Health, Safety, and Environment Assessment in Schools Using a New Tool (HSE-S) Based on an Audit System

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ABSTRACT

This study assessed the status of health, safety and environment (HSE) in all public schools (n=188) in Iran using a new tool (HSE-S) based on audit system.

The first part of HSE-S tool was about general specifications and environment conditions. The second consists of the physical conditions and school management. The HSE-S was validated using CVI and CVR, Cronbach's alpha and Kappa coefficient.

The CVI, CVR, Cronbach's alpha coefficient and Kappa index were 0.75,> 0.7, 0.99 and 0.736 respectively. Ten schools were ranked as one-star, 149 as two-star and 29 as three-star. The top priorities for achieving an acceptable HSE status in schools were establishing a HSE unit, improving ergonomics and having a risk management system in each school.

The HSE-S is an effective tool to evaluate and promote health, safety and environment in schools. Its application can help in implementing the "health promoting school" program of WHO.

Key words: Health; Safety; Environment; Audit System; School

INTRODUCTION

Generally, school is an environment in which a child spends one third of his/her daily life with teachers and other children (at least around six hours per day for180 days annually). Children, teachers, and other school staff are exposed to various physical, psychological, and social risks that may negatively affect their health and well-being [1]. Thus, establishing a healthy and safe condition is essential to prevent dangerous situations. All aspects including school's physical environment (premises, yards, equipment, and surrounding environment) and social environment (relationship quality) must be considered in this regard [2]. Schools with health and safety standards provide a social and physical environment that can nurture students' behavior properly [3].

In a scholarly study, Vicario *et al*. investigated the schools' safety management in Catalan, Spain, evaluating the efficiency of school deans in implementing the rules and regulations and their role alongside teachers and consultants in schools' safety management. The studied factors were the management of human relationships, educational and economic resources, documents, equipment, and buildings' maintenance, crises and preparing emergency plans and having a fire alarm. The results showed that factors such as sufficient management

support, increased time, and resources as well as improving employees' educational level are required to maintain a safety management system in schools [1]. In another study, Srichai *et al.* found that Thailand's school safety management has less priority than other educational constituents of this country and is not efficient. They used a new method for managing resources in increasing school safety. They concluded that Thailand has a high potential for improving schools' safety management which can be used with more efforts and planning [4].

Obioma and colleagues have defined a teaching safety method for children as a continuous changing learning process in which the child learns how to protect himself/herself from potential dangers. To provide the adequate safety for children, an educational safety program must contain all potential risks including drug abuse, diseases, life style, environment, and human rights [5]. Recently, a program has been developed for implementing, maintaining and improving the status of health, safety and environment in schools (HSE) of Iran by the Ministries of Education and Health, Treatment and Medical Education. Based on evaluation of schools' health and safety status, this program classifies schools in a ranking system from zero (not having most standards) to five stars (having all the standards). Thus, an implementation guideline

has been written by the two ministries for having a health promoting school [6]. In addition to these standards, other standards have been recommended by other organizations of Iran such as the National Standards Organization, Organization of School Renovation, and Management and Planning Organization to promote safety and health in schools. According to various studies in Iran it is clear that schools' health and safety management and their ergonomics are in need of improvement [7-10]. All of these studies were done by an approved checklist based on the action plan of health promoting schools in Iran and other checklists available at the school health instructions' records (published by the Office of Adolescent, Youth and Schools' Health of the Ministry of Health, Treatment and Medical Education and Office of Health of the Ministry of Education). These tools have considered various aspects of safety and health in schools. Of course they are not thorough and some of their pitfalls include not considering the un-organized establishment of HSE management in schools, risk assessment, physical space and schools and classrooms' conditions (including sound, lighting, and infrared radiation heaters), ergonomics, poor quality of the available safety educational programs, and a weak safety culture.

