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Emergency health evaluation of affected population during disasters: Are there new approaches?

Seyed Ahmad Bathaei[1,2], Hasan Abolghasem-Gorji[1,2], Bahram Delgoshaei[1,2], Hamid Reza Khankeh[3,4]

Abstract:

INTRODUCTION: Disasters are inescapable phenomena. Once they occur, reliable and objective information becomes vital in sound decision-making to respond. Emergency health evaluation of affected population can be used to gather information about the patterns of access to medical care, basic household needs, and other health needs. The objective of this review was to summarize evidence from scientific studies on the various methods of emergency health evaluation following disasters.

MATERIALS AND METHODS: A comprehensive list of studies was provided in May 2017 by an extensive search using PubMed, Web of Sciences, Ovid Medline, ProQuest Research Library, and World Health Organization Library.

RESULTS: Of the 1592 retrieved articles, 21 articles were included in this review. In a majority of the studies (n = 18), a questionnaire was used and an interview was conducted to collect information, but in three studies, smartphone-based methods were used. Sampling method in most of the studies was cluster sampling in Community Assessment for Public Health Emergency Response method. But in eight studies, random sampling method was used. In a majority of the studies, the demographic status of samples and in 18 studies, the condition of diseases, water, shelters, health, food, mortality rate, and existing medical services were investigated.

CONCLUSIONS: Although new methods such as social media and smartphones were already investigated in some articles, but these approaches require further investigation since there is a growing need for new methods.

Keywords:

Disaster, emergency health evaluation, need assessment, new approach

[1]Health Management and Economics Research Center, School of Health Management and Information Sciences, Iran University of Medical Sciences, [2]Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Sciences, [3]Health in Emergency and Disaster Research Center, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran, [4]Department of Clinical Science and Education, Karolinska Institute, Stockholm, Sweden

Address for correspondence:
Dr. Hasan Abolghasem-Gorji, School of Health Management and Information Sciences, Iran University of Medical Sciences, Rashid Yasemi Street, Vali-e-asr Avenue, Tehran, Iran.
E-mail: gorji.h@tums.ac.ir

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Introduction

Today, disasters have become an inseparable part of life's routines. Around the world, humans face various threats and disasters, the frequency and severity of which is greater now than ever in the past.[1] For example, the 2010 World Bank report on the economics of disaster risk reduction estimated that the number of peoples living under the threat of earthquakes and cyclones would double by 2050 (from 680 million in 2000 to 2015 billion in 2050).[2]

As a result of underlying risk factors, such as environmental degradation, widespread poverty, rapid and unplanned urbanization and climate change, some natural disasters are more frequent and more severe than ever before in all over the world.[3-5] During the past four decades, disasters such as hurricanes, earthquakes, bushfires, floods, and landslides have caused a considerable loss of human lives and livelihoods, environmental

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damages, and the destruction of economic and social infrastructures.[6,7]

Contemporary disasters, especially natural disasters around the world, are costly in terms of property, political stability, and lives lost.[8,9] Furthermore, when a sudden onset disaster strikes, acute health problems such as developing diseases or enhancing health-related needs such as medical treatment and medication use are likely to occur.[10,11]

The design and delivery of measures to reduce risks and enable better health outcomes can be achieved by a better understanding of the health impact of disasters[12,13] and information must be available to personnel on the ground to rapidly design a disaster response and develop an action plan. Therefore, considerable effort often is diverted toward conducting health evaluation.[9]

Emergency health evaluation is defined as the process of organizing and evaluating information about nature, the strength of evidence and likelihood of adverse health or ecological effects from particular exposures to develop a comprehensive understanding of a disaster situation.[14] To identify rapidly and respond effectively to public health threats associated with disasters and mitigate negative health consequences, emergency managers, public health officials, and local authorities investigate health evaluation methods in the early phase of the incidents and then periodically to the end of response phase and even during the recovery phase.[15] Therefore, after disasters, it is important to realize that apart from direct consequences for public health-care reliable, objective information is needed for decision-making in the response phase of the event.[16,17] Furthermore, early identification of affected communities' disaster-associated needs can guide resource management during the immediate response, especially when limited information is available about characteristics of the affected population.[18,19]

Emergency health evaluation employs survey sampling techniques in field settings to rapidly determine the health status and basic needs of an affected community in a statistically valid manner for an actionable response.[14] Therefore, appropriate methods are needed to ensure that reliable and relevant information is collected in the most time and resource efficient manner possible.[20]

The processes, methods, timeline, and type of tools and indicators for health evaluation maybe vary across stakeholders. Such variations in methods and related consequences often presents conflicting images of health needs and following coordination challenges, both within agencies and with other humanitarian and development actors.[21]

The need for a comprehensive approach to evaluating health issues and priorities following a disaster has been emphasized by recent crises.[22-25] If assessment teams and field officers did not have access to an integrated evaluating approach, this resulted in limited information being collected for decision-makers to allocate resources based on evidence and manage the emergency situation in a timely manner.[21]

Therefore, the objective of this review was to appraise and summarize evidence from scientific studies on the various and probably new methods of emergency health evaluation following disasters.

The main scopes of the review were to (a) provide data on health needs after disasters; (b) identify tools that have been used to collect data on the types of health needs and the number of people in need after a disaster; (c) compare different ways for collecting data on health needs; (d) show how the health of people affected by a disaster can be assessed; and (e) show when the needs of people might be evaluated following a disaster.

