Injury patterns and risk factors in high school futsal: An observational study

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ABSTRACT

Background: Sports injuries at an early age are crucial and must be given attention.
Objectives: This study aims to analyze injury patterns, causative factors, and prevention strategies specific to high school futsal players.
Methods: The research method used was descriptive quantitative with a cross-sectional study approach. The population in this study were male students of State Senior High School 1 Ponorogo who participated in class meeting activities, with purposive sampling technique found 24 samples. Data collected by questionnaire included information on the type of injury, location of injury, causative factors, injury treatment and type of rehabilitation.
Results: The results showed that the most common injuries were cuts/abrasions (29%) and bruises (23%), most common in the lower extremities, namely knees (23%) and ankles (20%), the most common cause of injury was physical contact (54%), most injuries occurred during the second half (67%), the most common first aid given was cold compresses (51%) and the most common rehabilitation/therapy was massage (25%) and physiotherapy (21%).
Conclusions: The findings can be concluded that the most dominant type of injury experienced by students is abrasion, especially in the knee area. In addition, the main causative factors of injury are fatigue, infrastructure, and collisions between players. The results of this study indicate the urgency of implementing injury prevention programs and the importance of conducting post-injury rehabilitation, in an effort to minimize the risk of injury to support the sustainability of students' careers in sports.

Keywords: cold compresses, fatigue, futsal, lower extremities.

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INTRODUCTION

Sport is an effective way to achieve physical fitness and health, whether done individually or in teams. Sport is a type of physical exercise consisting of coordinated and regular body movements that serve to improve a person's spiritual and physical well-being and are useful for realizing one's potential (Prakoso & Rochmania 2018). There are many popular sports in Indonesia, one of the most popular sports in Indonesia is futsal. Futsal is a team sport that is divided into two teams that are played on a closed field with each team consisting of 5 players including the goalkeeper (Kurniawan et al., 2020). Futsal sport is a game sport that is in great demand because both children and adults can participate in this activity, therefore futsal is widely used as a means of sports in schools, where futsal is included as an extracurricular activity that is widely followed starting from elementary school (SD), junior high school (SMP), senior high school (SMA).

As futsal continues to grow in popularity among school students, many schools organize inter-class competitions as part of extracurricular activities or annual sports events. These competitions can give students the opportunity to participate in a sport they are passionate about and also foster healthy competition and teamwork, according to Herdiandanu & Djawa (2020), futsal is categorized as a type of sport that demands high physical strength and stamina because students must actively run and move continuously to score as many goals as possible. The activity is therefore inseparable from situations where players touch each other and interact physically, which can increase the risk of significant injury for the players.

An injury is damage to the outside or inside of the body that can hinder daily activities. Sports injuries generally refer to tissue damage that occurs in the musculoskeletal system caused by physical activity (Fleming, 2016). Bahr & Engebretsen (2009) stated that sports injuries can be defined as damage to body tissues caused by physical activity beyond capacity or improper technique, characterized by symptoms such as pain, edema, and decreased mobility. Injuries can be mild or severe. Every type of sport has a potential risk of injury. Injuries usually occur to muscle tissue, bones or joints causing discomfort to the injured limb and interfering with daily activities. Injuries can result from a variety of factors, of which there are at least three main causes. First, external factors such as physical contact with players, field conditions or sports equipment. Secondly, internal factors such as anatomical abnormalities and muscle weakness. Lastly, overuse of the body.

Previous studies have identified various types of injuries frequently experienced by futsal players. According to Junge & Dvorak (2010), the most common injuries in futsal were lower extremities (69.7%), followed by head and neck (12.7%), upper extremities (10.3%) and body (7.3%). The most commonly injured body parts were the knee (15.8%), thigh (13.9%), ankle and lower leg (12.1%). Most injuries were diagnosed as contusions (44.2%), sprains or ligament ruptures (19.4%) and muscle fiber strains or ruptures (17.6%). According to Wu et al. (2019), the ankle is the area most prone to injury, with 37 cases or 47.4% of the total. The second most commonly injured area was the waist, with 27 cases or 34.6%. The knee joint came in third with 20 cases or 25.6%. Injuries to the head and face came next with 20.5%, followed by the hip and thigh (12.8%), injuries to the foot (16.7%), hand (10.3%), back (9.0%), neck (7.7%), shoulder (2.6%), and chest and arm (1.3%), leg (6.4%). In the goalkeeper position, the most vulnerable area is the waist, with 6 cases (50%). The second most commonly injured position for goalkeepers was the hands, with 4 cases (33%). The