Such health and safety shortages in school facilities can have irreversible consequences, negatively affecting the national education system and public opinion. The school fire in Sheen Abad village (in northwest of Iran) because of an old oil heater, the unsafe acts of children and school staff after it, i.e. failure to use the required safety trainings during emergencies, not knowing how to use fire extinguishers and lack of escape route or emergency exits in the building, was an example of lack of safety measures in a school which lead to severe casualties of children. Hence, this study sought to develop a new systematic HSE-S model based on an audit system for schools.

MATERIALS AND METHODS

All public schools (110 rural and 78 urban schools, n=188) of Iran, were evaluated in 2014 and 2015 based on a newly designed audit system tool that called HSE-S (Health, Safety, and Environment in Schools). Schools in Iran are either one-shift (from 8 am to 1 pm) or two-shift (one shift from 8 am to 1 pm and the other 1:30 pm to 6:30 pm). In some schools the morning shift is for one gender (boys/girls) and the other shift is for the other gender. Also, sometimes the morning shift is for one educational level (for example primary school) and the other for another level (guidance school).72.3% of the studied schools were morning shifts and 27.7% were afternoon shifts (Table 1).

There are no mixed boys and girls schools in Iran and all schools are either girls only or boys only.

Instruments

HSE-S questionnaire had two sections. In the first section, the school's general features and its environmental conditions, equipment and buildings were evaluated, including its location (urban/rural), students' sex, educational level (elementary /guidance/high school), shift (morning/afternoon), construction year, structure type, fire safety certificate, sound, and lighting, frequency of cleaning windows and lamps, and electric heaters' infrared radiation. The second section which was about HSE in particular, consisted of two sub-sections of physical conditions (each part of this subsection was encoded as A to O) and school management (encoded as P to W). In other words, the second section had five sub-categories: physical conditions' items consisted of statistical analysis (22 items) and compliance with safety standards (342 items in 14 sub-headings). The school management consisted of risk analysis (4 items), management support (36 items) and safety program (61 items). Thus, there were 364 physical condition and 101 school management items in our questionnaire.

Table 1: Distribution of the studied variables in the studied schools of Iran in 2014-2015

Variable	Frequency	%
School type* based on sex		
One-shift boys school	60	31.9
One-shift girls school	67	35.6
Two-shift boys/girls school	61	32.4
Educational level		
Primary school	95	50.5
Guidance school	52	27.7
High school	24	12.8
Art/vocational school*	5	2.7
Primary/guidance school*	4	2.1
Guidance/high school*	8	4.3
School construction year		
Before 1970	36	19.1
Between 1970 and 1983	39	20.7
Between 1984 and 2004	79	42
After 2005	27	14.4
Unknown	7	3.7
Type of material used in the school construction		
Reinforced concrete	77	41
Steel structure	10	5.3
Load-bearing wall	71	37.8
Clay	1	0.5
Other	29	15.4
Fire department certificate		
It does	72	38.3
It does not	116	61.7

* Schools in Iran are either one-shift (from 8 am to 1 pm) or two-shift (one shift from 8 am to 1 pm and the other 1:30 pm to 6:30 pm). In some schools the morning shift is for one gender (boys/girls) and the other shift is for the other gender. Also, sometimes the morning shift is for one educational level (for example primary school) and the other for another level (for example guidance school).

The second section (physical condition and school management) questions were responded in a five-point Likert scale (very good, good, fair, poor, and very poor) or (always, often, to some extent, few times, and not at all). Each category was weighted so that the sum of all sub-sections would be from 0 to 100. Two types of analysis were done for each school. In the first analysis the obtained scores were estimated of 60 and 40 for the physical conditions and school management, respectively. In the second analysis the score of 60 based on 100 was estimated for physical conditions and score of 40 based on 100 for the school management. Finally, based on the overall score obtained by HSE-S questionnaire (A1-W9) the studied schools were rated from zero to five stars based on conventional Hoteling. In this sense, a school with 0-15 score was rated as no star, 15-30 scores as one-star, 30-45 scores as two-star, 45-60 scores as three-star, 60-85 scores as four-star and 85-100 scores as five-star. These scores were used to set priority for improving the studied schools and helped to define measures for evaluating them.

