Health, safety, and education measures for fire in schools: A review article

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Abstract:

Fire buildings is considered as one of the most common and the most devastating disasters and emergencies. Saving school buildings against incidents such as fire is very important since students are so vulnerable to incidents especially fire. The most school classes were devoid of safety conditions and oil-burning heaters were used. Such a condition has increased the risk of disaster and is considered as a serious menace for students' lives. The present study conducted with aim of review the Health, Safety and Education Measures for Fire in Schools. To this purpose, we selected suitable keywords some articles published in Scientific Information Database of PubMed, Web of Science, Scopus, and ProQuest were searched. The search was limited to reviewed articles in English and Persian language published between 1970 and 2019, based on inclusion and exclusion criteria. Furthermore, the selected articles were reviewed for relevant citations. The reviewing of articles was conducted by two member of research team independently. The primary search found 194 relevant studies. After eliminating the duplicates and articles which were not related to the review of the abstract, 51 references were identified for inclusion. Finally, 13 articles were selected after screening and evaluated by two authors to final review main factors and dimensions of schools' health, safety and education include the rules and laws, allocating sufficient budgets, education the teachers, students and their families, exercise, risk analysis, intersectional relations, fire extinguishing equipment, early warning system, and also optimization and reformation of heating system. Applying these new approaches prevents disasters and increases the level of preparedness in case of fire occurrence.

Keywords:

Education, fire, health, safety, schools

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Introduction

Building fire is considered as one the most widespread incidents which cause death and injury for many people each year.[1] Building fires is regarded as the hazards facing all countries including low-income, middle-income, and high-income ones.[2] According to the fire department report of US Fire Administration, there had been annually 1,300,000 cases of fire from 2008 to 2017 by which 3400 persons were killed and 15,000 persons were injured.[3] Fire can target residential and commercial buildings and schools.[4] Fire disaster depends much on the behavior of the buildings' residents.[5] Children and students are the residents which are considered as one of the most vulnerable groups of the society.[6,7] About 100 million children are entangled by disasters and calamities each year.[8] When incident disrupts the functioning of schools, student's development, relationships, physical, and mental health are threatened.[9] When educational processes for students are disturbed, they may fail to major important academic concepts and skills. In turn, this may contribute to a path for a future of poor educational achievement. Thus, safe schools are needed to protect the positive social and cultural development of students after disasters. Safe schools are also needed to protect students, teachers, and other adult staff from death and injury, while improving disaster risk reduction and overall community resilience.[8] Burn

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injuries have been counted as the third main reason of child death after car accidents and drowning.[10] School fire has had its background from 1997 and brought about the death of tens students and teachers, the most important of which was the fire in Shinabad, a village in Iran that sent two students to death and burnt 28 primary school girl students.[11] In most of the similar cases, using oil heaters and unstandardized heating systems were accounted for the occurrence of fire. Based on lesson learnt of previous events, resolving the gaps in policies of fire safety and preparedness promotion can help to health of students and teachers. Most of the schools in the world are unsafe, and classes do not have the heating system. Therefore, there is the risk of serious injuries in the students in cases of fire.

Managing school fires means taking action in three areas. The first is emergency planning. The second is education for staff, students, and families about what actions to take in case of fire. The third step is ensuring the school building is kept fire-safe.[12] Through education, disaster management concepts can be cultivated in students, enabling them to establish proper perception of incident. Therefore, their incident response capability societies such as families can be improved. Schools and students need to build resilience to emergencies and be prepared to reduce their consequences, both to ensure that effectiveness response and also that the education continues as quickly and efficiently.

Therefore, the purpose of the present study was to conduct a review of school's preparedness measures to summarize and review the programs, plan or protocol for schools' actions against fire. Finally, we identify and categorize management and technical-specialized actions. The results of this study may help schools' managers and authorities and health system and policymakers to promote students and their family's preparedness for fire in schools.

Materials and Methods

This study is a narrative review with aim of gather information relating to fire in schools and health, safety and education action. We reviewed published articles in scientific databases from March 1970 to August 2019.

Information sources

Databases included PubMed, Web of Science, Google Scholar, Scopus, and ProQuest. Nation databases that used for search Persian key word include SID, Magiran, Civilica, and barakatkns. A broad search was performed using the Keywords alone or in combination included "Heath," "Education," "Safety," "Disaster," "Preparedness," "fire," and "school."

Eligibility criteria

To evaluate the studies related to a health, safety and education measures for fire in schools, three main keywords (heath, education, safety for preparedness) were included in from March 1970 to August 2019.

For selecting articles following inclusion criteria was considered:
a. Studies that were published in English and Persian language
b. The full text of the article is free
c. Studies that published with focus on school fire.