head, face and ankle were the third most commonly injured positions, with 2 cases each (17%). According to Lopes et al. (2023), the most common types of injuries in elite male futsal players included sprains (29%) and muscle ruptures/tears/strains (32%). The main affected body areas were groin (19%), thigh (17%), knee (19%), and ankle (15%). Additionally, noncontact injuries were prevalent, accounting for 65% of reported cases, while 24% of injuries were classified as overuse injuries. This highlights the significant risk of lower extremity injuries in sports.

Although previous research has investigated injuries in futsal players, most studies have focused on elite or professional athletes. For example, Junge and Dvorak (2010) examined injuries in international-level futsal players, with findings predominantly in the lower extremities (69.7%). Wu et al. (2019) analyzed injuries in adult futsal athletes in China, showing differences in injury patterns (47.4% in the ankle). Lopes et al. (2023) studied injuries in elite male futsal players, identifying risk factors such as non-contact fatigue (65%). However, this study focused on an under-explored population, namely high school students in Indonesia. Previous studies did not include the context of school environments with limited facilities (e.g., cement courts) and the developing physical characteristics of adolescent students. As such, these findings complement the existing literature by highlighting the unique risk of injury in non-elite populations and the urgent need for injury prevention at the secondary education level.

This study specifically examines futsal injuries to male students of State Senior High School 1 Ponorogo during class meeting activities. Class meeting is an activity organized by the school to bring together students between classes in various competitions and activities, which are usually competitions in sports such as futsal, basketball, volleyball and e-sport. With this specific focus, the study was able to identify injury types, body parts, causes of injury, and mechanisms of injury in the student population. The research population that is the focus of this study also sets it apart from previous research. While previous studies have often involved professional athletes who have reached the highest level of achievement, this study focuses on students, especially high school students. Thus, this study is expected to provide a more comprehensive picture of injuries in futsal at various levels of ability and experience. An in-depth analysis of injuries allows the identification of injury patterns and risk factors that can be used to develop more effective injury prevention programs. The findings of this study may provide benefits for coaches, athletes, healthcare workers, and schools to improve safety and performance in futsal sport.

The urgency of conducting research on sports injury analysis in futsal class meeting activities at State Senior High School 1 Ponorogo is very important and useful. This research is expected to be a reference in developing an injury prevention program that not only focuses on the physical health aspects of students, but also on the aspects of developing their potential in the field of sports. By preventing injuries early on, students can maintain their motivation and enthusiasm to continue being active in sports, thus improving their overall quality of life. In addition, injury prevention will also help students to maximize their potential in achieving higher sporting achievements, both at the school level and at higher levels. This study helps identify common injury patterns. The findings of this study are expected to contribute to safer and more appropriate training and injury prevention practices for young children, inform the formulation of youth sport safety policies, and open new directions for further research on injury prevention interventions at the grassroots level. This study aims to answer the following questions: 1) What are the most

common types and locations of injuries experienced by high school student futsal players?; 2) What factors are the leading causes of injury in futsal activities in the school environment? 3) How do students manage and rehabilitate after an injury?

METHODS

Study Design and Participants

This study employed a descriptive cross-sectional observational design, a thorough and comprehensive approach, to analyze injury patterns among high school futsal players during class meeting activities. Data were collected at a single time point (December 2023) to evaluate the prevalence and characteristics of injuries. The study included 24 male students from State Senior High School 1 Ponorogo who participated in futsal competitions. Participants were selected via purposive sampling to target injured players meeting the criteria. This method was chosen due to the limited population size (only injured players were relevant to the research objectives) and to ensure data relevance.

Inclusion criteria:

1. Active players who sustained an injury during the class meeting futsal matches.
2. Willingness to complete the questionnaire and provide informed consent.

