Review Paper: Associating Factors With Public Preparedness Behavior Against Earthquake: A Review of Iranian Research Literature

Maryam Ranjbar[1,2], Ali Akbar Soleimani[2,3], Bahram Saleh Sedghpour[4*], Farahnaz Mohammadi Shahboulaghi[1,5], Douglas Paton[6], Mehdi Noroozi[1]

1. Social Determinants of Health Research Center, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.
2. Institute for Humanities and Social Studies, Tehran, Iran.
3. Department of Psychology, University of Science and Culture, Tehran, Iran.
4. Department of Educational Psychology, School of Humanities, Shahid Rajaee Teacher Training University, Tehran, Iran.
5. Department of Nursing, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.
6. Department of Psychology, School of Psychological and Clinical Sciences, Charles Darwin University, Darwin, Northern Territory, Australia.

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Citation: Ranjbar M, Soleimani AA, Sedghpour BS, Mohammadi Shahboulaghi F, Paton D, Noroozi M. Associating Factors With Public Preparedness Behavior Against Earthquake: A Review of Iranian Research Literature. Health in Emergencies and Disasters Quarterly. 2018; 3(2):67-76. https://doi.org/10.29252/NRIP.HDQ.3.2.67

doi: https://doi.org/10.29252/NRIP.HDQ.3.2.67

Article info:
Received: 08 Jun. 2017
Accepted: 15 Oct. 2017

Keywords:
Earthquake, Preparedness, Public awareness, Community collaboration, Iran

ABSTRACT

Local preparedness against earthquakes has been recently highlighted in research and policies on disaster management and risk reduction promotion in Iran. To advance the understanding of public preparedness and how it can be applied in diverse localities, further information is required about the predictors of people's adoption of mitigation activities and earthquake preparedness. A synthesis of the available published research results on earthquake preparedness and the influencing factors in Iran are presented in this literature review. It emphasizes the complexity of both the concept of preparedness and the contextual factors that mediate its adoption. The predominant roles of public awareness, trusted information resources, social capital and community collaboration as predictors are discussed.

1. Introduction

Earthquakes, one of the most catastrophic natural events, is characterized by uncertainty in time and place; in other words, these events typically occur without any warning [1]. This unpredictability increases the risk of death and damage, creates mental and physical injuries in most of the affected populations, and is considered a significant threat to the public health [2]. Iran is a highly seismic-prone area because it is located on the Alpines-Himalaya belt and has many active faults. In the past century, the country sustained severe losses in lives, properties, and resources due to the occurrence of more than 40 medium- to large-scale earthquakes that affected the daily living and health of the population for a long time afterwards [3, 4]. The earthquake-related human losses accounted for more than 150.000 deaths in Iran, which is 45 percent of all natural disaster casualties in the country [5]. this accounts for 6 percent of the whole mortality rate aftermath earthquakes while Iranian population is only 1 percent of the total population in the world [3]. A summary of major earthquake consequences in the past two decades in Iran is presented in Table 1.

*** Corresponding Author:**
Bahram Saleh Sedghpour, PhD
Address: *Department of Educational Psychology, School of Humanities, Shahid Rajaee Teacher Training University, Tehran, Iran.*
E-mail: *sedghpour@srttu.edu*

There are 3 to 4 times more chances of death and up to 40 times of more injuries related to natural disasters in the developing countries compared to the developed countries [6]. This can result from the significant diversity in the available resources, information and services for people due to their different socioeconomic classes and community situations, which tend to result in different levels of knowledge, awareness, attitude and the ability to predict, prevent and evaluate the consequences of a hazard among them. In developed countries, the victims' behaviors and authorities' decisions are considered important for critical outcomes of a disaster. In contrast, in developing countries, the crises arises mainly due to the lack of information and irrational/traditional knowledge that can be prevented only through managing and supervising the environment. Therefore, this shows that the communities define their own capabilities and vulnerabilities and have the option to decide which risks are important [7].

The consequences of earthquakes depend on its magnitude, the focal distance from the urban area, the preparedness level, and the mitigation measures in the nearby residence [2]. Preparedness represents the essential steps that could raise the probability of avoidance or minimize the calamitous consequences of a hazard, which is considered as a basic component in any disaster risk reduction. These kinds of efforts have a predominant focus on human behaviors deriving from different factors [8].