Standards and Documents

Since many behavioral patterns affecting people's health status in adulthood are formed in the school years and childhood, many organizations have suggested interventional programs to help in shaping these behavioral patterns in schools [11]. Thus, the results of many of these interventions have been compiled into a comprehensive and advanced program known as "health promoting school" [12]. This program was recommended by the World Health Organization to support schools worldwide [13-15].

In this regard, to assess the schools' health and safety status and provide the lacking requirements, a guideline was published in Iran in collaboration between [1] the Office of Health of the Ministry of Education, [2] Modernization, Development and Equipping of Schools Organization, and [3] the Office of Adolescent, Youth and Schools' Health of the Ministry of Health, Treatment and Medical Education entitled "health promoting schools in the Islamic Republic of Iran".Although this guideline has a comprehensive and systematic framework to evaluate schools' safety and health status, it has pitfalls such as low-quality items in its audit checklist, excess of reporting forms, lack of systematic scoring, not considering environmental conditions (such as sound and lighting) and the available health and safety educational programs, and lack of measures to improve the existing conditions.

Consequently, we suggested a new audit model to rate the schools from zero to five stars and prioritize corrective actions. The national standards such as Iran's ISO:3763 entitled: "The general principles of site selection and health promotion of educational buildings", ISO:4571 entitled: "The principles of fire-safe designed schools – escape section",ISO:2086 entitled: "Schools' Health" ,the implementation guideline of protecting buildings against fire of Iran' Management and Planning Organization, regulations and criteria of designing educational spaces of Iran's Modernization, Development and Equipping of Schools Organization (3rd edition) plus international standards and guidelines such as the NFPA 101 [16], World Health Organization guidelines for health promoting schools (۱۳)and threshold limit values [17] were used to make the HSE-S questionnaire.

Data Analysis

The content validity index (CVI) and content validity ratio (CVR) were used to assess the validity. CVR (CVR= (Ne - N/2) / (N/2)) in which the Ne is the number of experts indicating "essential" and N is the total number of experts. Four experts from which fields were utilized to validate the HSE-S tool. Cronbach's alpha was used to determine the internal consistency and reliability of HSE-S items and statements. The Kappa's coefficient was used to assess inter-observer reliability. For analyzing the results to determine HSE-S status, descriptive statistics was used to calculate mean and standard deviation. The statistical t-test was used to determine the significance level between the studied variables. P-value less than 0.05 was considered significant. All data analyses were done by the statistical package for social sciences (SPSS) software version 22 (Chicago, IL, USA).

RESULTS

Criteria such as relevance, clarity and simplicity were evaluated for each HSE-S item in a four-point Likert scale by four experts to determine CVI and CVR. The CVI score was estimated based on the sum of scores for each item which had received 3 and 4 ranking by the experts. CVR score is calculated based on the ratio of experts who identified every item as essential .The acceptance criterion were having CVI and CVR scored more than 0.75 and 0.99 respectively (The CVR values were 0.99 for all items).

Regarding reliability, Cronbach's alpha less than 0.6 is considered unreliable, 0.6-0.8 is reliable and more than 0.8 is highly reliability. In our study all items had more than 0.75 score in content validity and each sub-section had more than 0.7 score in Cronbach's alpha (Table 2).

To assess inter-observer reliability the checklists in 10% of the samples were filled separately by four observers and the results were analyzed by Kappa agreement coefficient. The kappa index value is between zero and one and if the score is closer to one, there is more agreement. The Kappa coefficient less than 0.4 indicates poor agreement, between 0.4 to

0.7shows acceptable agreement and more than 0.7 shows highly acceptable agreement. Our results demonstrated that the kappa index for all HSE-S items were 0.736. So there was an agreement in this regard on HSE-S questionnaire.