Exclusion criteria included studies published in languages other than English. In addition, editorial studies, studies conducted before 1970, and studies that investigated the management of fire locations other than schools were excluded. To obtain authoritative information, this review included only peer-reviewed journal articles. Furthermore, the article that their full text was not available and the article that their method was not clear excluded.

At the initial search stage, 194 relevant articles identified. Then, duplicate and irrelevant articles were removed and by review of the tittle and abstract. Fifty-one articles were identified for inclusion by review of full texts. Finally, 13 articles were selected after screening and evaluated by two authors to final review Figure 1 and Table 1.

Data analysis

A thematic synthesis approach was used to analysis collected information and identify all themes.[13,14] The inductive analysis by two authors was adapted and used three stages: (1) Extraction of findings and coding of findings for each study; (2) grouping of findings (codes) according to their topical similarity to determine whether findings confirm, extend, or refute each other; and (3) abstraction of findings. The initial synthesis of studies was conducted separately for each of the included article formats. One author extracted data from the included studies into an extraction datasheet. The accuracy and completeness of the extracted data were checked by two other authors.

Results and Discussion

Management actions
Laws and regulations
The lack of any rules and specific applicable plans for preventing disaster, the shortage of human resources, and the unwillingness of public and private organizations to participate are regarded as some of the affective impediments in the enforcement of approaches for decreasing danger in schools.[15,16] Applying laws
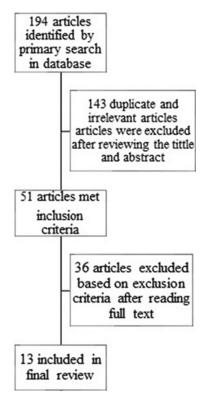
Figure 1: The flowchart for selecting process and enrolling the articles in the study

and regulations for educational centers in terms of constructional codes and structural, nonstructural and performative safety are enforceable. On the structural safety, the sturdiness of the structure and the rules related to the use of proper and firm constructional materials resistant to fire should be highlighted. In addition, utilizing decorative flammable materials and composites in the construction of schools increase the risk of fire.

Thus, they should be used by minimum. The paths and emergency exiting stairs design or other supplementary equipment for buildings, especially the great several-floored buildings, should focus on by the heads of the educational centers. Another code, which should be considered in designing the physical structure of prepared or to-be-prepared schools by the people in charge, is the existence of safety fire systems such as smoke and heat-illustrators and fire extinguishing systems. By a reformation in the rules pertaining to installation of such systems, the casualties arisen by fire can decrease remarkably.[17] In addition, taking action compliant with standards and rules for choosing and installing nonstructural devices and equipment in schools, especially heating equipment in cold seasons when the risk of fire occurrence is the most, is regarded as one of the vital actions for preventing fire. Checking the heaters and their chimneys annually, buying standard heaters, and considering proper distance between the heater and

flammable materials are some preliminary actions in preventing fire.[18]

Allocating required budget
Since students are regarded as a vulnerable group against disasters, especially fire, the risk of occurrence of disasters and school's vulnerability would become higher if the required budget is not allocated for supplying the equipment and renovation. Allocating the demanded budget for outfitting schools and particularly improving the heating systems result in improving the school's safety both in structural and nonstructural aspects.[8]

Exclusive education and training
One of the most significant factors in fire occurrence and the afterward casualties is the humans' unsafe actions and this is deemed as the main factor of burn incidents.[19] In this regard, controlling persons' unsafe behaviors is one of the useful strategies in lessening incidents which is practical by the development of education and the safety culture level.[20] The gap of teachings in a society is considered as a risk factor of fire occurrence.[21] The problem can be largely solved by teaching safety cautions regarding fire such as how to use fire extinguishers practically and exercise emergency evacuating for the target groups including the students and the school principals.[22] Theoretical and practical teachings presented by schools which are accompanied by playing such as prevention from burn and fire are so affective for students which can reduce the risk of burn injuries in these groups.[23,24] In addition, the high-risk students can be identified by school teachers and presenting preventive education.[25] Educational planning for students can not only focus on safety cautions teachings about fire, but also can accentuate on issues such as health and social consequences such as describing burn injuries, therapeutic period, and rehabilitation procedure. Further, teachers should spend more time teaching safety points about fire to the students.[26] Holding continuous sessions of exclusive exercise to improve the capabilities of students, teachers, and school principals in accelerating their performance at the time of the occurring incidents is regarded as an active approach for decreasing the vulnerability of educational centers.[27]

