

Risk factors threatening children's safety in the school environment

Aikaterini Toska ^{1, *} Evangelos Fradelos ¹, Konstantinos Petsios ², Dimitrios Papagiannis, ¹ Chrysoula Dafogianni ³, Eleni Albani ⁴ and Maria Saridi ¹

¹ Department of Nursing, University of Thessaly, Larissa, Greece.

² Faculty of Nursing, National and Kapodistrian University of Athens. Greece.

³ Department of Nursing, University of West Attica, Athens, Greece.

⁴ Department of Nursing, University of Patras, Greece.

Magna Scientia Advanced Research and Reviews, 2024, 12(01), 142–151

Publication history: Received on 28 August 2024; revised on 13 October 2024; accepted on 15 October 2024

Article DOI: <https://doi.org/10.30574/msarr.2024.12.1.0169>

Abstract

School safety encompasses risk reduction efforts to ensure that children act in an environment that is safe and promotes the well-being of the students to achieve their full potential. Therefore, a safe and secure environment is a prerequisite for effective teaching and learning. This scoping review aims to address a range of school safety risk factors and introduce the complexity of school safety. School is believed to be a safe learning and growing environment; however, various conditions can threaten children's safety in a school setting and lead to injuries caused by accidents, risky or/ aggressive behavior, or environmental exposure. In addition to the physical, psychological, and behavioral characteristics of children that make them particularly vulnerable to accidents, there are several unpredictable risks associated with natural or man-made conditions or disasters that can also put children at extreme risk. A balance between safety, surveillance, and emergency preparedness measures may be beneficial to create a safety culture in schools that will enable student behavioral and intervention support.

Keywords: Risk; Accidents; Injuries; safety; Prevention; School environment; Emergency preparedness

1. Introduction

The term school safety has been defined as creating a safe environment for children from the time they leave their homes for school and back. This term includes safety when transporting children, safety from any abuse, violence, psychosocial issues, and natural or man-made disasters. Nowadays, school safety is defined by the absence of negative incidents and is based on injury prevention and emergency preparedness [1]. According to Syrou and Sourtzi [2] the term school safety refers to the physical characteristics of the school environment, the formation of conditions, and the maintenance of the safety specifications of the school building and equipment, to prevent or eliminate the presence of risk factors that cause accidents in the school population. An indicator of school safety is implementing a plan that includes the school's formal policies and procedures for dealing with situations that may threaten students' safety. These plans are commonly formulated based on the all-hazards approach of hazard mitigation, preparedness, response, and recovery. The design of the plan to the actual security needs of the school and the degree of compliance in its implementation are key performance indicators [3].

An indirect indicator to evaluate perceived school safety is chronic school absenteeism. Research data supports that among other reasons, absenteeism is related to bullying, perceived lack of safety, poor school climate, and unreliable transportation. For example, perceptions of danger in a school may lead some parents to keep their children at home [4]. School safety assessments must be ongoing so that they can respond to any changes in school climate over time.

* Corresponding author: Aikaterini Toska

Incorporating the results of these assessments into developing policies and procedures is a good way to improve school safety.

Unintentional injuries remain the leading cause of death and disability among children and young adults in Western countries. However, most of these injuries, mainly in the school or home environment are preventable, and therefore preventing injuries must be a priority for all [5]. Annually in the U.S., there are >9 million emergency department visits for injuries and >16,000 deaths in children and adolescents aged 0-19 years. Research data indicates a decrease regarding unintentional injury rates among children and youth aged 0-19 years, estimated to be 11% from 2010-2011 to 2018-2019, from 10.1 to 9.0 per 100,000 population [6].

Obtaining epidemiologic data to define the wide range of school injuries for individual communities is challenging. The burden of morbidity can be expressed in Disability-adjusted life years (DALYs), which combine the burden of death and disability into a single indicator. A disability-adjusted life year (DALY) is a measure of the total burden of disease, expressed as the number of years lost due to illness, disability, or premature death. It is important to remember that children are disproportionately affected by environmental exposure compared to adults. Preventing childhood exposure to environmental hazards can prevent injuries, immediate disease manifestations such as respiratory infections and diarrheal diseases as well as diseases with a longer latency period such as cancer [7]. The school environment is believed to a quite safe environment, however, 6-21% of pediatric unintentional injuries occur in schools or during school transportation [8,9].

Accidents (unintentional injuries) in children, despite the noticeable decrease during the last decade, are still a leading cause of death and a significant contributor to childhood morbidity, long-term disability, and healthcare costs. It is estimated that nearly 900,000 deaths globally are related to pediatric unintentional injuries. Interestingly, it is believed approximately 90% of them could be prevented. Therefore, children's accidents remain a problem of immediate priority for public health, as they are accompanied by serious consequences [10,11].

