

Research Paper

The Strategy of Preventing Sports Injuries Among School Students With A Grounded Theory Approach



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ABSTRACT

Purpose: This study aimed to introduce a preventive strategy for minimizing sports-related injuries among students enrolled in Iranian schools, utilizing the grounded theory approach.

Methods: The qualitative research methodology using the grounded theory method was employed. Data were gathered through a combination of examining written documents and conducting semi-structured interviews with 15 esteemed professors in the areas of sports pathology and physical education instruction. The sampling process was conducted intentionally and continued until it reached theoretical saturation. To scrutinize the information collected, a constant comparison analysis approach was utilized across three distinct stages, which included open, axial, and selective coding. By scrutinizing the data, a total of 13 primary classifications along with 36 sub-classifications and 182 conceptual codes were identified.

Results: The findings indicated that some contextual factors played a role as causal factors in the issue, including unfavorable weather conditions, students' lack of motivation, teachers' lack of enthusiasm for teaching, non-standardized competitions, mental and psychological difficulties, over-emphasizing competition in gameplay, teacher-student ratio disproportion, the absence of a physical education instructor, and classroom capacity. In addition, inadequate sports equipment, insufficient sports space, and environment, school principal's attitude toward sports, officials' attitudes, issues with temperature regulation, physical fitness factors, anatomical condition, biological characteristics, sports history, incorrect techniques, and repetitive skills were regarded as contextual factors. The model's intermediate variables also encompassed various factors, such as the expertise and experience of teachers, their completion of first aid courses, and the presence of a sports assistant. Additionally, it included the knowledge of students and parents, the economic situation of their families, the ability of teachers to motivate and discipline the class, and their ability to ensure order in the classroom. Ultimately, some measures were proposed to prevent sports injuries among students including alterations to existing laws and regulations, an increase in the number of physical education hours, an increment in the budget, the development of an annual program, the utilization of protective equipment, the display of safety posters, medical health assessments, the formation of scientific and specialized task groups, and collaborating with other organizations.

Conclusion: By implementing these strategies, it appears that physical education teachers can significantly reduce the incidence of sports-related injuries among their students.

Keywords:

Strategy, Sports injuries, Preventing, Student

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Highlights

- Getting to know the causal, intervening, and background factors that cause sports injuries in students and lead to injury reduction.
- By implementing strategies to prevent sports injuries in schools, many injuries can be avoided during physical education classes.

Plain Language Summary

Each year, a significant part of students encounter physical injuries resulting from sports-related incidents and falls, often leading to significant and irreversible implications for them. Some notable consequences arising from these injuries include the lifelong abandonment of activities and sports, anxiety and apprehension toward engaging in such pursuits, feelings of isolation and depression, chronic pain, and diminished physical fitness levels. The concern surrounding the incidence of sports injuries resulting from children's physical activity in schoolyards or sports facilities is an issue that both professionals and parents find worrisome. This study used the grounded theory approach and interviews with sports pathology professors and physical education teachers to explore two topics. The first topic was the identification of sports injuries and their risk factors, and the second was the solutions that can prevent and reduce sports injuries in students. The goal was to provide solutions for the implementation of these solutions so that students have fewer injuries and absenteeism and participate more in physical education classes.

1. Introduction

Students form an integral part of a country's human resources and spend a significant part of their lives in the school environment. Apart from focusing on academics, students also engage in physical education and the development of fundamental skills within the school setting [1]. Sports and physical education have a crucial role in preserving the health and overall well-being of students as they go through their formative years [2]. Physical education is an educational procedure that utilizes physical activity as a tool to assist students in acquiring abilities, readiness, knowledge, and a positive mindset toward achieving desired development and overall well-being and optimal opportunities to engage in physical activities [3].

It appears that a significant portion of children's development is impacted by the transformations occurring in their surroundings. The most conspicuous characteristic of the modern age is the swift advancement of technology, which has led to decreased physical activity among various groups. Consequently, students are facing heightened risks, and increased weight and reduced mobility are the initial consequences of this prevailing social phenomenon. To address these issues, sports science experts propose exercise and physical activity as two effective and essential solutions for safeguarding individuals, particularly children, teenagers, and young

students. However, this specialized approach also entails certain repercussions, such as sports injuries that demand specific attention. Failing to provide proper care in such cases can expose students to physical and mental complications and incur irreparable financial losses and expenses [2].

Each year, a significant part of students encounter physical injuries resulting from sports-related incidents and falls, often leading to significant and irreversible implications for them. Some notable consequences arising from these injuries include the lifelong abandonment of activities and sports, anxiety, and apprehension toward engaging in such pursuits, feelings of isolation and depression, chronic pain, and diminished physical fitness levels. The concern surrounding the incidence of sports injuries resulting from children's physical activity in schoolyards or sports facilities is an issue that both professionals and parents find worrisome. Sometimes this concern becomes so much that despite the strong passion of parents for sports, they choose preventive measures. In most cases, these measures involve restricting children's participation in activities or entertaining them through alternative means, such as computer games [4]. According to Soghrati Ghasbe, out of all the incidents investigated in the community, the highest proportion, specifically 31.16%, took place within school premises. This indicates that for every 1000 individuals, approximately 26 people experience sports injuries, with the highest rate observed among children aged 5-14 years

[5]. Similarly, a study conducted in Shiraz schools in 2016 revealed that 3.16% of school accidents occurred during sports activities, while an additional 41.9% were attributed to falls that transpired within sports areas [6].

Instances of injuries resulting from inadequate safety measures are prevalent in various countries. For instance, a study conducted in the United States revealed that 19% of accidents involving children occurred within school premises, ranking second only to home-related accidents [7]. Similarly, Langley et al. assessed students in Otago, New Zealand, and indicated that school accidents accounted for 24.5% of all reported incidents [8]. Furthermore, Roderick from the United States declared over 200,000 injuries annually in students during play, with approximately 75% of these injuries attributed to playground collisions [9]. According to Knight et al., approximately 20% of all school injuries in children and adolescents aged 5 to 18 years take place outside the classroom during physical activities [10]. Additionally, Abernethy et al. revealed that the majority of injuries among children and adolescents at school occur during physical education lessons [11].