Risk assessment
Todays, due to the transformation of residential buildings into educational centers, the constructions are not resistant enough, and in addition, they are prone to various disasters due to the lack of required space, which is so crucial in emergency evacuation at the time of incident.[28] Purposes of risk assessment of fire are evaluating the possibility of incident occurrence, identifying the vulnerability and the consequences of the incident, recognizing the weaknesses and increasing

Table 1: Characteristics of included studies

Reference number	First author	Year published	Location	Subject	The aim of the study	Type of study	Results
[8]	Lai	2016	United States	Unclear	Experiences and lessons from disasters	Qualitative study	Several key points include coordinating visible global leadership for school safety, conducting audits of new school construction, and developing education materials that meet the needs of different populations
[15]	Kanyasan	2018	Laos	52 policy implementers from the disaster management committee	Clarify the present situation to inform better implementation	case study/interview	A comprehensive school-based DRR program would be beneficial in improving student knowledge and practices on DRR
[19]	Hwang	2006	Canada	Third and fourth grade students from two elementary schools	Determine the impact of a community-based fire prevention intervention	Quasi randomized controlled study	Fire prevention strategies have been shown to reduce fire related injuries. Fire safety behavior among households improves with an in-home fire prevention intervention
[30]	Khan	2013	Pakistan	Children of <15 years injured at school	To compare ED outcomes of the school-based injuries	A pilot injury surveillance study	Effective school-base burn-injury prevention program can be implemented with the cooperation of schools, and this survey is the initial step to create such an educational program
[22]	Lovreglio	2015	Sweden	Unclear	A case study of the proposed preevacuation time model	A case study	The main factors influencing the decisions were the time elapsed since the start of the alarm, the occupant's position, and social influence
[25]	Corrarino	2001	USA	49 young children	Ascertain what scald burn prevention practices parents of young children used and whether teaching	A pilot study/interviews	Implications for teaching families effective scald burn prevention strategies. Nurses are often in a unique position to teach parents of young children healthy behaviors, and they have an opportunity to play a key role in injury prevention with this population
[23]	Dougherty	2006	Michigan USA	113 teachers from kindergarten	Assess primary school educator knowledge and opinions regarding fire-setting behaviors and burn-injury prevention education	A written survey	Nearly all primary school educators surveyed agreed that burn injuries and attempting to curb fire-play are important societal issues. There was wide agreement that including a description of the medical and social consequences of burns in a preventive curriculum would enhance its efficacy. The younger students are, the more time teachers require to adequately convey fire safety instruction

Contd...

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Reference number	First author	Year published	Location	Subject	The aim of the study	Type of study	Results
[33]	Pires	2005	United Nations	Unclear	To assess human cognitive behavior in fire emergency evacuation situations	Simulation models	The logic diagrams have shown to be a very powerful tool to analyze the cognitive aspects of human beings during a fire emergency situation. Questions like how the approach is used, where to find the input data necessary and what results are obtained are discussed
[31]	Wang	2016	Taiwan	35 schools	An assessment framework for school disaster management	Focus group method	School disaster management indicator system can effectively distinguish and reflect the disaster management condition of each type of school. In addition, this system can facilitate schools to regularly inspect and verify various disaster management tasks, thereby enhancing their capability in responding to disasters
[27]	McCann	2001	USA	Unclear	Discusses the elements of a health and safety program	Unclear	Elements include curriculum content, ventilation, storage, housekeeping, waste management, fire and explosion prevention, machine and tool safety, electrical safety, noise, heat stress, and life safety and emergency procedures and equipment
[24]	Rebmann	2016	St. Louis	133 school nurses	Examined the impact of a school intervention	Survey/ preintervention, intervention, and postintervention	The education intervention was effective at improving school preparedness, though the impact was small. The education intervention needs to be reassessed, especially in regard to providing a longer intervention period
[28]	Kheradmand	2014	IRAN	Schools in west of Tehran	Evaluating the seismic structural vulnerability of education centers	A case Study	With regard to the importance of educational centers, the vulnerability and functional assessment before earthquake are necessary. Recommended strategies for reducing vulnerability have been classified into two static and dynamic groups
[32]	Khorasani Zavareh	2017	IRAN	Unclear	Report includes a fire at the Plasco building in Tehran	Lessons learnt	The challenges of emergency management on the scene of fires, unclear incident commander in the initial moments of fires, overcrowding and notification-related matters can be considered as the problems of Plasco building fires

ED=Emergency department, DRR=Disaster risk reduction

the strengths.[29] By utilizing the evaluation procedure of fire risk properly, the possibility of occurrence of disasters and their joint dangers is diminished and the preparedness for proper reaction to the incidents is developed.[30,31]