This scoping review aims to address a range of school safety risk factors and introduce the complexity of school safety. Many factors can cause accidents and endanger the physical integrity of children in school. We have categorized the main of them as:

- Risks of accidents related to the school's physical environment
- Risks of car accidents
- Risks of fire at school
- Risks of physical disasters
- Risks of electricity accidents
- Risks due to maintenance or construction

It must be clear that these risks are further modified by other characteristics such as age, gender, gender ratio, aggressive or risky behavior, cultural characteristics, and lack of safety measures or lack of preparedness plan [5,6]. For instance, gender differences may be related to different levels of exposure, physical and cognitive development, spatial ability, and motor coordination [11].

2. Risks of accidents related to the physical school environment

According to statistics, accidents among children aged 0-14 years and young adults are responsible for the most deaths from any other pathological entity and most of them concern the ages 0-4 years. The Centers for Disease Control and Prevention [12], estimates that between 2001 and 2019 there were about 159 million cases of unintended injuries among children and adolescents (0-19 years old) in the US. In a previous report from the Center for Research and Prevention of Accidents [13] (Accident Control and Prevention Center, 2007), in the years 1996-2001, there were 23,000 accidents at school among students aged 5-14, with falls being the main cause of accidents. Most accidents occurred in the forecourt, followed by the hall and stairs and more than half of the cases of serious accidents took place during sports activities (60%). Published accidents injury rates for schools, childcare centers, playgrounds, and summer camps are comparable [14].

In the US there is an estimation of 2.6 million emergency visits for sports-related injuries per year by children and young adults (5-24 years). They account for over 68% of the total 3.7 million sports injuries presented to the ED (all ages). Sports-related injuries accounted for more than one-fifth of the visits by persons 5 to 24 years old [15]. In a recently published study conducted in the Czech Republic, an incidence of 37,000 school accidents in Kindergartens, primary schools, secondary schools, colleges, and other school facilities from the years 2006/2007, until the school year

2014/2015 was reported [16]. An Australian survey [17]. showed that in the period, from 2016 to 2019, there were 26,970 Emergency Departments (ED) visits and 3,736 hospital admissions for children injured in Victorian primary schools, with male students having the most ED presentations (57%) and hospital admissions (60%). The peak affected age for hospital-treated injury was 8 years and the most frequently injured age group was 7 to 9-year-old children, with 41% and 43% of ED presentations and hospital admissions, respectively. The most common injuries, from both sources, involved fractures, mostly to the wrist/hand and elbow/forearm; several included the shoulder/upper arm as well. Other injuries involved open wounds to the head and upper extremity areas and intracranial injuries including concussions. Overwhelmingly, the most frequent cause of these injuries was falls (63% of ED presentations, 76% of hospital admissions), followed by being unintentionally hit/struck by objects or other persons (22% of ED presentations, 18% of hospital admissions). The most common activities recorded at the time of the injury were leisure/free play type activities (46% of ED presentations, and 38% of hospital admissions).

A study in secondary schools in Greece, showed falling from a height as the most important underlying factor for causing accidents, (66%), demonstrating the need to investigate school accidents concerning architectural design, safety standards, and the suitability of school buildings. Noticeably, most accidents (89%) took place despite being supervised by teachers. It was found that 37.40% of injuries involved simple muscle or ligament injuries followed by trauma (22%), abrasions (21.14%), and fractures (17%). One in two cases led to medical assessment while about 10% required admission to the hospital [18].

Building features themselves, such as floors, stairs, ceilings, walls, and other fixed structural elements, consist of significant factors of accidents in the school environment, causing about 20% of school injuries. Playground equipment, such as teepees and slides, accounted for about one in 10 school injuries, while head and neck injuries led to more hospital emergency room visits [15]. The main injuries concern soft tissue injuries, fractures, sprains, and abrasions, which can be controlled and prevented [19].

Sport-related injuries are responsible for approximately 30-50% of unintentional injuries in the school environment, usually presented as sprains and strains. Contact and outdoor sports (basketball, football, etc.) present more injuries than noncontact sports activities. However, all types of sports have a potential for injury. Although death from a sports injury is rare, the leading cause of death from a sports-related injury is a brain injury [20].

Preventive measures include close supervision during sports and school activities as well as regular maintenance of sports equipment and safety measures implementation. The level of attention by teachers supervising the children during breaks or sports activities is fundamental. The teachers on duty must ensure the safety of the environment during interactivity among students, and play and sports, without restricting the play or sports activities of children [21,22].