Numerous studies have been conducted to explore the factors contributing to sports-related injuries, as outlined by injury prevention models by Van Mechelen et al. [12] and Meeuwisse [13]. These causes can be categorized into groups of internal and external risk factors [14]. Internal factors refer to attributes, such as strength, endurance, age, gender, flexibility, and psychological aspects related to the individual's body. On the other hand, external factors encompass environmental elements that affect athletes during training and exercise. In this context, various factors can be identified, including unsuitable sports grounds, improper footwear, absence of standardized sports protective gear, unfavorable weather conditions, and non-compliant spaces [15]. Based on the instances mentioned above, students are not exempt from the risk of injuries while participating in sports activities within school settings and remain susceptible to such incidents. Ghadimi et al. (2009) conducted a study on sports injuries in schools and found that contusion accounts for 38.6% of the most frequent injuries among students. The unsuitable condition of the sports ground is identified as the most crucial external factor, contributing to 40.9% of injuries. In addition, the impact mechanism is determined to be the primary cause of injury among students, accounting for 72% of the cases [16]. A study conducted on the occurrence of sports injuries and falls among male and female students in Iran revealed that 457 students (10.42%) experienced injuries. Among them, the maximum number of injuries was observed in

female students (62.4%) when they were outside the gym bell (35.4%) and without the presence of a physical education teacher (67%). On the other hand, 45.4% of the injuries among male students occurred during the gym bell while the gym teacher was present (61.6%). Among classes with a larger student population, girls were found to have a higher risk of injury (49%). Conversely, boys in classes with a smaller population experienced more injuries (39.6%). When examining different sports, the highest number of injuries among boys occurred in football (69%) and futsal (11.6%), whereas girls had a higher occurrence of injuries in volleyball (17.2%) and handball (4.7%). The majority of injuries took place in overcrowded classrooms [17]. As students grow older, the percentage of sports-related injuries tends to increase. Consequently, the number of sports injuries among high school students is notably higher than that of elementary school students [18]. Specialists and coaches strive to achieve the goal of reducing and eliminating sports injuries by examining their causes and contributing factors. By understanding the injury mechanism and identifying the factors that influence their occurrence, such injuries can be prevented [19]. The investigation of injury mechanisms is also a significant aspect of epidemiological studies on sports injuries. Athlete students, both male and female, experience injuries through distinct mechanisms, and being aware of these mechanisms enables the development of injury prevention recommendations.

In the context of anterior cruciate ligament (ACL) injury, an essential factor is how athletes land, as it exerts excessive pressure on their lower body, particularly the knee. Instructing proper landing techniques plays a crucial role in preventing ACL injuries among students, especially female athletes [20]. Research has indicated that implementing injury prevention strategies is beneficial and effective in minimizing potential injuries across different sports [21]. Measures, such as maintaining optimal physical fitness, engaging in proper warm-up routines before training and competition, wearing appropriate sports attire, utilizing suitable sports equipment, and adhering to sport-specific equipment guidelines are among the methods employed to prevent injuries [15]. Furthermore, several studies have been conducted on the implementation of sports injury prevention strategies within schools in certain countries. For instance, a study conducted at the New Metal Show in Australia revealed that preventive measures, such as improving physical fitness and skills, including proprioception exercises, have the potential to decrease the occurrence of sports injuries in school [22]. Another study implemented a program called neuromuscular training (NMT) during physical education classes in schools to mitigate sports-related

injuries [23]. Research findings consistently demonstrated that employing preventive measures significantly reduced the risk of sports injuries [24]. To address injury prevention, various models have been introduced, with one of the most widely utilized being the injury prevention research model developed by Van Mechelen et al. in 1992 [12].

1. Injury identification: Frequencies, prevalence, temporal course, severity, and consequences (disorders, disabilities, and costs).
2. Identifying the causes of injury: Risk factors and injury mechanism
3. Introducing a preventive program
4. Evaluating the effectiveness or cost-effectiveness of preventive measures with first-step repetition [25].

Without a doubt, this model has been widely used for injury prevention over the past ten years. It originated from the prevention and public health model adapted to the sports field. However, it should be noted that this model primarily serves as a research tool in the prevention field rather than an operational framework for implementation. Furthermore, according to Finch and Donaldson, Van Mechelen's model is not effective in delivering comprehensive guidelines for research focused on direct injury prevention efforts [26]. Since the causes of injuries can vary in each society due to factors, such as conditions, facilities, and program types, it is valuable to identify injury factors from the perspective of physical education professors and teachers. These professionals, who share similar circumstances and possess practical knowledge, can offer useful insights to education ministry officials and planners. This information can then be utilized to develop appropriate strategies to prevent sports-related injuries among students. Given the absence of prior research on comprehensive approaches to school sports injury prevention, this study aimed to formulate a preventive model specifically designed for students. The objective was not only to identify the factors that contribute to injuries but also to ascertain their relative significance or impact. This will enable more effective planning, with a focus on prioritizing necessary improvements to existing conditions within physical education hours, fostering a safer environment that minimizes student injuries.

2. Materials and Methods

This study falls under the category of qualitative research, specifically suited for its practical nature and research objectives. Its primary goal was to develop a model for preventing sports injuries among students in schools. The research employed a heuristic approach using a qualitative research method known as the grounded theory approach. By employing a systematic approach rooted in grounded theory, a total of 15 people were chosen. The participants consisted of professors specializing in sports pathology within the field of physical education in schools, as well as physical education teachers actively involved in teaching the subject. Following the sampling principles of phenomenological research, a purposeful selection process was employed, ensuring the inclusion of individuals who could contribute valuable insights. Through purposeful interviews conducted under the concept of theoretical saturation, the necessary information was gathered to identify the key components of the theoretical model. In qualitative research, the process of collecting data concludes when saturation is achieved all desired categories are adequately covered, and there are no new insights or information obtained regarding the investigated theory or narrative. In this particular research, theoretical saturation was achieved during the 13th interview. However, to ensure thoroughness, two additional interviews were conducted. During this phase of the research, a semi-structured in-depth interview approach was employed as the data collection tool. The individual interviews with the participants involved the utilization of interview questions that were specifically designed to align with the research topic and the dimensions of the grounded theory. These initial inquiry questions are outlined in Table 1. Also, alongside each question, the researcher also posed additional sub-questions to gain a comprehensive understanding of the participants' experiences throughout the interview process.

Once the researchers made the required preparations, they went to the interviewee's workplace. They used a tape recorder to record the conversations during the interview, with the interviewee's permission, to extract codes. It is important to mention that this process took place after each interview, and the duration of each interview ranged from 30 to 50 minutes.

The recorded interviews underwent a coding process, where each line was analyzed according to the systematic grounded theory [27]. The data analysis followed the instructions of Strauss and Corbin, which involved three stages: Open coding, axial coding, and selective coding [28].

Table 1. Interview questions

No.	Questions
1	What are the factors that cause sports injuries to be prevented among school students in Iran?
2	What are the underlying factors that contribute to sports injuries among students in schools?
3	What are the influential factors that effectively impact sports injuries among students in schools?
4	What are the effective approaches to minimize sports injuries among students in schools?
5	What are the outcomes of effectively preventing sports injuries among students in schools?