Recently, international approaches to risk management have focused on the integrated process of pre-disaster risk reduction (prevention, mitigation and preparedness behaviors) followed by planning for post disaster actions for enhancing the resilience in the community to proactively decrease the impacts of the disaster. This has become a national strategy and the basis of reducing hazard risk in developed countries [9]. But studies suggested that despite the serious threat of seismic events, the levels of adoption of preparedness measures in developed and developing countries is low. This increases the magnitude of (preventable) losses that have occurred [4].

Despite the effort and considerable expenditure on public education, the level of individual and community earthquake preparedness among people living in highly vulnerable regions of Iran is low [4, 7, 10-13]. Furthermore, there is little evidence of people learning lessons from the destructive earthquakes that have occurred in recent decades [14, 15]. There is a discrepancy between risk knowledge and perception and preparedness behaviors in people living in Iran [4, 10, 11, 16]. In addition to issues concerning risk acceptance, factors such as social class, gender and/or other special conditions act to influence preparedness behavior [17]. Taken together, these factors identify a need to define which factors influence the people's preparation decisions regarding hazards such as earthquakes.

A review of research literature can provide meaningful information on identifying the gaps that need to be filled and articulate the opportunities that exist for enhancing the rates of preparedness at all levels of society. Considering the lack of any previous review of Iranian research literature on earthquake preparedness behavior, the present study was conducted to rectify this and identify the factors associated with earthquake preparedness in Iranian people.

2. Materials and Methods

This review was conducted to describe and analyze Iranian research literature regarding the factors associated

Table 1. The casualties, injuries and economic damages of major earthquakes (magnitude ≥6 Richter) in Iran since 1990

Earthquake	Magnitude	Year	Human Losses		Direct Economic Losses (Million $)
			Mortalities	Injuries	
Manjil-Roudbar	7.1	1900	40,000*	710,000*	3505
Bojnord	6.1	1997*	100*	84,500*	99
Ghaen-Birjand	7.3	1997	1,567	74,600*	280
Changureh (Avaj)	6.2	2002	230	1,466	65
Bam	6.5	2003	26,796*	267,628*	2995
Azarbaijan	6.4	2012	306*	61,546*	894
Kermanshah	7.3	2017	620**	7156***	Not reported yet

* Rechecked and modified statistics by EM-DAT database [accessed: 2017 February 18]

** Kermanshah General Office of Legal Medicine website [accessed: 2017 December 19]

*** Rechecked with Emergency Medical Services Organization in 2017/22/11

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Table 2. Search strategy and key words used to search each database

Data Base	Keywords	Articles Found	Research Conducted in Iran	Selected	Date
PubMed	((((((Earthquake [Title/Abstract]) OR seismic [Title/Abstract]) OR natural disaster [Title/Abstract]) OR natural hazard [Title/Abstract])) AND (((prepar* [Title/Abstract]) OR readiness [Title/Abstract]) OR mitigat* [Title/Abstract]))))) OR earthquake preparedness [Title/Abstract]) OR preparedness behavior [Title/Abstract] AND (Humans [Mesh] AND English [lang]))	451	17	3	20 Feb 2017 13: 56 pm
Scopus	(TITLE-ABS-KEY (factors) AND TITLE-ABS-KEY (preparedness OR readiness OR "mitigation behavior" OR "preventive behavior" OR "adaptive behavior") AND TITLE-ABS-KEY ("earthquake" OR seismic OR "natural disaster" OR "natural hazard")) AND (EXCLUDE (SUBJAREA, "SOCI OR ENVIOR PSYC OR HEAL OR MULT AND LIMIT-TO LANGUAGE")) AND (LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "PSYC") OR LIMIT-TO (SUBJAREA, "HEAL") OR LIMIT-TO (SUBJAREA, "DECI") OR LIMIT-TO (SUBJAREA, "MULT"))	186	4	-	20 Feb 2017 14:47 pm
Web of Science	TOPIC: ((prepar* OR read* OR "preparedness behavior" OR "mitigation behavior" OR "preventive behavior" OR "adaptive behavior")) AND TOPIC: (("earthquake" OR seism* OR "natural disaster" OR "natural hazard")) Refined by: WEB OF SCIENCE CATEGORIES: (EMERGENCY MEDICINE OR PSYCHOLOGY MULTIDISCIPLINARY OR PSYCHOLOGY SOCIAL OR MULTIDISCIPLINARY SCIENCES OR SOCIAL SCIENCES INTERDISCIPLINARY OR PSYCHOLOGY OR SOCIOLOGY OR SOCIAL ISSUES) AND RESEARCH AREAS: (PSYCHOLOGY OR EMERGENCY MEDICINE OR SOCIAL SCIENCES OTHER TOPICS OR SOCIOLOGY OR SOCIAL ISSUES) AND LANGUAGES: (ENGLISH) Timespan: All years; Indexes: SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH, ESCI	156	6	1*	20 Feb 2017 14:14 pm
SafetyLit	(Preparedness OR readiness OR mitigation OR preparedness behavior OR disaster preparedness OR earthquake preparedness) AND (earthquake OR seismic OR natural hazard OR natural disaster)	1198	16+16*	4	21 Feb 2017 12:45 pm
SAGE	Ti: (preparedness OR readiness OR mitigation) AND (earthquake OR seismic OR hazard)	8	0	0	21 Feb 2017 10:15 am
Wiley Online Liberary	Earthquake preparedness in article titles OR preparedness behavior in article titles OR preparedness in article titles OR mitigation in article titles OR mitigation behavior in article titles AND earthquake in article titles OR seismic in article titles OR natural disaster in article titles OR natural hazard in article titles	8475	19+1*	1*	25 Feb 2017 11:33 am
SID	Preparedness behavior OR mitigation OR prevent* (Key words) AND earthquake (Topic) "in Persian language"	16	13+3*	2	20 Feb 2017 15:48 pm
Magiran	Preparedness behavior OR mitigation OR prevent* (Key words) AND earthquake (Topic) "in Persian language"	34	23+11*	3	20 Feb 2017 13:48 pm
	Total	10.524	129	12	