Scheduling necessary maintenance work is also essential to keep all school premises safe for students and staff. This can be achieved by frequent maintenance of the building and equipment, ensuring adequate lighting in all external locations, and prompt replacement of defective lamps that significantly reduce visibility. Floors are a major cause of injury, and footwear that lacks adequate traction increases the chance of falling. Adequate ergonomics of the school environment is essential for school safety. For example, keeping classrooms free of obstacles and objects that can cause falls, is a measure of fracture prevention that can be achieved by rubber mats used under any rugs to prevent slippage [22].

Students should be advised to avoid risky behaviors such as running or climbing in areas that are not appropriate and without protective equipment when exercising. Therefore, both teachers and parents should ensure that children know basic safety rules and use sports equipment correctly where required. There is a challenge for any school administration to balance the safety and independence of children, by implementing prevention measures that maintain a healthy level of physical activity and a safe level of physical development. Children need to learn how to manage risk and avoid injury while exploring their environment in challenging ways [23,24].

Student-athletes should also have adequate rest periods between games and work to build muscle strength to reduce the risk of sprains. Students should also be aware of their surroundings and treat objects and school equipment with respect, to avoid injuries, scrapes, and bruises caused by accidental or angry collisions with walls or floors in the school building. Teachers can also work out a program outlining the individual needs and capabilities of the injured students to reintegrate them into physical education as well as to refer students to guidance counselors or other mental health professionals if they find they are having trouble processing their anger [25].

Teachers, parents, and students can contribute to the prevention of accidents. Parents should make sure that children get adequate hours of rest. Fatigue reduces response times and makes children prone to accidental injuries. To create a safe school environment in schools and avoid school accidents, it is important to regularly check and update safety standards in the external and internal spaces [26]. For example, regarding school exteriors:

- Stairs should have non-slip flooring and color combinations to avoid monotony, which is a cause of accidents.
- In addition, it is important that they do not show protrusions and erosions on their surface.
- The configuration of the floors should be done in a way that prevents water retention. Also important is the maintenance of hydraulic installations to prevent falls due to leakage.
- The surfaces of the walls and the rest of the facilities should not show protrusions and sharp edges.
- Floors should be flat with non-slip properties and resistant to weather conditions.
- If there are drainage grates on the floor, they should be smoothly connected to it.
- The fencing of the courtyard area must not have sharp corners, damage, and openings, to avoid injuries and the exit of students into the street.
- There should be no ledges or gutters, trash cans, tanks, or other objects that students might trip over.
- In the school exits and at the sidewalk there must be a protective railing and there must be visible pedestrian crossings on the road.

Similarly, examples regarding indoor precautions include:

- Doors in narrow corridors should not face each other, open outwards, and emergency exit doors should only be secured from the inside.
- Windows must be well secured and glass doors or other glass surfaces, located in student-accessible areas, must be covered with transparent plastic material and specially marked so that they can be easily identified.
- Indoor areas should not contain furniture, benches, or other objects that could be tripped over by students. The edges of stable or mobile equipment (e.g. furniture) must be rounded.
- There should be no sharp objects (eg nails, pins) on the walls accessible to students.
- Objects on the walls need to be well secured so that they are not at risk of falling.

Schools must foster a culture of safety. This means conducting regular risk assessments and removing any structures or equipment that could be dangerous, as well as ensuring that all student activity is monitored. Schools should develop, guide, and enforce strict safety rules, appropriate for the ages of their students, and conduct regular assessments of compliance with these rules. In many cases, school-based educational programs have been implemented to enhance safety culture and to teach students specific safety measures. However, there is insufficient evidence to determine whether school-based educational programs can prevent unintentional injuries. However, there is some weak evidence that such programs improve safety skills, behavior/practices, and knowledge [27,28].

2.1. Risks of car accidents during school transportation

The issue of road safety for children outside of schools is of vital importance as the statistics surrounding children's accidents on the road are particularly worrying. During school pick-up and drop-off times, the streets near the schools are particularly busy and there is usually a large amount of vehicular, pedestrian, and bicycle activity. This causes congestion and very often leads to resentment of residents and other drivers towards the apparent 'chaos' caused by parents and children arriving or leaving school [29]. Data shows that one in three pedestrians who are seriously injured are 11-12 years old. Boys are 9 times more likely to be involved in a bicycle accident than girls, while every month 1200 children are injured in traffic accidents that occur within 500 meters of school. Moreover, according to the US Department of Transportation [30], from 2012 to 2021 regarding car accidents involving school buses, among all school bus occupants killed, 16%, and among all pedestrians killed in school-transportation-related crashes, 22% were children 5 to 10 years old. Moreover, from 2012 to 2021 206 school-age children died in school-transportation-related crashes; 42 were occupants of school vehicles, 80 were occupants of other vehicles, 78 were pedestrians, and 5 were pedalcyclists. Donoughe and Katz [31] investigated fatal school bus crashes and concluded that school-aged pedestrians are a notably vulnerable group. Therefore, it is strongly recommended to increase awareness of school bus stop laws.