PHYSICAL TREATMENTS

During the initial stage of open coding, a total of 61 codes were identified. After eliminating duplicate ideas, the number of codes was reduced to 36. In the second stage, these similar codes were grouped into 13 classes. For each class, a title was selected that encompassed all the codes within that particular class. Classes possess a significant level of conceptual effectiveness as they are capable of encompassing various concepts within their domain. The researcher primarily handpicked the chosen titles based on their utmost relevance and consistency with the corresponding data. During the central coding stage, the concepts derived from the initial open coding phase were connected in the form of a paradigm model, which included causal conditions, central phenomenon, contextual factors, intervening factors, strategies, and consequences. In the subsequent selective coding stage, regarded as the primary phase of grounded theory, the central class was systematically linked to other classes, and these relationships were illustrated within the framework of the presented model. It is important to note that

the coding process was performed manually. Figure 1 shows the research methodology framework. Also, Figure 2 indicates the axial coding paradigm model.

Data validity and reliability (research reliability)

In this study, the validity was checked by presenting the findings to the participants and having them review the theory text and provide feedback. The final theory was then revised based on input from both the participants and professors. The process audit is a way to demonstrate the reliability of the study. The reliability of the results can be audited by having another researcher review the decision-making process used during the interview. To ensure the reliability of the data, the researcher provided all raw and analyzed data, codes, categories, study processes, objectives, and questions to supervisors and advisors. The accuracy of each step was confirmed through a thorough audit by experts.

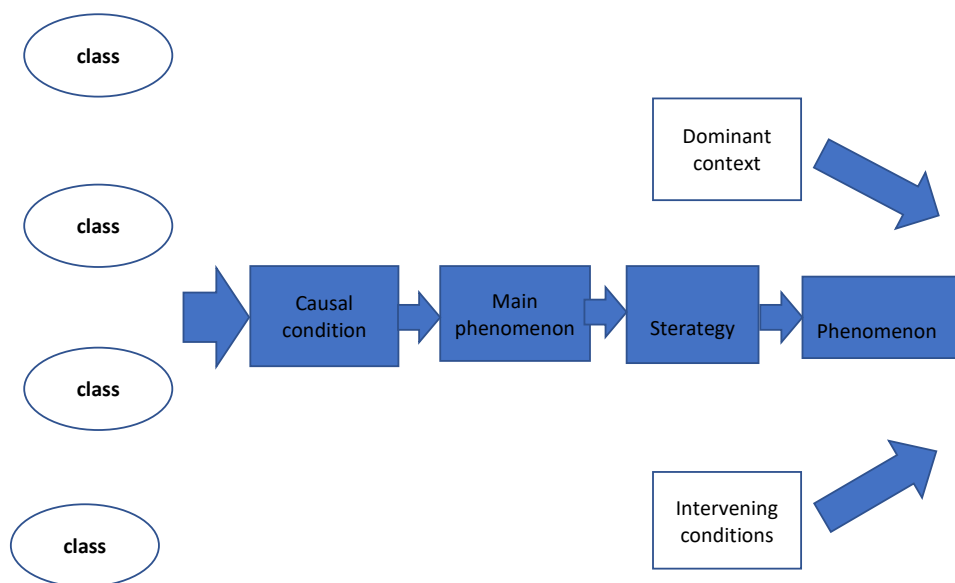


Figure 1. Research methodology framework

PHYSICAL TREATMENTS

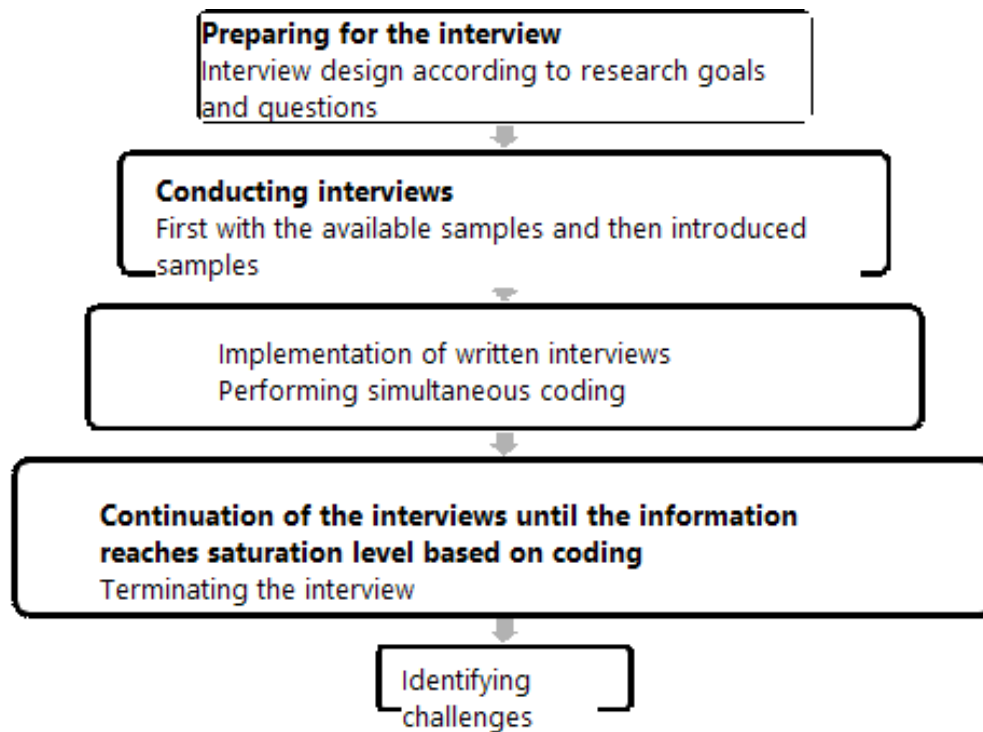


Figure 2. Axial coding paradigm model

3. Results

Demographic characteristics of the interviewees

In this study, data were collected through interviews with 15 experts, whose characteristics are detailed in Table 2, as the sample population.

Step 1: Open coding

A) Initial coding of a sample of interviews

Table 3 indicates open coding and primary codes.

After this phase, the concepts identified through open coding were regularly compared and reviewed. Open codes that were thematically similar were grouped under a subcategory. Figure 3 illustrates an example of how primary codes were connected to a subcategory.

Step 2: Axial (theoretical) coding of the qualitative study

Axial coding, the second level of coding in grounded theory, refers to the process of developing and connecting the main categories identified during open coding. Table 4 presents axial coding and its frequency.