* Used to show the number of articles that were found in at least one other prior database

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with earthquake preparedness. We found no prior literature review related to this topic via the Cochrane Library.

Search strategy

Key words and MeSH terms were used to search in eight medical, psychological, public health and social sciences electronic databases in both English and Persian languages. The databases, key words and terms are summarized in Table 2. We also searched the related references of the selected articles in Google Scholar and found 3 other relevant full papers, which were included in the 15 articles selected at the end of our search. Searching of databases ended on 25th February 2017.

Inclusion criteria

We included all the documents that presented the factors associated with public earthquake preparedness behavior all around Iran. Original articles, clinical trials, case presentation/studies, review articles and available electronic books and book chapters were reviewed. The outcome incorporated in this review was public earthquake preparedness behavior; accordingly, we defined it as the public behaviors which could meet two major goals: preparing the necessary supplements or an emergency kit and having a mitigation plan for the family and/or the neighborhood. All the included studies were reported in English or Persian languages. This review started on 19th February 2017 and finished on 15th August 2017 and had no time limitations for the publication dates.

Review protocol

All the retrieved titles and abstracts were screened to identify and remove duplicates and ineligible studies. This selection and full text articles were double screened and agreement measured. All the study team approved the selection.

We then identified the candidate documents through the following screening process. Firstly, all the found documents (N=10524) were refined by examining the relevance of their titles relevance. This resulted in 129 articles (99+31 duplications) related to the Iranian population. We then applied the inclusion criteria to the abstracts and finally selected 15 full-text articles for inclusion in this review study. All of the selected articles were related to earthquake preparedness and its associating factors in the Iranian people (Figure 1).

We included both original research designs (qualitative/quantitative) in this review in order to obtain the