To prevent accidents in or near school, it is important to implement all necessary measures to decrease the risks that may be associated with school transport activities. Staff members and parents should follow certain rules and undertake all necessary precautions to avoid accidents when arriving, dropping off, or picking up students. Improper turning, backing, not seeing conflicting objects or vehicles, and sideswiping occurred more frequently but were less likely to lead to injury [31].

A three-step approach is proposed. The first necessary step to prevent the risk is the determination of the risk profile which concerns the assessment of the risk for pedestrians, cyclists, and vehicles in the school area and the surrounding area. What could it harm, who could it harm, and how? What are the risk management actions?

The second step is the organization concerned with the provision of information, instructions, and/or training for staff, students, visitors, and parents as well as the development of positive communication, positive attitudes, and behaviors, and the third includes the implementation of the plan, which concerns the training and guidance of staff to ensure that everyone is competent and able to perform their duties. Communication is essential so that goals and expectations are clear to students, visitors, and parents, as well as monitoring that regulations are followed [32] In addition, Gutierrez et al (2014) acknowledge the important role of crossing guard presence in transportation injury prevention [33].

3. Risks of Fire at school

School buildings are structures where the application of fire safety is of utmost importance. Most of the school population consists of children and young people who panic easily and can be difficult to manage in an emergency or crisis. According to a US FEMA report regarding school building fires from 2009-2011, there are an estimated 4000 school building fires annually that lead to trauma to an average of 75 school-age children. According to the report, the three leading causes of school building fires are cooking (42%), intentional action (24%), and heating (10%) [34].

In occasion of a fire accident in a school, the consequences can be catastrophic. Such damages constitute loss of life, property, and school operations [35]. Serious fires that have occurred in the past have shown that it is not always possible for everyone to escape safely from a burning structure [36]. Heidari, et al [37], refer to the death of four students in a private school in Iran after a fire accident along with an increase in fire incidents in Iranian Schools. Also, a notable increase in intentional fires is noticed in schools in western communities. Therefore, fire preventive and protective measures such as the use of fire-resistant materials in the construction of schools and limitation of flammable materials, set up of a heat and smoke early warning system as well as the use of fire protection systems (portable fire extinguishers or roof fire extinguishing systems), optimization and refining of heating systems are essential steps towards fire safety. Furthermore, specific education and training of teachers, students, and parents, along with simulation exercises are of great importance. Determining the emergency exit routes, especially in classrooms and halls, is one of the main principles of school safety. A risk assessment performed by evaluating the possibility of incident occurrence and identifying the vulnerability and the consequences of a fire incident helps to design a management plan and enhances preparedness [38].

A fire safety management program consists of vital elements such as inspections, education and training, firefighting, emergency service, fire risk assessment, fire prevention, record keeping, and communication. Without these ingredients, most strategies can fail, and because one strategy can depend on another, this can lead to the failure of most strategies, resulting in increased risk.

Whether a fire threat comes from inside or outside the building, the safety of students and school staff is a priority. Smart planning and preparation can help schools prevent fires and, when prevention is not possible, respond appropriately to these situations. In the frames of a preparedness plan, an evacuation and response plan is required to be developed and updated regularly. The plan should be simple to implement, and all the members of the school must be informed and adequately trained. It is necessary to secure all areas from the risk of fire as well as to check compliance with all safety recommendations, which include the appropriate number of fire extinguishers, fire alarms, and smoke detectors in the school building. Also placing laminated plans of the building in prominent places, such as on the main doors, can help firefighters navigate the school in an emergency [27, 38, 39].

The assessment of a school's preparedness against the risk of fire should include the existence of a fire safety certificate which will be updated and renewed periodically, as well as the provision of adequate fire extinguishing systems. A trained school crisis management team is required for initial fire risk management who will have received ongoing training from local fire services on emergency measures.

Instructions for preventing and dealing with fire and an escape plan in the event of a fire should be posted in a visible place on the school premises. If the school is intended to train students with mobility problems, apart from that, it is required that the areas of the school building are accessible to these students with ramps with special markings, elevators, railings, and corridors. All schools should follow such plans to provide the most support for students and school staff when an incident occurs because studies have indicated that schools can reduce the problems and sufferings of people involved in incidents and disasters by developing an appropriate plan [40].

4. Risks of physical disasters

School-age children spend most of their daily time in school. Therefore, in case of a physical disaster, the possibility of being in school is increased. Physical disasters such as earthquakes, floods, tsunamis, hurricanes, and others occur in a massive way and some cases without warning. Therefore, the possibility of injury or even death in case it occurs during school hours is increased. Therefore, proper training and crisis management planning for the entire school community is essential to be prepared to respond appropriately during or after a massive physical disaster. Students and school staff can prepare for emergencies in several ways, from conducting regular simulation exercises as well as assessing and ensuring building resilience and resistance to earthquake risk.