Step 3: Selective coding of the qualitative study

Selective coding, the third stage of analysis in grounded theory, involves the selection of a central aspect of the data as a “core category” and focusing on it. The same techniques used in axial and open coding are applied but at a higher level of abstraction.

Causal conditions

In this model, causal conditions refer to events that give rise to situations and issues related to a phenomenon and explain why and how individuals and groups respond in specific ways. Table 5 indicates the classifications of causal conditions.

Contextual conditions

Contextual conditions represent a set of characteristics related to the phenomenon, typically referring to the location and events associated with it (Table 6).

Intervening conditions

Intervening conditions refer to general factors, such as time, location, and culture that can influence strategies by presenting opportunities or threats (Table 7).

Table 2. Demographic characteristics of the interviewees

Interviewee	Gender	Education Level	Area of Expertise	Teaching Experience (y)
P1	Female	Pathology of corrective movements, PhD	University professor	25
P2	Male	Pathology of corrective movements, PhD	University professor	25
P3	Male	Pathology of corrective movements, PhD	University professor	23
P4	Male	Pathology of corrective movements, PhD	University professor	27
P5	Male	Pathology of corrective movements, PhD	University professor	29
P6	Female	Pathology of corrective movements, PhD	University professor and physical education teacher	20
P7	Male	Pathology of corrective movements, PhD	University professor and physical education teacher	15
P8	Male	Pathology of corrective movements, PhD	University professor and physical education teacher	15
P9	Female	Pathology of corrective movements, PhD	University professor and physical education teacher	18
P10	Male	PhD student in pathology of corrective movements	University professor and physical education teacher	15
P11	Male	PhD student in pathology of corrective movements	And physical education teacher	14
P12	Male	PhD student in pathology of corrective movements	And physical education teacher	16
P13	Male	PhD student in pathology of corrective movements	And physical education teacher	15
P14	Male	PhD student in pathology of corrective movements	And physical education teacher	13
P15	Male	PhD student in pathology of corrective movements	And physical education teacher	24

Table 3. Open coding and primary codes

Primary Code	Concept	Respondent
Mental and psychological problems	It can be crucial to identify and manage students who exhibit hyperactivity and stress during physical education classes.	P2
Warming up and cooling down	It is important to instill in students the significance of warming up and cooling down during sports and physical education classes so that they are motivated to do it properly.	P2
Protective equipment	During physical education classes, students are required to wear suitable athletic clothing and footwear.	P2
Physical fitness factors	Physical fitness levels should be assessed at the start of the school year to make the necessary preparations for improvement.	P2
Climate	In inclement weather, there is an increased risk of sports injuries and students may discontinue their participation in sports activities.	P2
Economic conditions of the family	Students from economically disadvantaged backgrounds may be at a higher risk for sports injuries due to inadequate nutrition or lack of proper footwear and clothing.	P2
Annual lesson plan revision	Lesson plans implemented annually should span from elementary to high school and be tailored to the age-specific characteristics of the students.	P2
Amendment of rules and regulations	The teacher should review and update school sports rules and regulations annually.	P2
Cooperation of other organizations	Organizations, such as the municipality, the Red Crescent, and medical centers should collaborate with educational institutions to provide educational and medical services.	P2
Absence of sports teacher	The absence of a physical education teacher during class can result in overcrowding and lack of supervision, increasing the risk of injuries among students.	P2

Table 4. Axial coding and its frequency

Primary Classifications	Frequency	Axial Coding
	11	Teachers' awareness
Teachers' awareness	3	Experience
	6	Participation in first aid courses
Students' awareness	9	Students' awareness
	12	Parents' awareness
Family	4	Economic conditions of the family
	11	Sports equipment and facilities
Sports equipment and facilities	12	Space and sports environment
	10	Heating and cooling
	10	Physical fitness factors
Physiological factors	3	Anatomical condition
	2	Biological characteristics
	7	Sports history
Teacher skills	6	Incentive and punishment points in the class
	1	Ability to control the class
	8	School principal
Attitude	3	Officials' attitude
	3	Incorrect techniques
Sports skills	3	Repetitive skills
	8	Protective equipment
Safety	2	Safety posters
	1	Sports medicine health assessment
Connections	5	Cooperation of other organizations
	2	Specialized scientific working groups
	7	Amendment of laws and regulations
Revising the rules	4	Increasing hours of physical education
	1	Budget per capita
	5	Revising the annual lesson plan
	2	Unfavorable weather conditions
Injuries factor	2	Teachers' lack of enthusiasm for teaching
	1	Non-standardized competitions
	4	Mental and psychological difficulties
	2	Over-emphasizing competition in gameplay
	1	Teacher-student ratio disproportion
Conditions of physical education class	2	The absence of a physical education teacher
	9	Classroom capacity
	6	More student participation
Student participation	5	Safety and health
	4	Absence and medical expenses

Table 5. Classifications of causal conditions

Primary Classifications	Sub-classifications	Classifications
Injuries factor	Unfavorable weather conditions	P2, P10
	Students' lack of motivation	P4
	Teachers' lack of enthusiasm for teaching	P8, P13
	Non-standardized competitions	P9
	Mental and psychological difficulties	P5, P8, P10
	Over-emphasizing competition in gameplay	P8, P11
Conditions of physical education class	Inadequate number of teachers to students	P15
	The absence of a physical education teacher	P2, P7,P3
	Classroom capacity	P3, P6, P9, P10, P12, P13, P14

PHYSICAL TREATMENTS

Strategies

Strategies refer to the plans and actions that result from the central category of the model and lead to consequences. They are a set of measures taken to manage, address, or respond to the phenomenon being studied (Table 8).

Consequences

Consequences are the outcomes or results of actions and reactions. Through open coding, the concepts associated with the model's consequences were identified. Subsequently, extraction and labeling occurred based on the reciprocal interactions between the axial phenomenon and the strategies. The consequences were then determined using this process (Table 9). Also, Figure 4 illustrates the strategic model to prevent sports injuries of students in schools.

4. Discussion

Extensive research has established the beneficial impact of physical exercise across multiple domains, including physical, psychological, personal, and social aspects. However, a negative aspect is the prevalence of sports-related injuries that afflict a significant number of athletes, including students, each year. These injuries lead to temporary or permanent disruptions in their sporting endeavors, incurring medical expenses, fostering negative attitudes toward sports, and causing other adverse consequences. As a result, it is very important to know the effective factors in the occurrence of these injuries and to devise effective solutions for prevention and reduction, because this can be very useful.