The minimum, maximum, mean, and standard deviation were also calculated for HSE-S questionnaire (Table 3). Based on the results about prioritizing corrective actions, sub-sections of HSE-S, ergonomics, risk analysis, number of emergencies of the previous year and compensation costs, and protective measures had the lowest mean scores,

respectively. Fire protection, stairs and corridors, geographical location, school yard and floor surfaces, classes, heating and cooling system and senior school management had the highest mean scores, respectively. Based on the obtained scores, the weaknesses were detected and prioritized to be overcome in the future. Thus, building a HSE unit, improving ergonomics and assessment system, and having a risk management were the top priorities. Other required measures were prioritized based on the obtained scores (Table 3).

Table 2: Physical condition and school management content validity index of the studied schools in Sari city

Code	Number of questions	Investigated Cases	CVI*	(α) Cronbach's alpha
A1-A22	22	Event rates for the previous year and the cost of compensation	0.91	0.95
B1-B13	13	School Structure	0.76	0.84
C1-C7	7	Barriers(Guards)	1	0.76
D1-D32	32	Toilets(WC)	0.78	0.72
E1-E19	19	Electrical Safety	0.89	0.70
F1-F40	40	Fire protection	0.87	0.71
G1-G25	25	Stairs and hallways	0.84	0.78
H1-H35	35	classes	0.86	0.71
I1-I12	12	School grounds and floor surfaces	0.83	0.70
J1-J12	12	Geographical location and unsafe situations	1	0.74
K1-K7	7	first aid	1	0.75
L1-L27	27	Utilities / heating-cooling	0.78	0.99
M1-M4	4	Ergonomics	1	0.74
N1-N39	39	Systems (conditions) emergency	۱1	0.92
O1-O70	70	Etc.	0.75	0.72
Total physics	29۵		0.87	
P1-P4	4	Risk analysis	1	0.89
Q1-Q20	20	Senior management	0.90	0.82
R1-R16	16	headmaster	1	0.95
S1-S12	12	Inspections	0.75	0.90
T1-T15	15	Education	0.80	0.91
U1-U20	20	Safety Committee / performance safety coordinator	0.80	0.88
V1-V5	5	Safety Promotion	0.76	0.74
W1-W9	9	HSE unit	1	0.95
Total administrative cases	101		0.86	

* The CVR values were 0.99 for all items.

The mean and standard deviation obtained from HSE-S tool for school management (score of 40), physical conditions (score of 60) and their total (score of 100), as well as schools ranking (zero to five stars) were calculated for all the studied rural and urban schools (Table 4). The results showed that there was no zero-, four- and five-star school among the studied schools. However, there were 10 one-star schools, 149 two-star schools, and 29 three-star schools. The means (standard deviations) of HSE-S for schools rated as one star, two-star and three-star were 25.34 (5.59), 38.07 (3.79), and 48.28 (2.25), respectively.

The t-test analyses showed that there is significant difference between the mean score of urban and rural schools (P ≤ 0.005). The mean score of urban schools was more than rural schools. Also, we found out that there was a significant difference between the mean score of school construction year before and after 2005 (P ≤ 0.017).Schools built after 2005 had a higher HSE-S rating. In addition, the mean score of schools in terms of gender were significantly different (P≤0.003).Girls' schools had a higher HSE-S rating. However, there was no significant difference in the mean score of schools regarding educational level (primary/guidance/high school) (P ≤ 0.142).