Exclusion criteria:

1. Players with no reported injuries during the event.
2. Unwillingness to participate or incomplete responses.

Ethical approval statement

The study was approved by the Ethics Committee of Universitas Negeri Malang (No. 11.09.9/UN32.14/PB/2024). All participants provided informed consent.

Research Instruments

Our data collection process was guided by a structured questionnaire, which was developed through three main stages. To ensure the questionnaire's effectiveness, a pilot test was conducted on five students. This test, though not part of the final sample, was crucial in evaluating the questionnaire's clarity and ease of use.

The questionnaire covered several important aspects related to injuries, namely: (1) type of injury (such as abrasions, sprains, etc.), (2) location of injury (lower/upper extremity, etc.), (3) causative factors (contact/non-contact), (4) time of injury (first/second half), and (5) treatment received (cold compress, physiotherapy, etc.). The questionnaire is expected to collect comprehensive and accurate data on injury patterns in student futsal players through this approach.

Data Analysis

The collected data were analyzed using descriptive and inferential statistical approaches with the help of SPSS software version 26. Descriptive statistics were used to calculate frequency distributions and percentages for categorical variables (type of injury, location of injury, etc). Inferential statistics used the Chi-square Test and Pearson Correlation Analysis. The Chi-square test was used to test the association between categorical variables (e.g., association between physical contact factors and time of injury). The primary objective was to determine if there was a significant association between the variables, ensuring the objectivity and credibility of the findings.

RESULTS

This description aims to describe the data, namely the various answers obtained from respondents met in the study to determine the incidence of injuries experienced by male students at State Senior High School 1 Ponorogo.

Types of Injuries

Table 1. Frequency Distribution of Injury Types in Futsal Players of State Senior High School 1 Ponorogo

Question	Type of Injuries	Number (n)	Percentage (%)
What type of injury was sustained?	Abrasions	20	29 %
	Muscle Cramps	15	21 %
	Strain	3	4 %
	Sprain	13	18 %
	Bruise	16	23 %
	Dislocation	2	3 %
	Fracture	0	0 %
	Head Injury	1	2 %
	Others	0	0
	Total	70	100%

Based on Table 1, abrasions were the most dominant type of injury (29%), followed by bruises (23%) and muscle cramps (21%). These findings are consistent with the characteristics of the cement pitches used in matches, where friction between the skin and hard surfaces increases the risk of abrasions. In addition, the lack of use of knee protection/long socks may have contributed.

Table 2. Causes of Injury

Question	Answer	n	Percentage (%)
What caused your injury?	Physical contact	13	54%
	Non-physical contact	11	46%
	Total	24	100%

Based on Table 2, the causes of injuries to students at State Senior High School 1 Ponorogo were physical contact (collision with opponents) totaling 13 (54%), non-physical contact totaling 11 (46%).

Injury Locations

Table 3. The Part of The Body That Injured

Regio	Sub Regio	n	Percentage (%)	Total
Head, Neck	Head	1	1%	2%
	Nose	1	1%	
	Neck	0	0	
Upper Extremities	Shoulder	1	1%	24%
	Elbow	4	5%	
	Hand	9	12%	
	Fingers	5	6%	
Torso	Back	0	0%	1%
	Chest	0	0%	
	Stomach	0	0%	
	Hips	1	1%	
Lower Extremities	Thigh	6	8%	73%
	Knee	18	23%	
	Ankle	16	20%	
	Toes	7	9%	
	Calf	9	12%	
	Shinbone	1	1%	
Total		79	100%	100%

Based on Table 3, the body part that is most frequently injured by students at State Senior High School 1 Ponorogo is the knee with 18 (23%), and the ankle is in second place with 16 (20%).

Table 4. Distribution of Injury Locations on the Player's Body

Injury Locations	Number (n)	Percentage (%)	95% CI*
Knees	18	23	[15.1, 32.9]
Ankle	16	20	[12.8, 29.2]
Thighs	6	8	[3.2, 15.8]
Total	79	100	

CI: Confidence Interval (95% confidence level)

The knee and ankle were the most vulnerable areas (23% and 20%, respectively) (Table 4). This is primarily due to the high intensity of cutting and jumping in futsal, activities that put significant stress on these areas. The lack of use of shoes with adequate ankle support further exacerbates the risk. Non-overlapping confidence intervals (CIs) between sites showed significant differences in the distribution of injuries, highlighting the urgent need for effective injury prevention strategies in futsal.