Since earthquakes are the most unpredictable natural disasters, we will focus on them. The first step to ensure safety from earthquakes is to build schools that are structurally resistant to earthquakes following the updated anti-seismic regulations of each country. However, in many cases, there are still older school buildings that may not meet these standards. It could be helpful to consult an expert, who will assess the building and point out areas that could be strengthened. Any tall shelves, audio-visual equipment, and heavy cabinets should be fixed to the wall. It is also necessary to avoid placing heavy objects on shelves or other surfaces that may fall during severe seismic shaking [41].

Another important step towards safety and risk management, is to organize preparedness exercises within the school premises, which will concern self-protection in the classroom during the earthquake, the evacuation of the school building immediately after the earthquake, and the safe transition to the courtyard. These simulation exercises should be repeated at regular intervals (at the beginning of the school year and twice a year, per quarter), to be consolidated by students and teachers. These exercises also help managers to identify and understand those points in the process that need re-evaluation. It is also necessary to ensure that students are familiar with safety procedures, such as taking cover under their desks to "Drop, Cover and Hold" until the earthquake subsides, while a class discussion on preparedness is necessary for an earthquake at the beginning of each school year [41]. Knowledge and attitudes are key factors that must be taken into account in efforts to increase teacher and student preparedness to reduce the risk of a natural disaster, independently of its nature [42].

For example, the assessment of the preparedness of a school against the risk of an earthquake includes the seismic hazard of the area in which the school is located, the anti-seismic protection provided by the school building, the availability of emergency measures in case of disasters and the continuous training of the school staff in disaster management. Research findings support the belief that targeted training creates a significant change in both the knowledge level regarding physical disaster management and the preparedness plans as well.

Natural disasters have potentially a highly traumatic impact on children's psychological functioning. Therefore, further interventions fostering children's resources to promote learning related to emotional preparedness are needed and digital technology, simulation, and artificial intelligence are promising technologies in that direction [43]. A multidisciplinary systematic literature review concluded that isolated school-based intervention enhances the theoretical disaster knowledge which may also extend to practical skills; however, the best results are obtained by combining theoretical and practical activities in school, family, community, and self-education programs [44].

Another form of school accident related to climate change is traumas related to exposure to solar radiation exposure. Childhood UV exposure and sunburn are major risk factors with long-term health effects, including skin cancer and cataracts, damage that can be prevented through reasonable sun exposure [45]. Schools are vital settings for promoting sun protection. Taking safety measures such as planting shade trees around school grounds or building sheds over a significant portion of the schoolyard can reduce the risk of overexposure to UV rays for students and staff, particularly when the sun is at its peak. The incidence of sunburns in school-aged children has increased and it is linked with less knowledge regarding sun protection [46].

In Australia, where the incidence of skin cancer is the highest in the world, The Cancer Council Victoria's SunSmart Schools program emphasizes a sun protection policy that includes the whole school community. Students at SunSmart schools are strongly encouraged to wear sun-protective clothing, hats, and sunglasses, apply sunscreen, avoid outdoor activities when the sun is at its highest, plant shade trees, and study UV levels at different times of the day. Over 70% of Victoria's primary schools have been converted to SunSmart schools since the program began in 1994. Turner et al [47], evaluated the comprehensiveness of these primary school programs in North Queensland. At least 96.6% of primary schools sampled had a sun-protection policy. Most policies addressed hat-wearing, while criteria related to shade provision at outdoor events, regular policy review, and using the policy to plan outdoor events were poorly addressed. Further support is needed to achieve and maintain exemplary sun protection compliance. Furthermore, teachers should be systematically supported to increase their awareness of the dangers of overexposure to ultraviolet radiation (UV)

and to support them with knowledge, skills, and confidence to teach sun safety in school settings, since they play a vital role in developing children's sun protection routines [48].

5. Risks of electricity accidents

Electrical injuries in the school environment are quite uncommon but when present they are associated with significant morbidity and mortality. They can range from minor to life-threatening, and they can cause multisystem complications [49]. Injury severity is based on the characteristics of the electricity, the duration of contact with the electrical source, and the current's pathway through the body. This issue discusses the specific threats posed by high-voltage, low-voltage, and lightning injuries. The various presentations are described, including burns, arrhythmias, respiratory arrest, cardiac arrest, blunt trauma from falls or blast events, rhabdomyolysis, tympanic membrane rupture, and altered mental status, among others [50].

