and traumatic injuries during training. However, the analysis of match injuries in relation to time spent in matches showed that high-skill teams of the intervention group had 30% fewer injuries than did the corresponding control group, whereas in the low-level

teams the difference was 18%. This result might (partly) be caused by different initial conditions in the high- and low-skill teams. In the control group of the present study, the incidence of injuries, especially of overuse injuries and injuries during training, was higher in low-skill than in high-skill teams. Other studies in which researchers have examined the issue of skill level have had somewhat inconsistent findings, although the results of the present study are in agreement with those of Blaser and Aeschlimann[5] and Peterson et al.[27] regarding the incidence of all injuries, and with those of Ekstrand and Tropp,[14] Nielson and Yde,[26] and Peterson et al.[27] concerning the incidence of injuries during practice.

A possible explanation for the higher incidence of soccer injuries in low-skill teams might be that these players have a poorer physical performance capacity than high-skill players. Nonetheless, a recent risk factor analysis demonstrated that no performance variables other than poor endurance had an influence on the occurrence of injury.[9] The lower training-to-game ratio in low-skill teams compared with high-skill teams might result in the low-skill players being not so well prepared for the demands of the match. However, this might be expected to elicit a higher incidence of match injuries but not necessarily overuse or training injuries. Most probably, the differing standards of training and the differing education levels of the coaches and players were responsible for the observed differences in injury rates between high- and low-skill teams.

In the present study, the main emphasis of the interventions was determined, to a certain extent, by the initial situation of high- and low-skill teams, for example, amount and quality of training and physical performance of players. We observed that coaches of low-skill teams seemed to be less well educated than coaches of high-skill teams and, furthermore, the high incidence of injuries, especially training injuries, might indicate a poorer standard of training. As such, the interventions in the low-skill teams were concentrated primarily on improving the structure and methods of training and on increasing the players' physical fitness. In high-skill teams, the standard of training and the physical performance of the players were better than in low-skill teams. Under this condition, the interventions were more focused on improving technical skills and tactics, which might have resulted in the reduction of match injuries.

As a result of the prevention program the incidence of injuries in the low-skill intervention group was similar to that of the high-skill teams without intervention. This was achieved through better education and supervision of coaches and players. Results from the high-skill teams showed that a further prevention of injury, especially of match injuries, was possible.

CONCLUSIONS

The prevention program was effective in reducing soccer injuries, especially in low-skill teams. Coaches and players need better education regarding injury prevention strategies and should include such interventions as a part of their regular training program. However, soccer injuries can be prevented only in part by interventions focused on players and coaches. For the development and implementation of prevention programs, the specific initial situation of the players and their environment should be considered, including extrinsic risk factors such as quality of pitches and equipment. Furthermore, important aspects in the prevention of soccer injury concern also the laws of the game, their observance, and, especially, the spirit of fair play; a broader view and the involvement of other target groups (such as referees, official representatives) would be desirable to make soccer a healthier game.

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