Injury Causal Factors

Table 5. Time of Injury

Question	Answer	n	Percentage (%)
At what stage did you get injured during the class meeting activity?	First Half	6	25%
	Second Half	16	67%
	Extra-time Round	2	8%
	Total	24	100%

The most common injury experienced by State Senior High School 1 Ponorogo students occurred in the second half as many as 16 (67%) (Table 5).

Table 6. Relationship between Contact Factors and Time of Injury

Variable	OR*	95% CI	p-value**
Physical Contact	2.1	[1.3, 3.5]	0.02
Second half	3.4	[1.8, 6.2]	0.001

**OR: Odds Ratio; *Chi-square Test*

Contact injuries were 2.1 times higher risk (OR=2.1; CI 1.3-3.5) than non-contact injuries (Table 6). Injuries in the second half were more common (OR=3.4; CI 1.8-6.2), presumably due to accumulated fatigue and decreased player concentration. A p-value of <0.05 indicated a statistically significant association.

Injury Management

Table 7. Injury Management

Question	Answer	n	Percentage (%)
What treatment is given when an injury occurs?	Applying cold compresses to the injury site	22	51%
	Administering painkillers	8	19%
	Bandages	8	19%
	Referral to a health facility	5	11%
	Total	43	100%
Who provides first aid in the event of an injury?	Teacher	2	8%
	Medical Team	16	67%
	Committee	6	25%
	Total	24	100%

The most common injury treatment given to students at State Senior High School 1 Ponorogo was the application of cold compresses to the location of the injury, totaling 22 (51%), and the medical team provided the most treatment, totaling 16 (67%) (Table 7).

Table 8. Playing Experience

Question	Answer	n	Percentage (%)
How long have you been playing futsal? *following a club	Less than 1 Year	0	0%
	1-3 Years	3	12%
	4-6 Years	7	29%
	7-9 Years	10	42%
	More than 10 Years	4	17%
	Total	24	100%
How many times have you been injured while actively playing futsal?	1-3 times	4	17%
	4-6 times	9	38%
	7-9 times	3	12%
	10 times more	8	33%
Total		24	100%

Students of State Senior High School 1 Ponorogo actively play futsal for the most time for 7-9 years with a percentage of 42% and experience injuries 4-6 times while playing futsal with a percentage of 38% (Table 8).

Table 9. Types of Rehabilitation/Therapy

Question	Answer	n	Percentage (%)
What type of therapy/rehabilitation did you undergo after your injury?	Physiotherapy	5	21%
	Hot and cold therapy	1	4%
	Medical surgery	0	0%
	Hydrotherapy	0	0%
	Modality therapy	0	0%
	Massage therapy	6	25%
	Not undergoing	12	50%
	Total	24	100%
Do you experience the same injury over and over again?	Yes	19	79%
	No	5	21%
Total		24	100%

The type of injury rehabilitation most frequently undertaken by students of State Senior High School 1 Ponorogo was massage therapy at 25% and the second position was physiotherapy at 21% and 79% of students experienced the same injury repeatedly (Table 9).

DISCUSSION

This study aims to conduct a descriptive analysis of the injury profile of students participating in class meeting activities of futsal sports at State Senior High School 1 Ponorogo. The variables to be studied include the type of injury, the cause of the injury, the time of injury, and the method of handling the injury. Data collection was conducted through a survey method in the form of a questionnaire to students who were injured.

The results indicated that abrasions (29%) and bruises (23%) were the most common injuries among high school futsal players, particularly in the knee (23%) and ankle (20%) areas. These findings are in line with the characteristics of cement courts, where the hard surface increases the risk of abrasions (Kadir et al., 2022).