Electrical accidents in the school environment can be prevented through simple safety measures. These measures include safety covers in all the electrical sockets and the use of safety switches in all devices. Prevention measures also include limited accessibility of children to electrical sources and non-unintended use of electrical devices. To protect the school from atmospheric electrical discharges (lightning), a cage-type lightning rod is required, which will be connected to all the metal parts of the building.

6. Risks due to maintenance or construction

School buildings must change, adjust, and be repaired. However, some issues have to be considered to make sure that the work is completed securely so that the final result will be secure for the instructors, children, and guests within a long time to come. Whether it is new construction, renovation, or maintenance, there should be guidelines and procedures. Under all such circumstances, it is necessary to evaluate and manage the risks that potentially hazardous or disruptive construction operations pose to students, guests, and school personnel. Possible hazards encompass the possibility of students entering construction or maintenance zones, the possibility of objects toppling from an elevated position, excessive noise, dust, or other types of disruption to faculty and students, a heightened likelihood of slipping due to dust, debris, tools, equipment, uneven pavement or flooring, associated with construction activities, and the risk to pedestrians posed by the traffic on the property. To make sure that all construction projects are completed with the required safety precautions and procedures, school management must collaborate closely with designers and contractors. When feasible, large-scale construction projects should be scheduled for school vacations and breaks. Children are particularly vulnerable following an accident in the school setting or exposure to a mass casualty event due to their physiological makeup. They have distinct psychosocial requirements, are more susceptible to danger, cannot typically flee or seek help, and have less developed coping mechanisms [51].

7. Conclusion

Schools are places where a significant number of accidents take place that can threaten the health and physical integrity of students. Ensuring a safe environment for increased use of initiatives that include surveillance and supervision during games, routine maintenance of buildings and equipment, as well as emergency, natural, and man-made crisis response plans. Injury and accident prevention efforts should also include education programs involving students' families and teachers about school accidents and emergency action plans to provide a safe physical environment. Also understanding the patterns and trends of school injuries can enable the development of effective prevention policies at national, municipal, and local levels.

Therefore, measures to manage and reduce distress or subclinical symptoms in pediatric survivors of school mass events or to deal with post-traumatic stress after a school accident should also be implemented in the school environment by experts in collaboration with the teachers and families. It is recommended that every school should design its response protocol based on its unique characteristics. The unique physiological, developmental, and psychological needs of school-aged children must be reflected in every phase of disaster planning. Close collaboration among experts, teachers, communities, families, and children is needed to ensure preparedness for children in every stage of the planning process. These plans should be evaluated and adjusted periodically. Preparedness for the unexpected in a structured way will lead from chaos to lifesaving.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest is to be disclosed.

References

- [1] World Health Organization. The Physical School Environment: an Essential Element of a Health-Promoting School, WHO information series on school health, document 2 (WHO/PHE and WHO/NPH), 2017. <https://apps.who.int/iris/handle/10665/42683>.
- [2] Syrou, N. and Sourtzi, P. (Knowledge and perceptions of school staff on school safety and hygiene. PRIME. 2015; 8 (2):105-117.
- [3] Flaherty EA. Emergency preparedness: school nurses leading the way. NASN Sch Nurse. 2013 Jul;28(4):192-6.
- [4] Allen CW, Diamond-Myrsten S, Rollins LK. School Absenteeism in Children and Adolescents. Am Fam Physician. 2018 Dec 15;98(12):738-744.
- [5] Dorney K, Dodington JM, Rees CA, Farrell CA, Hanson HR, Lyons TW, Lee LK; and the Injury Free Coalition for Kids®. Preventing injuries must be a priority to prevent disease in the twenty-first century. Pediatr Res. 2020 Jan;87(2):282-292.
- [6] West BA, Rudd RA, Sauber-Schatz EK, Ballesteros MF. Unintentional injury deaths in children and youth, 2010-2019. J Safety Res. 2021 Sep;78:322-330.
- [7] World Health Organization. The physical school environment: an essential element of a health-promoting school. Geneva: World Health Organization 2004. <https://apps.who.int/iris/handle/10665/42683>
- [8] Zagel AL, Cutler GJ, Linabery AM, Spaulding AB, Kharbanda AB. Unintentional Injuries in Primary and Secondary Schools in the United States, 2001-2013. J Sch Health. 2019 Jan;89(1):38-47.
- [9] Özdemir S, Akça HŞ, Algin A, Kokulu K, Özkan A. Characteristics of School Injuries Presenting to the Emergency Department. Avicenna J Med. 2022 Jun 20;12(2):61-66.
- [10] Petridou, E. and Trichopoulos, D. Epidemiology and prevention of accidents and injuries. Athens: Zita Medical Publications 2000.
- [11] Yu X, Wang Y, He C, Kang L, Miao L, Wu Y, Yang S, Zhu J, Liang J, Li Q, Dai L, Li X, Deng K, Tao J. The trend of unintentional injury-related mortality among children aged under-five years in China, 2010-2020: a retrospective analysis from a national surveillance system. BMC Public Health. 2023 Apr 11;23(1):673.
- [12] Centers for Disease Control and Prevention. Leading causes of death visualization tool [Internet]. 2021
- [13] Center for Control and Prevention of Children's Accidents (KEPPA) (2007). Child accidents: The numerical components based on the Statistical Data Portal. Available at: <http://www.keppa.gr/>. Retrieved 13.09.11.
- [14] Hashikawa AN, Newton MF, Cunningham RM, Stevens MW. Unintentional injuries in child care centers in the United States: a systematic review. J Child Health Care. 2015 Mar;19(1):93-105.
- [15] Burt CW, Overpeck MD. Emergency visits for sports-related injuries. Ann Emerg Med. 2001 Mar;37(3):301-8.
- [16] Beranek V, Stastny P, Novacek V School injuries and their prevention from the present perspective. Balt J Health Phys Act. 2021;13(1):45-53.
- [17] Stathakis V, Berecki-Gisolf J. Profile of hospital-treated child injury in primary schools, Victoria, 2009/10 to 2018/19. Hazard Edition 88. Melbourne, Victoria: Victorian Injury Surveillance Unit, Monash University Accident Research Centre. 2020.
- [18] Georgiakodis F - Vozikis A. Epidemiology of School Children of Accidents: Conclusions from research in secondary schools . Hellenic Statistical Institute Proceedings of the 17th Panhellenic Conference on Statistics . 2004; 83 – 92.
- [19] World Health Organisation (WHO). World report on child injury prevention. Geneva 2008: Available at: https://apps.who.int/iris/bitstream/handle/10665/43851/9789241563574_eng.pdf;jsessionid=67D45786A21BB006DC908A75E4D97392?sequence=1

