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Assessment of school resilience in disasters: A cross-sectional study

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Abstract:

BACKGROUND AND OBJECTIVES: School resilience is defined as risk-reducing strategies used to create a safe environment for students when faced natural disasters. Resilient schools, in addition to their educational role, provide a suitable capacity for responding to disasters and rehabilitation after the incidence. This study determined the level of disaster resilience of schools in Yazd, central Iran.

MATERIALS AND METHODS: This is a descriptive-analytic study conducted among 400 schools and 367 participants in Yazd, 2018. To collect data, we used the school resilience in disasters questionnaire (α =0.95 and intraclass correlation coefficient = 0.97 [95% confidence interval: 0.96–0.98]) containing 48 questions. We also analyzed the gleaned data through the Pearson correlation coefficient, one-way ANOVA, and independent *t*-test.

RESULTS: The total score of school disaster resilience was 153.30 ± 29.57. In these schools, the function had the highest (47.76 ± 13.96), and safety had the lowest (6.74 ± 3.18) score among all areas of school disaster resilience. There was a positive significant correlation between total resilience and areas of function, education, structural, nonstructural, architecture, commute routes, safety, location, and equipment ($P < 0.001$). Location had the smallest ($r = 0.424$) and function had the greatest ($r = 0.854$) correlation with total resilience.

CONCLUSION: It can help the school management board in assessing the level of resilience of their school and determining the priorities for disaster risk reduction. Awareness of the status of resilience can help policy-makers and experts create an effective program for increasing resilience.

Keywords:

Natural disasters, resilience, schools, students

Introduction

Disasters can cause the destruction of buildings, infrastructure and lead to casualties and death tolls. The destruction and damage to schools are also one of the consequences of natural disasters, which may eventuate the disability or death of teachers and students.[1,2] Furthermore, there is the possibility of interruption of education at disasters if there are damages to school buildings.[3,4] Previous earthquakes indicate that school buildings are relatively more vulnerable than other buildings.[5] For example, the Sichuan earthquake in 2008 caused the death of 19,000 students and destruction of about 7000 schools.[6] In addition, the Bam earthquake in Iran in 2003 destroyed more than 90% of schools in that city.[7] It is necessary to pay attention to the resilience in the local community and important places (e.g. schools) and provide appropriate solutions when disasters occur.[8]

The schools are important because the kids go there from the age of 6 years old and spend much of their time.[9] Schools play an important role before and after disasters.[10] Moreover, they has significant role in the reaction and rehabilitation phases in disasters they are used as distribution centers and also the deployment of service

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providers such as Emergency medical service after a natural disaster[11] According to the Iranian Ministry of Education and Training (2012), there are 12.2 million students and 918,500 teachers at schools[12,13] Thus, the necessity of school resilience to decrease vulnerability is felt more than ever.

Resilience is an ever-changing dynamic concept. In educational system, it refers to any attempts made to absorb and/or manage disaster effects and return to the previous function by the use of resources.[14] It aims to reduce vulnerabilities, enhance capabilities, and manage properly to address the risks of natural disasters. Therefore, cities need to achieve a suitable level of resilience in various dimensions.[15] Hugo document (2005–2015)[16] and Sendai framework (2015–2030)[17] as higher-order documents have prioritized school risk reduction and resilience promotion.[18-20] in resilient schools, structural, nonstructural, managerial, human resources, education, staff, and students are conspicuous.[21,22] It is, therefore, very important to prepare them against the disasters and aware them of the school disaster resilience level and interventions to improve their resilience particularly in high-risk disaster-prone countries.[23,24]

Despite the available tools for the school resilience,[25,26] the climatic conditions and cultural-social status of each community can affect the resilience. It seems that countries should have a tool to measure the resilience based on their situation. Due to the lack of a comprehensive native tool in Iran, we conducted this study in 2018 through school resilience in disaster (SRD) questionnaire based on the Iranian native conditions.

Materials and Methods

Study design and setting

The current investigation was a descriptive-analytic cross-sectional study approved by Yazd University of Medical Sciences and Yazd Education Ministry. The study included 400 boys and girls schools and 367 participants who completed the questionnaire.

Assessment tools

Developed by the research team in a two-stage, systematic review[27] and a qualitative study with 24 experts in disaster resilience[28] appropriate to the culture-based in Iran, school resilience in disaster questionnaire was used as a valid and reliable tool (α = 0.95 and intraclass correlation coefficient = 0.97 [95% confidence interval (CI): 0.96–0.98]). It was then followed by the pilot study applied to 30 schools in Yazd for 2 weeks. The questionnaire consisted of two parts: first, 48 questions about school location, structural, nonstructural, architecture, commute routes, equipment, safety, education, and function; and second questions about school construction year, school surface (area), number of classes, type of school (primary/first period of high school/second period of high school, students gender, and governmental or non-for-profit school), and manager's work experience.