Table 3: Minimum, maximum, mean and standard deviation of the studied schools

Codes	No.	Items	Score	Mean	Min	Max	SD
A1-A22	1-1	Event rates for the previous year and the cost of compensation	5	0.70	0	2.9	0.85
B1-B13	2-1	School Structure	4	2.02	0.42	3.31	0.57
C1-C7	2-2	Barriers (Guards)	4	0.81	0	4	0.92
D1-D32	2-3	Toilets (WC)	2	1.01	0.45	1.38	0.19
E1-E19	2-4	Electrical Safety	4	1.36	0	2.50	0.39
F1-F40	2-5	Fire protection	7	3.65	1.38	6.18	0.12
G1-G25	2-6	Stairs and hallways	5	2.42	0	3.60	0.62
H1-H35	2-7	classes	5	2.53	1.54	3.53	0.42
I1-I12	2-8	School grounds and floor surfaces	4	2.47	0	3.33	0.44
J1-J12	2-9	Geographical location and unsafe situations	4	2.45	0	3.67	0.50
K1-K7	2-10	first aid	3	1.41	0	2.68	0.46
L1-L27	2-11	Utilities / heating-cooling	5	2.61	0	4.13	0.61
M1-M4	2-12	Ergonomics	1	0.27	0	0.58	0.14
N1-N39	2-13	Systems (conditions) emergency	٣	0.90	0	1.89	0.40
O1-O70	2-14	Etc.	4	1.99	0.5	2.91	0.40
P1-P4	3	Risk analysis	٥	0.40	0	2.19	0.59
Q1-Q20	4-1	Senior management	5	3.13	3.13	3.13	0
R1-R16	4-2	headmaster	5	1.53	0.08	3.85	0.82
S1-S12	5-1	Inspections	5	1.83	0	3.75	0.67
T1-T15	5-2	Education	5	1.90	0	3.75	0.71
U1-U20	5-3	Safety Committee / performance safety coordinator	5	2.12	0.13	3.75	0.67
V1-V5	5-4	Safety Promotion	5	1.75	1.75	1.75	0
W1-W9	5-5	HSE unit	5	0	0	0	0
A1-W9	-	TOTAL	100	38.97	15.47	52.75	6.14

Table 4: Mean and standard deviation of the physical condition and * and management** of urban and rural schools in Mazandaran province

			Management	Physical condition	Total Score
Urban	One star (15-30)	Mean	7.66	16.77	24.44
		S.D	2.40	4.86	6.85
		N	6	6	6
	Two star (30-45)	Mean	12.85	26.36	39.21
		S.D	2.66	2.78	4.09
		N	52	52	52
	Three stars (45-60)	Mean	16.50	32.02	48.52
		S.D	1.37	1.94	2.02
		N	20	20	20
		Mean	13.39	27.07	40.46
		S.D	3.28	4.748	7.29
		N	78	78	78
Rural	One star (15-30)	Mean	9.76	16.92	26.69
		S.D	1.10	2.50	3.39
		N	4	4	4
	Two star (30-45)	Mean	11.75	25.71	37.46
		S.D	1.31	2.72	3.49
		N	97	97	97
	Three stars (45-60)	Mean	14.55	33.21	47.76
		S.D	1.67	1.93	2.77
		N	9	9	9
		Mean	11.91	26.01	37.91
		S.D	1.58	3.79	4.94
		N	110	110	110
Total	One star (15-30)	Mean	8.50	16.83	25.34
		S.D	2.18	3.90	5.59
		N	10	10	10
	Two star (30-45)	Mean	12.13	25.94	38.07
		S.D	1.95	2.75	3.79
		N	149	149	149
	Three stars (45-60)	Mean	15.89	48.28	48.28
		S.D	1.71	2.25	2.25
		N	29	29	29
Total		Mean	12.52	38.97	38.97
		S.D	2.54	6.14	6.13
		N	188	188	188

*Physical conditions of schools: consisted of statistical analysis and compliance with safety standards;
** The school management: consisted of risk analysis, management support and safety program.

DISCUSSION

This study has introduced the HSE-S questionnaire as an evaluation tool to check the status of health, safety, and environment based on an audit system. As an important factor students' health and safety can impact their learning capacity. School environment has a direct effect on self-esteem, health, and academic achievement of its students and staff [18]. Thus, based on physical infrastructure and management approaches regarding health, safety and environment, HSE-S questionnaire was designed and its content validity, internal consistency and inter-rater reliability were confirmed. HSE-S tool is unique in terms of content, being comprehensive and specific, reviewing the HSE factors with detail, and using the available standards and guidelines of schools.