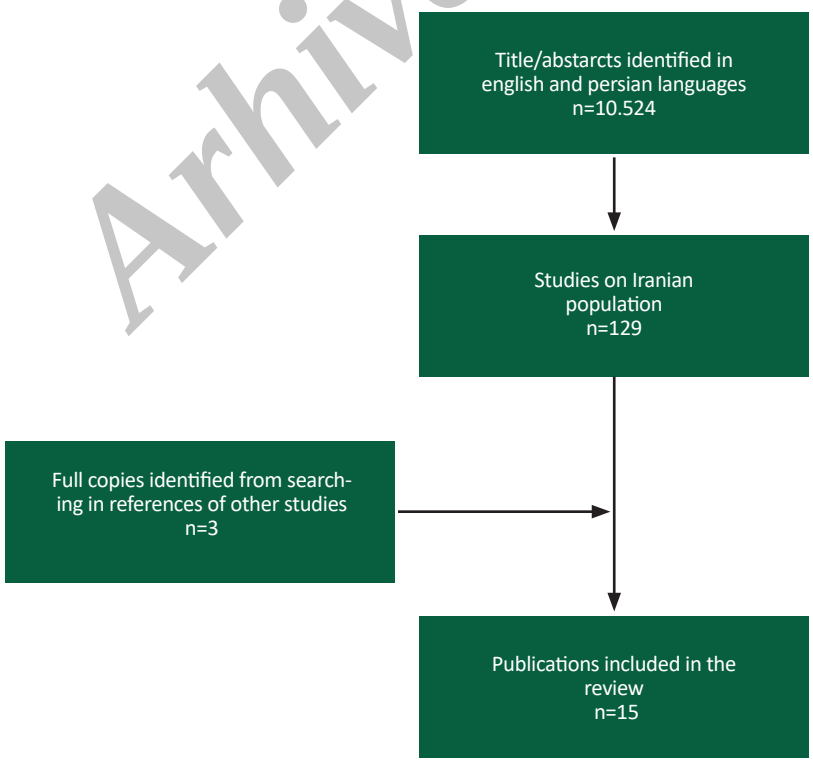

Figure 1. The protocol of article review

Table 3. Key findings of the studies about public earthquake preparedness

Author	Year	Design	Population/N/Sampling	Key Findings
Ardalan et al. [18]	2013	Interventional (Controlled trial with pre-post assessment)	9200 households in intervention and 10010 households in control areas of 3 provinces in Iran/1500 (250 each area each province)/Systematic random sampling of registered households in each area	There was a significant correlation between community risk perception and previous experiences of natural disasters with relative changes in awareness and readiness. The combination of group training, face to face education, and color posters was significantly correlated with the higher levels of awareness and readiness among the intervention participants.
Taghizadeh et al. [19]	2012	Observational (cross-sectional)	Tehran residents≥15yrs/1195/systematic random sampling in randomly chosen blocks of all 22 districts of Tehran	Low knowledge, high-school education or less and living in Northern high-risk regions of Tehran were related to lower levels of preparedness against earthquake. Having no previous experience about earthquakes and job status were identified as risk factors to low preparedness. Living in the Southern high-risk regions were significantly related to higher levels of knowledge about earthquakes compared to people living in low-risk regions.
Jamshidi et al. [21]	2016	Interventional with control neighborhood	All households in district 17 Tehran/305 intervention+314 control/Systematic cluster sampling	Public education about disaster preparedness affects the knowledge, attitude and preparedness behavior of people, but a collaborative approach is essential to preserve the level of obtained preparation.
Rakhshani et al. [13]	2016	Observational (cross-sectional)	All the residents of quake prone cities of Fars province/500/Systematic random cluster sampling	The education level of the head of household contributed to the preparedness trainings, whereas age, gender, past experience of earthquakes, marriage situation and the size of household were insignificant factors regarding to their earthquake preparedness.
Najafi et al. [11]	2015	Observational (cross-sectional)	Tehran residents≥18yrs/1250/Random multistage sampling	Income level, past experience of disaster, district of residence and job situation had a significant direct effect on disaster preparedness among Tehran citizens. Gender, family members in a household, type of house, home ownership and being the head of household had no significant effect on preparedness. Only 10 percent of the participants scored more than the medium 4 disaster preparedness behaviors.
Asgarizadeh et al. [10]	2014	Observational (cross-sectional)	Head of households in Tehran≥18yrs/267/Not specified	Age, knowledge, home ownership and education level were related to actual mitigation behaviors. While risk perception showed positive effects, but controllability, trust to the urban emergency authorities and the length of stay had negative direct effects on the intention to mitigate behavior. The indirect effects of age, self-efficacy, need to protection, optimistic biases and income mediated by risk perception on intention to mitigation action had been significant.
Hosseini et al. [22]	2014	Case study	4 communities in 3 districts of Tehran/102 for the 1st workshop+10 of former participants for 2nd workshop+125 school children 8-13 yrs+53 school teachers/Purposeful+purposeful+random+volunteer sampling	The importance of community capabilities (awareness of both vulnerability and mitigation criteria) in decreasing the impacts of earthquake and the community's effective responses has been highlighted. Community-based organizations were identified with some physical, informational and technical shortages in disaster mitigation and management.
Mahdaviazad et al. [16]	2014	Observational (cross-sectional)	Adult citizens of Shiraz/384/Stratified random sampling	The practice of preparedness against earthquake showed higher levels related to female participants. Education level and job situation had significant relations with knowledge regarding preparedness. Age had a significant relation with knowledge and showed negative impacts on practice of preparedness. The attitude of preparedness was significantly higher among students.