However, they differ from a study of elite athletes (Marques et al., 2024) who reported sprain (29%) as the primary injury. This suggests that factors such as the type of court (cement vs. vinyl) and the level of competition (student vs. elite) influence injury patterns. The lack of use of protective equipment (such as knee pads) among students is a significant contributing factor, highlighting the importance of promoting their use for injury prevention.

The findings are supported by the "Dynamic Systems Theory" (Bahr & Engebretsen, 2009), which states that sports injuries are the result of an interaction between intrinsic factors: Fatigue (increased injuries in the second half, 67%), extrinsic factors: Hard pitch (Abate et al., 2012) and physical contact (54%), and Lack of recovery: 50% of students do not undergo rehabilitation, increasing the risk of recurrent injury (Defi, 2023).

The most injured body parts in State Senior High School 1 Ponorogo students occurred in the lower extremities with a percentage of 73%, especially in the knees as much as 23% and ankles as much as 20%. This is in line with the results of the study which stated that 85.2% of injuries occurred in the lower extremities, especially in the ankle (Angoorani et al., 2014). According to Abate et al. (2012) the hard and inelastic surface of the futsal court significantly increases the risk of injury, especially to the lower extremity joints. The hardness of these surfaces causes the impact forces generated from physical activity to be unevenly distributed, but instead concentrated on the joints supporting the lower body, thus triggering injuries. The high intensity of futsal play, characterized by the frequency of repeated short sprints, rapid changes in direction, and frequent physical contact, results in significant mechanical loads on the lower extremities of the players.

The findings in this study showed that injuries to the lower extremities were the most prevalent (73%), which is in line with the results of Junge & Dvorak (2010), who reported that 69.7% of injuries in soccer occurred in the same body area. This similarity indicates that the lower extremities remain the most vulnerable to injury in soccer and futsal, mainly due to the high involvement of these limbs in activities such as running, kicking, and quick maneuvers. However, there are significant differences in the causes of injury. This study found that injuries due to physical contact dominated (54%), whereas research conducted by Lopes et al. (2023) on elite athletes showed that most injuries (65%) were non-contact in nature. These differences can be attributed to variations in playing techniques, experience levels, and coach supervision. In addition, the intensity of matches at the grassroots level, which are more spontaneous and not always supported by strict regulations or game structures, also contributes to the high proportion of injuries due to physical contact.

The causes of injuries experienced by students of State Senior High School 1 Ponorogo occurred due to physical contact with other players with a percentage of 54% and non-contact with a percentage of 46%, This is in accordance with the results of research conducted Hamid et al. (2014) shows that the incidence of injury in contact sports is often positively correlated with the level of physical interaction between players. Both contact with opponents and teammates can trigger trauma due to excessive impact, pulling or pressure on soft tissue and bone. The causes of injuries experienced by State Senior High School 1 Ponorogo students showed that injuries due to physical contact with other players dominated, with a percentage reaching 54%. This indicates that direct interaction in the game, such as collisions or bumps, is the main factor causing injuries among students. On the other hand, non-contact injuries, which include injuries due to internal factors such as fatigue, incorrect

technique or inadequate physical condition, accounted for 46% of the total injuries. Although the percentage is lower, non-contact injuries are still significant and show that technique and fitness aspects also need to be considered in injury prevention efforts. Thus, it is important for schools and coaches to develop training programs that not only focus on avoiding risky physical contact, but also improve students' playing techniques and physical fitness, in order to reduce the overall risk of injury.