Scores for each area were calculated according to the 5-point Likert scale from the lowest to the highest number that was equivalent to the total of questions, and the total resilience score was calculated by summing the scores of all areas. The Cronbach's alpha obtained was 0.95, and the validity and the reliability were 0.71 and 0.95, respectively.

Inclusion and exclusion

All girls' and boys' governmental and non-for-profit schools in three levels of primary, first and second period of high school were included in the study. The schools were selected randomly and voluntarily. The aim of the study was explained, and written consent was obtained. Those schools which were not interested in participating along with kindergartens and preschools were excluded. The questionnaire was completed by school managers, assistants, and teachers during office hours and distributed anonymously. All the information remained confidential.

Data analysis

The data were analyzed through SPSS Version 22 (SPSS Inc., Chicago, IL, USA, SPSS) software, descriptive statistics, independent *t*-test, one-way ANOVA, and Pearson correlation coefficient to examine correlations among quantitative variables ($P < 0.05$).

This study was part of a larger-scale project conducted at Research Center of Shahid Sadoughi University of Medical Sciences with a code of ethics no: IR.SSU.SPH.REC.1397.046. All research processes were performed with the approval of Yazd Training and Education Office. The questionnaires were filled out during the office hours, so the classes were not interrupted. The questionnaires were distributed anonymously, and all information remained confidential.

Results

The finding showed that the assessment of 367 school resilience against natural disasters in Yazd were girls 131 (35.7%), boys 236 (64.3%), primary schools 184 (50.1%), secondary schools 146 (39.8%), and high schools 37 (10.1%). Of these, 308 (83.9%) were governmental schools and the rest were non-for-profit schools. Three hundred and sixty-seven participants from 400 schools completed the SRD. About 8.25% of the questionnaires were excluded because they were not properly answered.

The participants included 238 teachers (64.9%), 35 assistants (9.5%), and 94 managers (25.6%). Their average was 40.35 ± 8.62 years with 17.64 ± 7.3 years of work experience. One hundred and ninety-six (53.4%) participants were female with 95 (25.9%) academic degrees. At least 151 (59.4%) of participants had natural disaster experiences such as flood, fire, accident, and drought. The schools had 1660.41 ± 1338.97 m^2 average surface; it was 311.84 ± 132.65 m^2 average surface for each student.

Other findings of the study showed that scores of resilience areas included 15 scores for location (11.05 ± 2.28), 15 scores for structure (9.97 ± 2.69), 15 scores for the nanostructure (10.88 ± 2.44), 25 scores for architecture (19.19 ± 3.76), 20 scores for the commute routes (11.86 ± 3.82), 15 scores for equipment (11.16 ± 3.00), 15 scores for the safety (6.74 ± 3.18), 40 scores for the education (24.64 ± 7.08), 80 scores for the function (47.76 ± 13.96), and finally, from 240 scores of total resilience was 153.30 ± 29.57. Thus, the functional area obtained the highest points (47.76 ± 13.96) and safety the lowest points (6.74 ± 3.18).

The Pearson correlation coefficient suggested a positive significant correlation ($P < 0.001$) among all parts of school resilience, including function, education, safety, structural, nonstructural, architecture, commute routes, location, and equipment. This correlation was greater in the areas of function, education, commute routes, safety, nonstructural, architecture, equipment, structural, and location, respectively [Table 1].

This study also compared resilience scores in terms of school characteristics. The results of ANOVA suggested a significant difference between education levels and resilience ($P = 0.033$). In addition, Bonferroni *post hoc* test revealed a significant difference between the mean scores of education levels and the first period of high school [Table 2].

Other results of ANOVA demonstrated no significant difference between school location, building shape, and resilience score. Moreover, the findings of independent *t*-test showed no significant difference between students' gender, governmental schools, non-for-profit schools, history of school reconstruction, and school resilience ($P > 0.05$).

The school average of construction was 21.97 ± 9.52 years. The Pearson correlation coefficient showed a significant negative correlation between school construction year and resilience score at CI of 99% ($P < 0.001$, $r = -0.222$).