In a study Karbassi *et al.* proposed a new model of HSE for citizenship based on five factors of management's responsibility and commitment, infrastructures, resource management and documentation, planning, management and monitoring HSE, and improvements of schools and daycares [19]. This model was based on the management standards of HSE in industries, production facilities and services sectors, and partly schools which had a management view of HSE. However, ignoring the ergonomic conditions of schools was one of its weak points. Also, some of the standards that were used to make their questionnaire were mostly based on standards and guideline of Tehran Municipality, Ministry of Oil, National Petrochemical Production Company and Integrated Aviation Safety Management System that were not much fit to evaluate schools. However, our model has overcome such pitfalls by considering all national and some international HSE standards and guidelines for schools. In other words, our questionnaire was made primarily for schools.

Similar to our study, Aghili *et al.* evaluated establishing and maintenance of HSE management systems in Iranian schools. Their questionnaires have been used to evaluate HSE systems in some other national studies in Iran [6]. Still it had a limited number of items (65 to 81 items) and did not consider environmental aspects. Also, it has not evaluated the requirements systematically and is not quite fit for schools. The grading scale of their checklist was the two-point 'yes or no' (0 or 100) and each item was not ranked separately. The manufacturing and services industries use standards and systems to check the status of HSE implementation which include the integrated management system standards such as OHSAS: 18001 and ISO: 14001 [20, 21] HSE-MS [22]. Each of these standards and systems are restricted to a particular industry and cannot specifically be used in schools.

Our HSE-S tool not only covers the three areas of health, safety and environment, it is specifically developed for schools. Also, with some changes it can be used in other educational facilities such as universities. This HSE-S tool can derive out the existing HSE problems just like an integrated management system, but more accurately. It can also suggest a solution to the problems and then prioritized measures for improvement. For example, in this study it was found that the studied schools were not in an acceptable HSE condition and establishing HSE unit in schools, improving ergonomics, management systems, and risk assessment are required to improve the current HSE status. HSE-S can be adapted to the HSE standards of educational facilities of any country and translated into any language to be used after reaffirming its validity.

Our HSE questionnaire showed that most of the studied schools (79.25%) had 40% of the HSE requirements (were two-star) and 15.5% of schools had 60% of the HSE requirements (were three-star). The rest (5.25%) of schools had only 20% of the HSE requirements. No school had more than 80% of the HSE requirements and none had zero percentage of the requirements. Our study showed that most areas of health, safety, environment, sanitation, ergonomics, and risk assessment were in need of improvement in the studied schools.

In another study in 2012, Aghili and colleagues evaluated the health systems in Iranian schools. They found out that schools' HSE status had improved compared to their previous study in 2007 so that no school was in a poor level of implementing the HSE requirements and 40.8% of the schools had a high level of compliance with the requirements of the health system [23]. Also, Halvani and Ketabi investigated level of safety in public and private schools of Yazd city, Iran. Their study showed that the safety status of schools is in need of reconsideration and improvement according to international safety standards to cover all the safety and health requirements of schools [24].

According to the mentioned studies and our results, schools' HSE status is in need of substantial improvements in Iran and most probably many other countries. Promoting HSE status and culture and compliance with its obligations can be done by setting standards, systematic application of methods and using tools such as HSE-S. In addition to the allocation of funds to the HSE in schools, this makes HSE essential and since it is applied at childhood and adolescence to students, it can institutionalize the HSE culture in their minds and their lives which can be helpful for their employment in future.

CONCLUSION

Our HSE-S questionnaire is a comprehensive and appropriate tool to assess health, safety and environment of schools and can aid in implementing the "health promoting school" program of World Health Organization. Since HSE-S it is a systematic tool, it can be used to effectively implement the continuous improvement cycle of Plan-Do-Check-Action (PDCA) in all sub-categories of HSE according to the standard process of OHSAS: 18000.

ETHICAL ISSUES

Ethical issues such as plagiarism have been observed by the authors.

CONFLICT OF INTEREST

Authors of the manuscript did not have a conflict of interest.

AUTHORS' CONTRIBUTION

Authors contribute to this study as following items: Mohammad Amin Mououdi and Jafar Akbari: Study design and management, writing and reviewing the final version of the manuscript; Seyed Nouraddin Mousavinasab: statistical analysis of study.

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