Author	Year	Design	Population/N/Sampling	Key Findings
Ghadiri et al. [17]	2013	Observational (cross-sectional)	300380 households of Shiraz in 2011/350/Random cluster sampling	Job position, income, education level and socio-economic status had significant effects on the community's earthquake preparedness in a positive way.
Khankeh et al. [23]	2013	Interventional (Controlled trial with pre-post and followup-40 days after- assessment)	High-school boys in Eshtehard-Karaj/117: 53(experiment)+64(control)/ Inclusion criteria+random assignment in control-experiment groups	Education of high school children could significantly increase the level of knowledge, anxiousness and skills of their household preparedness in the experiment group. Skill of confrontation as an outcome was consistent with their preparedness behavior
Nikmard Namin et al. [6]	2015	Qualitative: developing questionnaire+Observational (cross-sectional survey)	The households of district 22 in Tehran/96/not specified	The level of contribution in preparedness against earthquake was significantly higher among young female adults who had a higher sense of belonging to the place in which they lived. Education was related to the level of risk knowledge and perception.
Kalantari et al. [24]	2012	Observational/ develop a tool (qualitative) +field survey (quantitative)	All the 1420 households in Fahadan Yazd/300/Not specified	Community contribution, familial and social relationship, and the trust of inhabitants to the local groups will positively enhance the tendency of people to participate in earthquake risk mitigation programs
Jahangiri et al. [4]	2010	Observational (cross-sectional)	Tehran residents>15yrs/1211/ Systematic random cluster	Job position, location of house, old age, not being married, low education level and crowded households had less knowledge, attitude and practice of earthquake preparedness
Izadkhah et al. [15]	2010	Qualitative	Review of literature and documents about four previous big earthquakes in Iran	The belief that the governmental organizations have the main role in disaster management, lack of public education and awareness, lack of sufficient infrastructures for disaster management, initial action plans and sufficient equipment, tools and materials, weakness of coordination and operation command for disaster management at the local level, low professional expertise about all aspects of preparedness, limited effectiveness of national media, lack of specialized coherent and standard training programs and lack of professional control of constructional competence from in charge institutions were highly related to being unprepared against four devastating earthquakes that occurred in 1990-2006 in Iran.
Asgary et al. [2]	1997	Observational (cross-sectional survey)	Residents of Tehran and Rasht in 1994/1300 Tehran+600 Rasht/Multistage cluster sampling	Fatalistic attitudes and risk perception were significant determinants of households' responses in both cities (Tehran, Rasht). Meanwhile, economic status influenced mitigatory response only in Tehran. The other influencing variables (Intercept, earthquake safety needs and threat) were found to be insignificant with respect to the household mitigation behaviors.

broadest available evidences. Studies on post-event issues and those responding to disaster and rehabilitation, managerial elements, buildings mitigation engineering and geophysical parameters rather than discussing public preparedness behavior were excluded. In addition, an editorial, a letter to editor, and a brief report were also excluded.

3. Results

In total, 15 articles met the inclusion criteria. Tehran citizens were the participants in seven studies published between 1997 and 2016. Households comprised the most common subject groups in all the studies. The majority of the selected studies were quantitative research projects that employed self-made and/or standard questionnaires. The qualitative studies mostly used in-depth interviews and focus group discussions.

The source articles were assessed for reporting validity and reliability. Eight articles reported acceptable ranges of Cronbach's alpha as the reliability measure of the instrument. The evidences of at least one validity measurements of the tools were produced in eight papers. Standardized instruments were used in two source articles. One source was purely qualitative and used content analysis of literature and documents. Validity and reliability measures for the tools used in three surveys and two field work interventional studies were not introduced. Twelve source articles provided sufficient details of their sampling strategies. Systematic Random cluster or multi-stage sampling was the most common sampling methods used in these studies. Purposive or convenient sampling was employed in 2 smaller qualitative studies. A few studies (4 of 15) addressed the issues of missing data and response rate.

Earthquake preparedness

Preparedness is a multidisciplinary concept that draws expertise from various fields such as economics, information technology, medicine, psychology, social studies, and public health. This diversity means that the definitions and measures of preparedness vary considerably between scientists and researchers in different disciplines. Academicians generally defined the frame of earthquake preparedness as collecting a standard set of supply stockings besides having a plan for mitigation. They have tried to identify both the barriers to earthquake preparedness and its facilitators. Most studies identified insufficient disaster preparedness of communities and households all over the country [4, 7, 10, 11, 13, 15, 20-22].