- [20] Prieto-González P, Martínez-Castillo JL, Fernández-Galván LM, Casado A, Soporki S, Sánchez-Infante J. Epidemiology of Sports-Related Injuries and Associated Risk Factors in Adolescent Athletes: An Injury Surveillance. *Int J Environ Res Public Health*. 2021; 18(9):4857. doi: 10.3390/ijerph18094857.
- [21] Ramstetter CL, Murray R, Garner AS. The crucial role of recess in schools. *J Sic Health*. 2010;80(11): 517–26.
- [22] Jaffe, E., Khalemsky, A. and Khalemsky, M. Game-related injuries in schools: a retrospective nationwide 6-year evaluation and implications for prevention policy. *IBRD J Health Policy Res* 2021; 10: 51 .
- [23] Little, H., and Eager, D. Risk, challenge and safety: implications for play quality and playground design. *European Early Childhood Education Research Journal*. 2010; 18(4): 497-513.
- [24] Brussoni M, Olsen LL, Pike I, Sleet DA. Risky play and children's safety: balancing priorities for optimal child development. *Int J Environ Res Public Health*. 2012 Aug 30;9(9):3134-48.
- [25] Kelm J, Frank K, Frank A, Dietrich A, Dietrich P, Werner P, Engel C. School Sports Accidents: Analysis of Causes, Modes, and Frequencies. *J Pediat Orthop*. 2001; 21(2):165-8.
- [26] School Buildings Organization (OSK) Study Guide for Teachers of all Levels 2008. Available at: http://www.osk.gr/UserFiles/File/Odigos_Meleton.pdf. Retrieved 04/19/11.
- [27] Centers of Disease Control And Prevention. The National Institute for Occupational Safety and Health (NIOSH) DHHS (NIOSH) PUBLICATION NUMBER 2004-101 Emergency Action Plan.
- [28] Orton E, Whitehead J, Mhizha-Murira J, Clarkson M, Watson MC, Mulvaney CA, Staniforth JU, Bhuchar M, Kendrick D. School-based education programmes for the prevention of unintentional injuries in children and young people. *Cochrane Database Syst Rev*. 2016 Dec 27;12(12): CD010246.
- [29] AXA. Roadsafes for Schools report. Facts about road accidents and children 2020. Available at: www.cornwall.gov.uk/media/3625035/AXA-report.pdf - accessed March 2020
- [30] U.S. Department of Transportation. Traffic Safety Facts: A Compilation of Motor Vehicle Traffic Crash Data. 2023 Annual Report. <https://crashstats.nhtsa.dot.gov/>.
- [31] Donoughe, K., and Katz, B. Evaluation of fatal school bus-related crashes and near-term crash mitigation strategies. *IATSS research*. 2015; 38(2):135-141.
- [32] Pogotovkina NS, Volodkin PP, Demakhina ES. Method for Assessing Risk of Road Accidents in Transportation of School Children. *IOP Conf. Ser.: Mater. Sci. Eng*. 2017;262 012205.
- [33] Gutierrez, C.M.; Slagle, D.; Figueras, K.; Anon, A.; Huggins, A.C.; Hotz, G. Crossing Guard Presence: Impact on Active Transportation and Injury Prevention. *J. Transp. Health* 2014; 1: 116–123.
- [34] FEMA. School building fires (2009–2011). *Topical Fire Report Series*. 2014;14(14):1–16.
- [35] Hassanain, M.A. and Mudhei, A.A. "Post-occupancy evaluation of academic and research library facilities", *Structural Survey*. 2006; 24 (3):230-239.
- [36] Hellenic Institute of Occupational Health and Safety (EΛ.I.N.Y.A.E.). Regulation of fire protection of buildings (Government Gazette 32/A\17.2.1988). Available at: http://www.elinyae.gr/el/lib_file_upload/a32_1988.1132134692147.pdf.
- [37] Heidari M, Jafari H, Heidari S. Zahedan School Fire: Endless Fire Incidents in Iranian Schools. *Disaster Med Public Health Prep*. 2020 Jun;14(3):360-363.
- [38] Seyedin H, Dowlati M, Moslehi S, Sakhaei FS. Health, safety, and education measures for fire in schools: A review article. *J Educ Health Promot*. 2020 May 28; 9:121. doi: 10.4103/jehp.jehp_665_19.
- [39] Kobes M., I. Helsloot, B. deVries, J. G. Post. Building safety and human behavior in fire: a literature review. *Fire Saf. J*. 2010; 45: 1–11.
- [40] Kataoka S, Langley AK, Wong M, Baweja S, Stein BD. Responding to students with posttraumatic stress disorder in schools. *Child Adolesc Psychiatr Clin N Am*. 2012 Jan;21(1):119-33.
- [41] Earthquake Protection Organization (OASP) (2015). Draft Memorandum of Actions for Seismic Risk Management in a School Unit. Available at: http://www.oasp.gr/sites/default/files/OASP_SXEDIO_MNHMONIOU_ENERGEION_2015_0.pdf.