Technical-specialized actions
Inter-organizational interaction
Cooperation and interaction between Schools and Fire Departments, Emergency Medical Services (EMSs), Municipalities, Hospitals, and Burn-related Centers in critical for appropriate response to fire. The task of any organization giving services is to manage the incident optimally and correctly, which should be exercised in different operation conditions which can lead to giving proper services at the time of incident by means of a single and competent management.[32] Expert rescuers such as firefighters and EMS staff enter the incident field from the first phases. In this regard, correct and effective interaction between these organizations and the other people responsible in the management of the incident is considered as one of the main factors in reducing the losses and casualties.[33,34] Furthermore, the intersectional interaction between ministry of education and municipality is necessary for designing schedules for counteracting with and responding to the incidents, along with periodic inspection of constructing education centers.[28] On the other hand, inviting nurses and the staffs of burn-related centers to schools and asking their comprehensible explanations on the consequences of burn for the students are regarded as other comprehensive plans for observing safety cautions and preventing fire. Thus, regarding the involvement of different organizations in preventing and dealing with incidents arisen by fire, lack of congruence among different sections, suitable managing strategy, and attention given to the prevention stage, and reducing the risks are considered as among factors which make the situations worse.

Fire-extinguishing equipment and early-warning system
The number of fire occurrences is high in underprivileged and low-income countries due to the low investment in proper mobilization of fire extinguishing tools for places. In most of the localities and zones of these countries, which are in a low rank economically and socially, the percentage of deaths and the repercussions of fire are higher since safe firefighting equipment such as detectors and warning devices are used less in the buildings.[26,35] Therefore, it is necessary to supply the required governmental or nongovernmental budget for equipping organizations and schools with safety devices against fire. In addition, organizations should have operational plans for renovation, mobilization, and updating safety firefighting tools in order not to experience much casualty in case of occurring incidents.[32]

Optimization and refining of heating systems
The use of unstandardized heating devices is regarded as the main cause of fire in the schools.[36] Using unsuitable and unsafe domestic oil-heaters and other unstandardized heating systems can raise the risk of fire in buildings. The use of these devices has long been stopped in high-income countries. However, in low-/average-income countries, the risk of deaths by fire has increased due to inefficient political and economic strategies, giving no priority to the safety plans, as well as the shortage of financial sources for purchasing safe and standard equipment.[37,38] In this regard, correct utilization of safe and standard equipment, periodic inspections, eliminating dangerous, and unsafe tools play a significant role in preventing resulted casualties by fire.

Strengths of the Study

The strengths of this study were the first review article that reviewed in health, safety, and education measures for fire management in schools with thematic synthesis approach. Major strategies for promotion of education, health, and safety including establishing understanding of risk in teacher and students, policymaking and decision-making to budget allocation for fire risk management, creating for prevention and reduction of incidents, promotion of level knowledge, risk assessment and evaluation of safety level of school and development of a comprehensive plan for disaster management in schools.

Weakness of the Study

In our opinion, organizations, schools' authorities or teachers may perform many innovative measures for children education and safety promotion, but as they did not publish or report these actions, we could not access to them so, there is a possibility of missing unpublished other measures. This problem can be solved by encouraging of authorities or teachers for presenting of their plan and ideas in format of article and meeting and supporting of this plan for using in schools.

Suggestions

It is suggested that an education students, parents and teachers should be performed by expert trainer and according to proper plan. Furthermore, appropriate actions for safety promotion should be planned and conducted. Furthermore, evaluation of school preparedness level for disaster should be performed to solving weakness and improve strengths.

Conclusion

Building fire and more specifically, school building is

deemed as a serious threat for the health of students and teachers. Regarding the influential role of students and teachers in developing any society, and the vulnerability of this group to incidents, preventing incidents, reducing the outcomes, and being prepared should be highlighted. Based on our findings, observing health and safety rules and education in schools and promoting the level of preparedness of students, their families, and schools' staffs regarding fire seem very effective in preventing and responding properly to the incidents. The current review has shown management actions including establishing and implementation laws and regulations, consideration and allocating sufficient budget for safety measures and education, education and training with best methods as well as comprehensive and exclusive, risk assessment including hazard identification, capacity assessment, and estimation of potential losses. Technical-specialized actions are cooperation and interaction between schools and external organization such as fire departments, EMS, municipalities, hospitals, and burn-related centers, use of proper equipment for fire-extinguishing and development early-warning system and optimization of heating systems in schools. Finally, it is suggested that a standard and comprehensive education plan for students, parents, and teachers be designed and conducted by professional trainer. Afterward, the effectiveness of these measures should be evaluated to improvement of strength and solving weakness.

Conflicts of interest
There are no conflicts of interest.

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