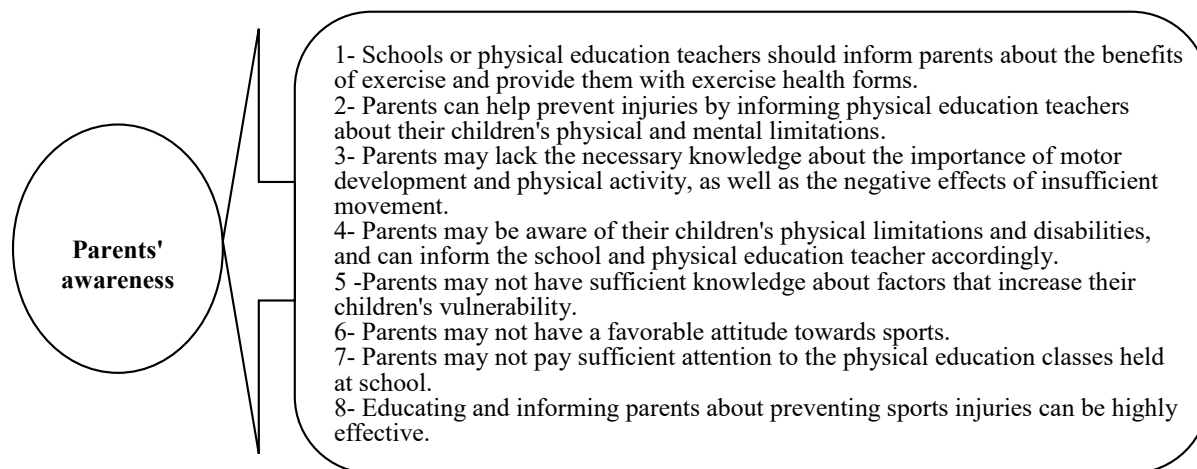


Figure 3. A sample of connecting open codes

PHYSICAL TREATMENTS

Table 6. Classifications of contextual conditions

Primary Classifications	Sub-classifications	Classifications
Sports equipment and facilities	Sports equipment and facilities	P1, P4, P5, P8, P10, P11, P12, P13, P14, P15
	Space and sports environment	P4, P5, P7, P9, P11, P12, P13, P14, P15
Attitude	School principal	P3, P4, P5, P11, P12, P13, P14
	Officials' attitude	P1, P4, P8
Physiological factors	Warming up and cooling down	P2, P3, P6, P7, P8, P10, P11, P13, P14, P15
	Physical fitness factors	P2, P6, P9, P11, P12, P14, P15
	Anatomical condition	P3, P6, P10
	Biological characteristics	P7, P12
	Sports history	P10, P12, P13, P14, P15
Sports skills	Incorrect techniques	P4, P6, P7
	Repetitive skills	P3, P6, P10

PHYSICAL TREATMENTS

The research findings revealed that the 13 main categories, 36 subcategories, and 182 conceptual codes were among the significant factors associated with sports injuries among students in schools.

The findings of this study indicated that factors, such as weather conditions, students' lack of motivation toward sports, physical education teachers' lack of motivation, non-standard competitions, mental and psychological issues, transforming games into competitive events in school sports, teacher-student ratio disproportion, the absence of sports instructors, and limited capacity of sports facilities during physical education classes were significant contributors to sports injuries among students in schools. A study

conducted by Aslankhani et al. (2002) [37], addressed this issue. The lack of essential and comfortable living facilities, inadequate salaries and benefits for teachers, their inclination towards non-sports jobs to earn a higher income, insufficient sports facilities and equipment, as well as time-consuming administrative procedures are the factors contributing to this lack of motivation [29]. Livington (1996) identifies several issues in physical education lessons in schools, including lack of motivation, lack of interest, and a negative attitude among both students and teachers. Additionally, teachers often neglect the evolving needs of schools and students. These problems contribute to students' lack of motivation to participate in physical education activities, their disinterest in warming up and cooling

Table 7. Classifications of intervening conditions

Primary Classifications	Sub-classifications	Classifications
Teacher awareness	Teachers' awareness	P1, P4, P7, P8, P11, P12, P13, P14, P15
	Experience	P1, P3, P5
	Participation in first aid courses	P4, P5, P9, P15
Teacher skills	Incentive and punishment points in the class	P10
	Ability to control the class	P3
Family	Parents' awareness	P1, P3, P4, P5, P7, P9, P10, P11, P12, P13, P14
	Economic conditions of the family	P2, P5, P6, P10
Students' awareness	Students' awareness	P1, P3, P5, P7, P9, P11, P13, P14

PHYSICAL TREATMENTS

Table 8. Classifications of strategies

Primary Classifications	Sub-classifications	Classifications
Revising the rules	Amendment of laws and regulations	P2, P6, P7, P12, P13, P14, P15
	Increasing hours of physical education	P3, P6, P8, P10
	Budget per capita	P12
	Revising the annual lesson plan	P2, P4, P6, P9, P11
Safety	Protective equipment	P2, P4, P6, P8, P10, P12, P13
	Safety posters	P11, P13
	Sports medicine health assessment	P13
Connections	Cooperation of other organizations	P10, P14
	Specialized scientific working groups	P2, P4, P8, P10, P11

PHYSICAL TREATMENTS

down properly before and after exercises, and their inability to perform sports skills correctly. As a result, students may be more prone to injuries as they refuse to follow proper techniques, protective protocols, and the guidance provided by sports teachers [30].

Energetic and enthusiastic teachers play a crucial role in establishing a vibrant and dynamic classroom environment. In a study by Barzegari and Mehdivand (2013), the connection between physical injuries and psychological injuries in schools was examined. The findings revealed that chronic injuries were strongly associated with younger individuals and lower average grades. Furthermore, factors, such as anger, lack of seriousness, restlessness, and worry were also found to contribute to these injuries [31]. According to Alizadeh and Karimizadeh (2010), the highest number of injuries occur when there is no teacher or sports coach, and there is a large number of students in sports classrooms or even outside the school premises without adequate supervision of their activities. Consequently, classes with a high student population increase the risk of sports injuries [17]. Therefore, the findings of this study align with the results obtained by Alizadeh and Karimizadeh (2018) [17],

Razavi et al. (2010) [29]. No studies contradicting the findings of this research were observed.