- [42] Sujarwo, Noorhamdani, Fathoni M. Disaster Risk Reduction in Schools: The Relationship of Knowledge and Attitudes Towards Preparedness from Elementary School Students in School-Based Disaster Preparedness in the Mentawai Islands, Indonesia. *Prehosp Disaster Med.* 2018 Dec;33(6):581-586.
- [43] Raccanello D, Vicentini G, Florit E, Burro R. Factors Promoting Learning With a Web Application on Earthquake-Related Emotional Preparedness in Primary School. *Front Psychol.* 2020 Apr 24;11:621.
- [44] Codeanu TA, Celenza A, Jacobs I. Does disaster education of teenagers translate into better survival knowledge, knowledge of skills, and adaptive behavioral change? A systematic literature review. *Prehosp Disaster Med.* 2014;29(6):629-42.
- [45] World Health Organization Health Education and Health Promotion Unit and UNESCO. Sun protection: an essential element of health-promoting schools. Geneva: World Health Organization 2002.
- [46] Saridi, M. I., Toska, A. G., Rekleiti, M. D., Tsironi, M., Geitona, M., and Souliotis, K. Sunburn incidence and knowledge of greek elementary and high school children about sun protection. *Asian Pacific journal of cancer prevention : APJCP.* 2015; 16(4): 1529-1534.
- [47] Turner D, Harrison SL, Buettner P, Nowak M. School sun-protection policies-does being SunSmart make a difference? *Health Educ Res.* 2014 Jun;29(3):367-77.
- [48] Scott JJ, Johnston RS, Darby J, Blane S, Strickland M, McNoe BM. A novel skin cancer prevention strategy: Preservice teachers' perceptions of a sun safety intervention and experiences in schools. *Health Promot J Austr.* 2023 Feb;34(1):255-263.
- [49] Roberts S, Meltzer JA. An evidence-based approach to electrical injuries in children. *Pediatr Emerg Med Pract.* 2013 Sep;10(9):1-16; quiz 16-7. PMID: 24191428.
- [50] Schissler K, Pruden C. Pediatric electrical injuries in the emergency department: an evidence-based review. *Pediatr Emerg Med Pract.* 2021 Dec;18(12):1-24.
- [51] Petsios, K. Paediatric Mass Disaster Preparedness: Obstacles and Recommendations. Chapter 13 in "The Impact and Implications of Crisis: A Comprehensive Approach Combining Elements of Health and Society". Edited by M. Saridi and K. Souliotis. Nova Science Publishers 2018. ISBN: 978-1-53613-191-8