The results showed that injuries occurred more in the second half (67%) than the first half (25%), reflecting the difference in physical condition and intensity of play in the two halves. In the first half, players are still in optimal physical condition, with enough energy to maintain coordination and focus, so the risk of injury is relatively lower. In contrast, in the second half, the accumulation of physical and mental fatigue, decreased reflexes, and increased psychological pressure make players more susceptible to injury. In addition, physiological factors such as lactic acid buildup due to intensive anaerobic metabolism during the first half can also affect muscle performance and increase the risk of injury. The accumulation of lactic acid can lead to muscle fatigue, cramps, and decreased endurance, making players more susceptible to injury. According to Bangsbo & Hostrup (2019), lactate accumulation leads to a decrease in muscle pH, resulting in acidosis, which impairs muscle contractility and efficiency. According to Ishii & Nishida (2013), the buildup of lactic acid can provide information to the brain about the level of muscle fatigue. This information will affect how the brain recruits muscle fibers to contract during physical activity. This can affect the performance of one's ability to play sports. This difference underscores the importance of fatigue management, player rotation strategies and a focus on recovery during half-time to reduce the risk of injury, especially in the second half. The combination of physical fatigue and the desire to win the match can reduce a player's performance and physical condition (Riffai, Imanudin, & Hamidi, 2018). They increase the risk of sports injuries by impairing balance, motor skills and decision-making processes. This increases vulnerability to injury, and environmental factors such as poor pitch conditions, are thought to contribute to the increased risk of injury in the latter stages of matches.

The data results showed that cold compress was the most commonly applied treatment modality for injured class meeting participants, with a percentage of 51%. This choice was influenced by various factors, including ease of application, as well as limited availability of resources. This indicates that cold compress is considered an effective initial treatment to reduce inflammation and pain. According to Kristiani (2019), cold therapy is effective in relieving inflammation and muscle spasms that often occur after a sports injury. It also helps to reduce bleeding in the injured tissue, thereby accelerating the healing process. These findings support the effectiveness of compresses as a non-pharmacological intervention in pain management and joint function recovery. The data obtained showed that 67% of class meeting participants who were injured received immediate treatment from the medical team. According to Pasternak & Krabak (2020), medical teams at sports competitions are essential to ensure athlete safety, manage emergencies, and provide immediate care. The findings indicate that the presence and intervention of the medical team is crucial in providing appropriate and effective first aid.

The impact of an injury can have a significant impact on a person's abilities. According to Reese, Pittsinger, & Yang (2012), injuries in athletes can trigger high levels of anxiety, hindering optimal performance on the field. According Sun (2023), injuries can lower an athlete's confidence and cause anxiety, especially when

returning to competition. The fear of re-injury often discourages athletes from taking risks to perform complex or aggressive movements, which in turn can limit their ability to compete effectively. Sports injuries not only impact the physical aspect, but can also have a significant psychological impact on a person According to Cheon & Lim (2020), regular physical activity, such as exercise, has been shown to be effective in reducing stress levels in individuals. Physical activities such as exercise can actually reduce stress and anxiety levels, improve mood, support the healing process of mental disorders, and strengthen social relationships (Shalahuddin, 2024). Physical injuries often prevent physical activity, especially sports, which in turn can trigger mental health issues. Lack of physical activity due to injury can lead to a decrease in the production of endorphins, a mood-boosting hormone, triggering feelings of lethargy, irritability and stress. The inability to perform normal activities can also lead to frustration and hopelessness, worsening one's mental state.

The data showed that the most common rehabilitation/therapy was massage (25%) and physiotherapy (21%). 50% of the 24 students who did not undergo injury rehabilitation eventually re-experienced the previous injury and of the 12 students who underwent injury rehabilitation 42% of students did not experience the same injury and 58% of students experienced the same injury repeatedly, this can happen according to Kim (2008), the tendency of some athletes to return to training before the injury recovery process is complete can result in more serious re-injury. According to Defi (2023) a person who does not follow a recovery program properly risks a longer recovery period and a higher chance of re-injury. Although the percentage of students who had a recurrent injury was higher in the rehabilitation group, it is important to note that rehabilitation provided benefits to 42% of students who did not have the same injury. This suggests that although rehabilitation does not completely eliminate the risk of re-injury, the intervention may help some students to recover better and reduce the likelihood of future injuries. Therefore, it is important to evaluate and improve rehabilitation programs to make them more effective in preventing re-injury among students. There is a significant relationship between the length of time a person has been involved in the sport of futsal and the risk of recurrent injury. Students who have practiced futsal for a longer period of time (4-10 years) tend to experience injuries more frequently, reaching more than 7 times. The length of experience playing futsal can be one of the risk factors for recurrent injuries. This indicates that the longer a person practices, the potential for injury increases. The fact that recurrent injuries are more common in those with long experience shows the importance of good injury management. Athletes with more experience need to pay more attention to injury prevention, proper treatment, and rehabilitation programs to minimize the risk of recurrent injuries.