Table 1: School resilience in disasters, Yazd, 2018

Different parts of resilience	Correlation between parts and total resilience	*P*
Location	0.424	<0.001
Structural	0.450	
Nonstructural	0.556	
Architecture	0.547	
Commute routes	0.691	
Equipment	0.528	
Safety	0.651	
Education	0.808	
Function	0.854	

Table 2: Comparison of mean school disaster resilience in Yazd in terms of different educational levels of school in 2018

Variable	*n* (%)	Mean±SD	*F*	*P*
Educational levels				
Primary	184 (50.1)	156.32±33.25	3.453	0.013
The first period of high school	37 (10.1)	142.78±25.39		
The second period of high school	146 (39.8)	152.16±24.70		

SD=Standard deviation

Discussion

This study examines the resilience of schools against natural disasters. The findings of the study showed that the resilience of schools is directly associated with the functional, educational, safety, structural, nonstructural, architectural, commute routes, locational, and equipment domains which affect the level of school resilience.

One of the most influential areas of school resilience is the location of schools. It is access to the main street and relief services as well as being away from high-risk sites are considerable. Appropriate school placement, building codes, quality control of construction in the important Grimaz (2016) study have been stated to support the findings of our study.[29] Considering the emergency exit routes and evacuation safety, which are being confirmed by another study of the physical building, the location of schools has been identified as an important element to access the roads in the event of disasters.[30] Since the overcrowding potential of disasters[31] and the complexity of how nonstructural items are arranged,[29] more research is required to clarify objective school resilience. School equipment and safety, such as a fire alarm system and fire extinguishers, are essential for resilient schools based on Hassanain[32] and Hosseini and Izadkhah (2006) studies.[33]

Education and function are other important areas examined for the resilience of schools, for which important points have been mentioned, including the existence of a coordination agreement between the school and other organizations, the preparation, and planning for unexpected events, and the existence of safe and risky places at school. On the other hand, training of the principals and other school staff to provide psychological

support after the disaster is of an important factor in the preparation of schools. Other studies include the preparation of students and school staff, the availability of agreements with other agencies responsible for disasters, predisaster planning, and the availability of appropriate school response plans to improve school preparation and improve performance to increase the resilience of schools in disasters.[25,29]

In this study, among the influential areas, functional area acquired the highest and the safety obtained the lowest score of resilience level which indicates that more measures have been taken in the function than other areas, Therefore, increasing the safety of schools in urban tissue reconstruction programs, especially in areas at risk of earthquakes, is significant. The results of Paton's and Johnston's study on factors affecting school preparedness indicated that the emergency programs were the priority followed by "emergency resources and equipment" and "response operations programs" ranking second and third like Paton and Johnston study.[34] Shiwaku *et al.* explored that physical components, human resources, function, external relations, and natural conditions are affecting the resilience. In this study, the physical aspect of building and human resources obtained higher scores than others. They reported that since it is demanding to change some conditions in schools (e.g., construction places), changeable aspects such as function and external relations must be underscored.[25] Some areas (e.g., function) can increase school resilience; however, location does not.

Moreover, resilience scores showed a significant difference in terms of school educational levels. In this respect, primary schools obtained the highest, and the first period of high school acquired the lowest resilience scores. Primary schools had a better function in resilience than higher education levels of high school both in boys and girls schools. Öcal and Topkaya[3] reported a significant correlation between type of school (primary or high school) and school preparation level supporting our findings; nevertheless, high school preparation level was greater than that of primary school regarding the risk of earthquake due to the location of Turkish high schools in socioeconomically more privileged zones and greater access of these schools to financial resources. In contrast, our findings showed that primary schools had greater resilience than the first and second periods of high school. This may be due to the random selection of schools from different zones of Yazd. In addition, our study showed no significant effect on managers' experience on increasing school resilience. This finding is consistent with the results of the study by Öcal and Topkaya.[3] On the one hand, we should remember that higher educational levels (e.g., the first and second periods of high school) require more attention because of their students' age and their more risky behaviors in their interactions. Besides, this spirit of the youth may play a role in promoting their resilience. On the other hand, primary schools demand greater attention from the teachers and principals, especially regarding the safety of the physical space, due to their vulnerability. The awareness of influencing factors in school resilience may not only improve the school preparation and reaction but also save many lives during the disasters.

Conclusion

Our results indicated that the school disaster resilience level is directly influenced by location, construct, equipment, architecture, nonconstruct, safety, transportation paths, education, and function. Due to the cost and unchanged ability of some areas, equipment, safety, education, and function can be improved with proper management and planning, thereby increasing the resilience of schools. Students' educational level and type of school construct also affect resilience. Awareness of the total status of resilience can help policy-makers and experts create an effective program for resilience. Moreover, the results may help the school management board in assessing the level of resilience of their school and determining the priorities for correction.

Limitations of the study

One limitation was school personnel unawareness about some construct characteristics of schools due to the special nature of the issue. This study considered extensive detailed discussion of total resilience for the general assessment that was understandable to all individuals. Some schools did not cooperate in completing the questionnaires. Thus, they were replaced by other cooperated schools.

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Conflicts of interest

There are no conflicts of interest.

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