It was also found that the underlying factors encompass various aspects, such as availability of sports equipment and supplies, suitable sports facilities and environment, support from the school principal, attitudes of officials, warm-up and cooling-down practices, physical fitness factors, anatomical condition, biological characteristics, students' previous sports experience, as well as the adherence to correct techniques and repetitive skills. According to Farsi (2007), failure to comply with the standards of sports equipment and supplies does not sufficiently prevent sports accidents and injuries, and in some cases even leads to death [32]. In a report by Tinoroff, it was revealed that between 1990 and 2000 in the United States, there were 147 deaths among students under the age of 14, of whom 82 cases (56%) were associated with faulty equipment and play structures, while 31 cases (20%) were attributed to falls [32]. The safety conditions of school sports spaces are another contributing factor to sports injuries among students. A study conducted by Jabri et al. (2013), titled "Examining the health and safety status of sports halls in Mashhad", revealed that sports venues had inadequate health and safe-

Table 9. Classifications of consequences

Primary Classifications	Sub-classifications	Classifications
Student participation	More student participation	P2, P4, P8, P10, P12, P7
	Safety and health	P11, P13, P10, P1, p4
	Absence and medical expenses	P13, P2, P6, P1

PHYSICAL TREATMENTS

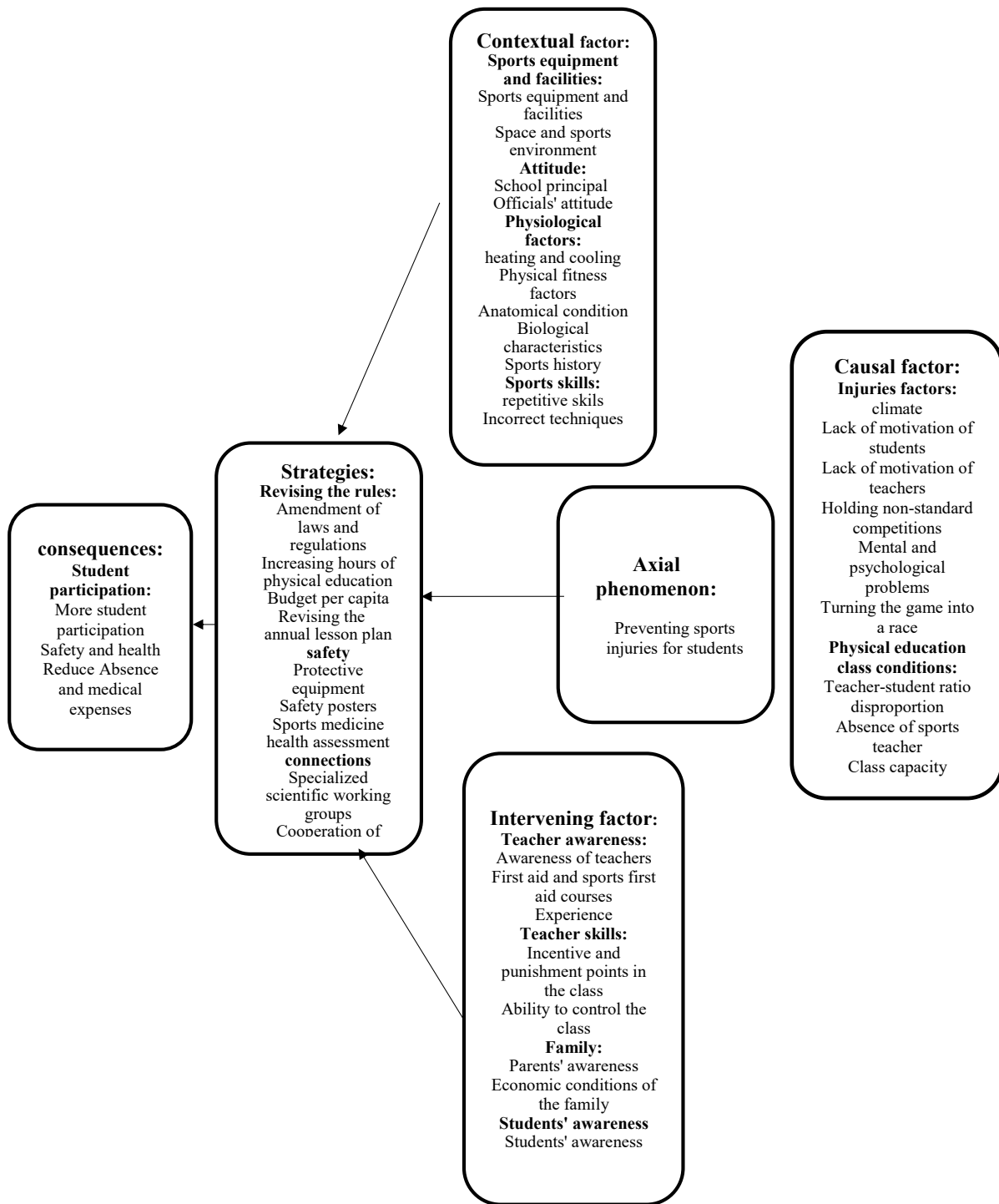


Figure 4. The strategic model to prevent sports injuries of students in schools

ty standards [33]. Farsi et al. (2007) indicated that the safety level of school sports spaces, including the quality of flooring, platforms, coverings, and boundaries, was low. This lack of safety measures increases the risk of sports injuries in schools [34]. Shajie et al. (2016) reported that school administrators must possess accurate comprehension and insight, and consistently implement

organization, supervision, and control when designing physical education classes [35]. School managers evaluate different approaches for physical education classes based on available space and sports facilities. However, if the manager lacks understanding and fails to cooperate in equipping and ensuring safety during physical activities at the school, it can result in injuries occurring within

the school environment. According to Avazzade Samani (2004), there are numerous issues with the physical education curriculum in the country, with one of the most significant being a lack of emphasis on the role of physical education in education [36]. Aslankhani et al. (2002) reported that the implementation of the physical education course in the studied schools is short in terms of quantity and quality, and the level of cooperation of the officials in the implementation of the course is average [37]. The absence of warm-up exercises is a key factor contributing to sports injuries during physical education classes. Meeuwisse et al. (2005) demonstrated that incorporating warm-up exercises among students results in a reduction in injuries [13]. Hence, warming up serves as a crucial aspect of physical preparation, enabling students to engage in sports activities safely and without injury [38]. Consequently, while the absence of warming up cannot be regarded as a definite cause of harm, warming up can potentially decrease the likelihood of injury. According to Ranjbaran, many individuals tend to overlook the importance of cooling down. This program holds significant value in preventing injuries and enhancing performance [38]. To ensure injury prevention, physical education instructors should thoroughly elucidate the importance and need for cooling down to students. They should also dedicate time after their classes for cooling down activities and actively encourage students to engage in them. Maintaining optimal physical fitness is crucial for injury prevention. Students with inadequate levels of basic physical fitness are more susceptible to various types of injuries, including those resulting from accidents, collisions, and overexertion [15]. According to Frowalt, inadequate physical fitness and extreme exhaustion significantly contribute to the prevalence of sports injuries. In schools, approximately 70% of injuries occur toward the end of training and sports sessions [39]. Several studies have investigated the relationship between sports injuries and athletes' skeletal muscle structure, consistently confirming a positive correlation [20]. As an illustration, girls tend to have a higher occurrence of crossed knees than boys. This difference stems from various factors, one of which is the wider hip width in girls compared to boys. Due to this anatomical condition, female student-athletes are six to eight times more likely to experience damage to the posterior cruciate ligament compared to boys. The crossed knee position observed in girls during landing diminishes their ability to adequately control their lower body and increases stress on the knee's supporting structures. This mechanism contributes to the elevated risk of knee injuries among girls [20]. Another crucial aspect of injury prevention is the correlation between the type