Low knowledge and attitude about earthquake mitigation activities in communities were accompanied with less preparedness practice [4, 19]. However, public awareness regarding earthquake mitigation was commonly reported to be infrequent [4, 15, 18-23]. Five studies noted the positive effect of public education in improving knowledge and practice 15, 18, 21-23] while two others demonstrated that preparedness would not often be improved only by providing related education and information for people [10, 20].

Some results emphasized on the effectiveness of community-based activities on public awareness, attitude and actions of preparedness [7, 21, 22]. Communities rarely collaborated with their local authorities related to mitigation and preparation. There are cultural and fatalistic beliefs/attitudes that could inhibit positive outcome expectancies and impose the doubt of ineffectiveness of mitigation and preparedness against disasters like earthquake [4] while affecting disaster preparedness [15] in the whole country.

Factors influencing public preparedness

Demographic determinants

Primarily, demographic characteristics have shown different impacts on earthquake preparedness of Iranian people. Age was mentioned in 7 articles (in one not as a significant factor [13]; in the others, it had direct [4, 6, 16, 22] and/or indirect [10, 19] effect on preparedness. This work indicated that younger people were inclined to be more aware and prepared [21]. Job position [4, 11, 16, 19], income level and socioeconomic status [7, 10, 11, 20], education [4, 7, 10, 13, 16, 18, 19, 21] were identified as having both direct and indirect positive impacts on preparedness knowledge and behavior. Gender [6, 16], marriage status [4], and having previous experience of earthquake [19] were also indicated as having a significant positive influence on increasing awareness and readiness in some studies, whereas other studies reported them to be insignificant [11, 13, 19, 21]. Home ownership [11, 19] and family size [11, 13] were not found to influence public preparedness. However, house location or the region in which people lived [4, 11, 18] was identified as having a positive impact on preparedness.

Earthquake preparedness awareness

Some variations in knowledge about general earthquake preparedness in the communities were observed. However, the impact of education on knowledge, attitude and practice revealed different findings. Exposure

to preparedness information was associated with increasing knowledge, perception of risk, and practice in some studies [18, 21, 23], whereas good knowledge of earthquake risk and high risk perception was not necessarily associated with preparedness behavior in some others [10, 20]. The higher levels of education and better awareness is related to the behavior of preparedness among the general public [4, 6, 7, 13, 16, 19], which was also correlated with their prior experiences of such event [11, 13, 19].

Psychosocial predictors

Some studies suggested psychosocial factors that can increase knowledge, attitude and behavior of earthquake preparedness in different Iranian communities. The positive direct impacts found for participatory interventions were mediated by empowering local communities and mutual trust [21], risk perception [10], sense of belonging to the place of living [6], community contribution, social and familial relations and general trust [24]. Accordingly, the responsibility belief, optimistic biases, self-efficacy, and the need for protection were mentioned as the predicting factors that showed indirect impacts through increasing risk perception on the seismic preparation activities in the communities [10]. Controllability, trust to emergency authorities [10], technical, informational and physical shortages in community organizations [16] were found to be the factors that could hinder the preparedness action in different societies (Table 3).

The limitations of the current study were as follows: It is possible that we have missed some relevant publications (e.g. research reports that do not have wide circulation) in spite of the systematic search protocol used in this review. Although both English and Persian databases were included, we cannot discount the possibility that some potentially relevant studies may have been omitted due to the used search strategy and inclusion criteria. However, considering these limitations, the present review could identify several articles with pertinent topics and content. The research methods used in these fifteen studies were diverse, but we included all of them to optimize the scope and integration of the literature included in the review. This can give us a more authentic picture of the current research into the actual earthquake preparedness in Iran.

4. Conclusion

This review suggested the necessity of providing clear, realistic, operational and trustable preparedness directives for the general public soliciting their own collaboration. The literature is inconclusive about the influencing and hindering factors meanwhile contradictory in some aspects. The topics did not include perceived versus actual preparedness, preferable sources of information, the exact role of government and authorities, and the influencing factors on the preparedness of minorities and special groups. Operationally, the lack of necessary information, fatalistic attitudes and low level of general trust and collaboration in the general public have been mentioned as inhibiting factors. It appears that specific instructions based on community participation besides encouraging the activities that enhance general trust and eliminate mistrust to the authorities and the information resources they provide may have positive impacts on the potential resiliency and actual preparedness against earthquake. Understanding how community members perceive the relevance of preparedness and vulnerability to their own lives needs to be investigated.

Acknowledgments

This article reports the initiating part of the study collaboration between the Social Determinants of Health Research Center and The Institute of Humanities and Social Studies.

Conflict of Interest

The authors declared no conflicts of interest.

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