Preventive efforts to reduce the incidence of injury in futsal players require a varied approach, Pre-workout physical activity or warm-up aims to increase body temperature, muscle elasticity, and joint agility, thus minimizing the possibility of strains, sprain, or other acute injuries. According to Febyadevani et al. (2023), a proper warm-up increases blood flow to the muscles, thus ensuring an adequate supply of oxygen and nutrients. This can minimize the risk of muscle cramps and strains. Through warm-up, the muscles are protected from the risk of injury due to sudden and intensive movements, thereby minimizing the chance of unwanted muscle stress (Permata, 2023). According to Khairunnisa et al. (2024), the FIFA 11+ program can be recommended as an effective warm-up protocol to reduce the risk of injury in various sports. Research shows that by warming up using the FIFA 11+

program, the likelihood of sustaining an injury can be reduced by almost half (46.1%). Not only that, even if an injury does occur, the time taken to recover and return to activity can also be shorter (reduced by 28.6%). The program is designed to improve the body's functional readiness before physical activity through a series of specific exercises. The exercises significantly improve muscle strength, especially in the knee joint stabilizing muscle group, which is a commonly injured area. This creates an optimal microenvironment for muscle metabolism, increases muscle elasticity and accelerates the process of tissue repair, thus indirectly reducing the risk of injury.

The findings of this study have important implications for coaches, schools, and the development of academic literature in sports injury prevention. From a practical perspective, coaches and sports teachers are advised to implement structured warm-up programs such as FIFA 11+, effectively reducing the risk of injury in young athletes (Khairunnisa et al., 2024). In addition, using courts with softer surfaces such as vinyl can help reduce the risk of skin abrasion due to direct impact with hard surfaces. In the context of school policy, there need to be regulations that require protective equipment such as knee pads and ankle supports in every extracurricular futsal activity. Schools also need to consider limiting the duration of matches, for example, to 2×20 minutes, as a mitigation measure against excessive fatigue that risks causing injury.

Theoretically, this study enriches the literature on the epidemiology of sports injuries, particularly in the under-researched non-elite adolescent population. The findings open up opportunities for future research that can test the effectiveness of injury prevention interventions explicitly tailored to the characteristics and needs of adolescent populations. Future research could also explore the adaptation of prevention programs such as FIFA 11+ in the context of physical education and extracurricular activities in schools. Thus, the results of this study not only contribute to the development of science and provide a basis for education and health policies that are more responsive to the safety of learners in sports activities.

Limitations of the study

One of the limitations of this study is that it has a limited sample criteria, so it cannot represent the entire population of young athletes. The use of questionnaires or interviews can be influenced by social and psychological factors such as the desire to please the researchers, which may lead to biased responses. Finally, the study's results may not apply to types of sports with different characteristics from football games.

CONCLUSIONS

The current study reveals that the most frequent injuries sustained by high school futsal players are skin-related, such as cuts and abrasions, predominantly affecting the lower limbs—especially the knees. These injuries tend to occur more often during the second half of matches. Immediate injury response, with medical personnel playing a crucial role, is vital in these situations. This research is one of the first to examine the injury trends and types among high school futsal players, offering important insights into this less-explored group within youth sports. The results also show that ankle sprains and knee injuries are particularly prevalent, with physical contact being a significant factor.

Given these findings, schools need to adopt structured injury prevention strategies. Implementing warm-up routines like the FIFA 11+ program and improving the quality and safety of sports facilities should be prioritized. Coaches and school staff, as the frontline of student-athlete safety, must actively promote injury awareness and educate students on how to avoid risks.

Preventing injuries in student-athletes is vital not only for immediate safety but also for maintaining long-term athletic potential. A holistic approach—including proper training, facility inspections, effective injury protocols, and comprehensive rehabilitation—can reduce injury rates and enhance recovery, ultimately supporting students' performance and well-being.

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DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, RJA. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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CONFLICT OF INTEREST

The author officially certifies that there are no conflicts of interest with any party with respect to this research.

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