of exercise and activity and factors, such as age, gender, weight, and students' abilities. In his study, Mohammad (2011) examined the relationship between body mass index (BMI), body fat percentage, height, and weight with sports injuries among school-aged individuals, specifically in the age group of 12 to 15 years. The findings revealed a positive relationship between BMI and muscle injuries as well as fractures. In addition, there was a relationship between body fat percentage and muscle injuries, bone fractures, dislocations, and ligament tears. Height and weight were also correlated with bone and muscle injuries, with the strongest correlation observed during physical activities [40]. However, engaging in sports activities contributes to the development of skills and enhances the ability to anticipate injury risks. Alizadeh and Karimizadeh (2018) demonstrated that a significant proportion of injured students had no prior sports history. The injury rate among these individuals was found to be 4.39% in boys and 6.54% in girls. The current study's findings indicated that having sports experience plays a vital role in preventing sports injuries, with male and female students who possess such experience exhibiting greater immunity against the risk of sports-related injuries [17]. Engaging in repetitive skills is an additional factor contributing to injury occurrence. Alizadeh and Karimizadeh (2018) noted that the highest incidence of injuries was observed in football in boys and volleyball in girls. This could be attributed to students' keen interest in these sports and the characteristics of the respective fields, such as the simplicity of their activities and the minimal facilities required. Football and volleyball are widely popular among male and female students. In soccer, it is common and accepted for players to engage in physical confrontations with opponents. This is seen as a natural part of the game, and due to its competitive nature, male students might exhibit more aggressive behaviors and tactics. Furthermore, playing soccer in the schoolyard only necessitates basic facilities and can be done using an inexpensive plastic ball. In the realm of volleyball, there is a greater inclination among girls to participate. This can be attributed to the specific technique of consecutive jumps and landings, which increases the likelihood of injuries, particularly in the area beneath the net. Consequently, a higher rate of injuries was observed among girls in this sport [41]. It is noteworthy that the findings of this study align with previous research conducted by Ranjbaran (2014) [38], Farsi et al. (2007) [34]. No study contradicting the outcomes of the present research was identified.

The factors that contribute to the incidence of sports injuries among students in schools were found to include various conditions. These conditions encompass the

awareness and experience of teachers, their participation in first aid courses, the presence of sports assistants, the awareness of students and parents, the economic situation of the family, the teacher's ability to utilize effective teaching methods, such as encouragement and discipline, and their classroom management skills. Based on Nasr Esfahani's research (2007), the level of knowledge and awareness among physical education teachers regarding injury prevention, sports injury management, and first aid in schools was determined to be average [42]. The knowledge and awareness of different types of sports injuries and their causes and factors, play a crucial role for students, teachers, and coaches in preventing such injuries. Adequate knowledge of these factors is one of the key solutions to prevent injuries. Several studies have highlighted that a significant number of students lack the necessary knowledge to effectively handle sports injuries. In a study conducted by Bohrani (2010), both male and female students had a very low level of knowledge regarding the prevention and management of sports injuries [43]. Huang and Yang (1996) surveyed 2000 graduate students in Taiwan. The findings revealed that the mean scores were relatively low [44]. As a result, increasing students' awareness of injury prevention strategies can be effective in identifying and minimizing the number of injuries. The involvement of parents is crucial in nurturing students during their formative years. Parents' accurate understanding of students' engagement in physical activities contributes to positive performance and academic advancement. Unfortunately, due to misinformation and negative attitudes, physical education and sports classes have not received the rightful importance from parents. Nowadays, they are merely associated with games and entertainment. Soroushfard (2018) [31] examined the role of parents in reducing sports injuries based on two factors:

- 1- Selecting suitable sports for children based on their age and physical development, rather than solely focusing on their physical abilities.

- 2- Placing less emphasis on winning competitions: It is important for children to recognize that during the initial stage, playing for enjoyment takes precedence, while in the later stage, competition outcomes may carry more significance. A child who experiences mental stress is more prone to getting hurt or injured compared to a child who enters the playground with support and positive encouragement from adults [31]. Based on the analysis from professors, economic challenges were identified as one of the contributing factors that lead to injury. This issue affects students' susceptibility to injury from three distinct aspects: The inability to afford appropriate

sports equipment, inadequate and insufficient nutrition, and incomplete post-injury treatment. The equipment and supplies utilized in sports hold great importance in preventing injuries or enduring their consequences. Sports footwear is a common type of equipment employed in various sports. Numerous studies have investigated this aspect, such as studies by McKay et al. (2001) [45], Murphy et al. (2003) [46], and Giza et al. (2003) [42], which all underscored the significance of shoes as a contributing factor to vulnerability in their respective articles [45-47]. Consequently, the findings from research in this area align with the results of Nasr Esfahani (2008) [42], Alizadeh and Karimizadeh (2021) [17], and Bohrani (2009) [43].

To effectively prevent sports injuries among students in schools, several measures should be taken. These include making changes to laws and regulations, increasing the weekly hours of physical education, allocating an adequate budget, reviewing the annual lesson plan, promoting the use of protective equipment, displaying safety posters, conducting medical health assessments, establishing scientific and specialized working groups for injury prevention, and fostering cooperation with other organizations. One of the fundamental issues in school sports is the lack of regulation by the Supreme Council of Education concerning the standards of school sports. Despite the approval of educational indicators in Resolution 886, this council has not set any standards for school sports in terms of sports availability per student or the student-to-sports-teacher ratio [48]. Dehghani (1980) attributed the inadequate execution of physical education lessons to the absence of a comprehensive program and erroneous policies [49]. Additionally, Finch and Donaldson (2010) argued that the establishment and advancement of a thorough maintenance program, specifically targeting the quality of physical education in schools, is crucial for ensuring the future of this discipline [26]. Furthermore, a significant proportion of student injuries occur due to non-compliance with sports rules and regulations. Consequently, physical education teachers in schools must adopt safety-oriented rules during physical education sessions, aiming to minimize the occurrence of physical collisions. One of the fundamental strategies to foster greater student participation in physical activities and prevent sports injuries is to allocate an adequate per capita budget for equipping school spaces, equipment, and sports facilities. Khavari and Yousefian (1989) emphasized the need to increase the budget allocated to students' sports activities to enhance the quality of physical education lessons [50]. Similarly, Zarabian' (2004) demonstrated that according to most officials, the main obstacle to the successful implementation of physical ed-

education courses is the lack of high-priority funding [51]. Giving attention to the per capita provision of school sports requires significant focus on two crucial areas: Physical infrastructure and specialized human resources. The findings revealed an unfavorable situation in both aspects [48]. Increasing the number of hours dedicated to physical education classes per week is another effective strategy to prevent sports injuries among students. Currently, due to the limited time and duration of each exercise session, teachers are compelled to include students with varying levels of physical fitness in the same class simultaneously. This situation significantly raises the likelihood of injuries among students. Alizadeh and Karimizadeh (2018) revealed the highest rate of injuries among students who had only 1-2 hours of exercise at school. While increased activity levels may contribute to these injuries, the research findings indicate that all girls and 95.4% of boys sustained injuries within this timeframe when considering their assigned duties [17]. The annual lesson plan undergoes separate revisions for various age groups, ranging from elementary school to high school, and these reviews occur annually. The divergence in age and individual traits among students accounts for the majority of injury causes. The implementation of the lesson plan varies based on the physical, motor, and cognitive capabilities of the students. Consequently, the lesson plans should strike a balance between offering specialized exercises and considering the person's physical and movement abilities to prevent sports injuries from transpiring.

The use of protective equipment plays an important role in reducing the impact and possible injuries caused by contact with people and sports surfaces. Ghadimi Ilkhanlar et al. (2010) demonstrated that the absence of knee braces, ankle braces, and protective footwear significantly contributes to lower limb injuries, particularly affecting the knee, ankle, leg, and toes [52]. As a result, physical education teachers have an essential responsibility to promote and enforce the usage of protective equipment among students during physical education classes and school sports competitions. To enhance students' understanding of sports injury prevention, supplementary methods, such as brochures, wall newspapers in corridors, PowerPoints, and CDs are employed. These training materials provide information on various aspects, including familiarizing students with muscle groups, corrective movements, minimizing abnormalities, understanding injury causes, and implementing strategies for injury reduction. These strategies encompass considerations, such as wearing appropriate sports shoes, suitable sportswear, and protective equipment [31]. In addition, the physical education teacher must

review the health certificate forms of all students at the beginning of their work and gather accurate information about their physical and mental well-being. This measure aims to prevent potential injuries that may occur during physical education classes. According to Zarabian (2013), there can be severe repercussions if physical education teachers neglect the issue and fail to consider the specific physical and mental conditions of students. This negligence, coupled with the intensity of exercises and sports activities, can lead to significant challenges for students with special needs. Not only might these students refrain from participating in sports for an extended period, but they may also face irreversible legal consequences [51]. Another strategy involves establishing specialized scientific working groups dedicated to preventing sports injuries among students. These groups would monitor the factors contributing to sports-related injuries in schools and provide crucial information to physical education teachers. Accordingly, they can ensure and promote the improvement and well-being of students' sports health. The plan to enhance awareness and promote sports knowledge (campaign for sports injury prevention) offers several advantages. It includes conducting courses on corrective movements and minimizing abnormalities, educating individuals on injury causes, providing solutions to reduce injuries, and granting sports enthusiasts access to accurate, up-to-date, and comprehensive statistical data regarding schools across the country [31]. Consequently, the research findings in this aspect align with the results obtained by Razavi (2010) [29], Alizadeh and Karimizadeh (2018) [17], Ghadimi Ilkhanlar (2019) [52].

The final section of the study focuses on the results, which encompass increased student engagement, enhanced sports safety, decreased absenteeism, and reduced medical expenses. Encouraging greater student participation in sports activities and implementing policies that promote such engagement is not limited to a select few countries. Authorities worldwide are striving to increase children's involvement in sports activities more than ever before [20]. Establishing and ensuring safe conditions during physical education classes enables students to engage consistently in sports activities and fosters an environment conducive to achieving athletic success. Moreover, when families do not hinder their children from participating in sports but instead encourage them with a positive mindset, it further promotes their involvement. Each year, significant financial resources are allocated toward the treatment and care of injured students. A study conducted by Moeijes et al. (1998) on students aged 5-17 years revealed that a quarter of the participants experienced sports-related injuries, often necessitating

medical attention, temporary disabilities, and incurring substantial medical expenses [53]. Unfortunately, our country lacks a precise system for accurately assessing the number of injured students and the corresponding expenses. Consequently, there is an absence of reliable statistics on the annual treatment costs associated with student injuries in schools. However, implementing practical sports injury prevention strategies within schools can effectively reduce medical expenses and minimize student absences throughout the year. Therefore, the research findings underscore the substantial impact and importance of employing preventive measures in significantly reducing sports-related injuries.

5. Conclusion

Considering the coding and analysis of qualitative findings from interviews, several factors were identified as contributing to sports-related injuries. These factors include weather conditions, students' and teachers' lack of motivation, non-standard competitions, mental and psychological issues, excessive focus on competition rather than the game itself, an imbalance in the ratio of teachers to students, the absence of a sports teacher, limited physical space in classrooms, availability of sports equipment and supplies, the overall sports environment, the attitude of the school principal, the attitude of officials, inadequate warm-up and cool-down practices, physical fitness levels, anatomical conditions, biological characteristics, sports history, incorrect techniques, and repetitive skills. These factors collectively serve as the underlying causes of sports injuries. The influencing factors in the model encompassed various elements, such as teachers' knowledge, experience, participation in first aid courses, and availability of sports assistants. In addition, the knowledge of students and parents, the family's economic conditions, classroom management skills, including encouragement and discipline, as well as the ability to maintain control, were recognized as important contributing factors. Ultimately, a range of strategies with significant potential for preventing student sports injuries were proposed. These strategies include amending laws and regulations, increasing the duration of physical education classes, allocating more budgetary resources, revising the annual lesson plan, promoting the use of protective equipment, displaying safety posters, evaluating sports medicine health protocols, establishing scientific and specialized working groups, and fostering collaboration with other organizations. By implementing the strategic model for preventing students' sports injuries, physical education teachers can not only promote and enhance student participation in physical educa-

tion classes but also ensure the safety and well-being of students by minimizing the occurrence of injuries. This proactive approach can effectively prevent substantial medical expenses and student absences resulting from injuries throughout the year.

Ethical Considerations

Compliance with ethical guidelines

The Research Institute of Physical Education and Sport Sciences of [University of Tehran](#) approved the study.

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Authors' contributions

All authors contributed equally to the preparation of this article.

Conflict of interest

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