Materials and Methods

A systematic search was carried out in May 2017 of the core literature published between January 1, 2000 and May 1, 2017, by an extensive search. A comprehensive list of studies was provided using the databases selected based on sufficient coverage of the cross-disciplinary research objectives. We started our search by defining search terms and keywords identified based on the current literature.

Scanning of reference lists was used to improve article identification. Therefore, all the articles which had reported on methods of emergency health evaluation strategies were included. All of the articles that provided a framework for health evaluation methods in disasters and worldwide articles that introduced tools and indicators of health evaluation in disasters were also included in the study. All of the non-English articles, articles without an available abstract and studies that not reported time of evaluation and type of tools and indicators were excluded from the study.

The selection of relevant published studies for this systematic literature review included a structured search in the following five electronic databases:

- PubMed
- Web of Science
- Ovid Medline
- ProQuest Research Library
- World Health Organization (WHO) Library.

The main search terms were categorized into four categories [Table 1]:

Table 1: Selected databases with the search strategies

Database	Search strategy
PubMed	(Disaster*[tiab] OR emergency[tiab] OR crisis*[tiab] OR life event*[tiab], OR traumatic event*[tiab], OR environmental exposure[tiab], OR calamity*[tiab], OR mass accident*[tiab]) AND health evaluation"[Mesh] OR assessment*[Mesh], OR method*[Mesh], OR protocol*[Mesh], OR system*[Mesh], OR procedure*[Mesh], OR survey[Mesh], (immediate/ pre-existing) health problems*[Mesh], health status*[Mesh], health conditions*[Mesh], stress*[Mesh], distress*[Mesh], concerns*[Mesh], worries*[Mesh], anxieties*[Mesh], psycho trauma somatic symptoms/complaints* [Mesh], physical symptoms/complaints*[Mesh], diseases*[Mesh], illness*[Mesh], casualties and fatalities/injured and wounded*[Mesh], dead*[Mesh], death rates*[Mesh], morbidity*[Mesh] AND (immediate) health needs*[Mesh], care needs*[Mesh], medical needs*[Mesh], medical services*[Mesh], medicine needs*[Mesh], aftercare needs*[Mesh], psychosocial needs*[Mesh], practical needs*[Mesh], logistic needs*[Mesh], communication needs*[Mesh], accommodation needs*[Mesh], food needs*[Mesh], financial needs*[Mesh], information needs*[Mesh]
Web of science	TS=(Disaster* OR emergency OR crisis * OR mass accident *) AND TS=(health evaluation OR assessment OR method OR protocol OR health status OR health conditions) AND TS=(health needs OR care needs OR medical needs OR medical services OR medicine needs)
Ovid medline	(Disaster OR crisis OR mass accident) AND (health evaluation OR assessment OR method OR procedure OR survey AND health problems OR health status) AND (health needs OR care needs OR medical needs)
ProQuest	ab((Disaster* OR emergency OR crisis * OR mass accident *)) AND ab((health evaluation OR assessment OR method OR procedure AND health problems OR health status OR health conditions)) AND ab((health needs OR medical needs OR medical services OR food needs))
WHO	(Disaster OR crisis OR mass accident) AND (health evaluation OR assessment OR method OR procedure OR survey AND health problems OR health status) AND (health needs OR care needs OR medical needs)

WHO=World Health Organization

(1) The keywords related to disasters, (2) the terms related to health needs, (3) the keywords related to disaster management, and (4) the terms related to evaluation methods.

The controlled vocabulary of Medical Subject Headings (MeSH) from PubMed was used, when applicable to adjust and control the terms and search the databases. It ensured a controlled vocabulary, even in databases that do not use MeSH to index articles. In addition, the search strategy of the PubMed database was used as a model to search the other databases [Table 1]. The search strategies of all databases were checked and revised by the health information specialist and according to his revision, the final search strategies were modified. The following table illustrates the applied keywords used to search the databases.

The search included a predetermined search strategy developed by the authors. The principal author conducted the search in May 2017. The titles and abstracts of all identified papers were scanned and only the studies that clearly met one or both of the inclusion criteria were selected for the next stage of screening. In addition, the studies that met one of the exclusion criteria were rejected. The abstracts and full texts of all selected literature were then investigated separately. Furthermore, the references list of each of the identified studies was hand-searched for relevant additional publications. Data extraction of all selected articles was carried out using a predefined checklist created by the authors. The search strategy was inspired by the approach from the PRISMA guideline for systematic reviews.[26]

To analyze the characteristics of the included studies such as study setting, study design, information on the country of origin, the kind of disasters, sample size and outcome measures and the methodologies, descriptive analysis was done. In addition, a comparison of the main outcomes extracted from the reviewed studies, such as investigation issues, assessment tools, and indicators in disasters was made.

Results

The initial search yielded 1592 publications of which 842 were excluded based on the title and 623 were excluded after reviewing the abstract. Reviewing references lists and related articles included four articles. This left a total of 21 publications to be retrieved for full-text review [Figure 1]. The target of the majority of reviewed studies was public health evaluation in disaster settings for better response and situation management. Between reviewed studies, nine studies had been conducted following earthquakes;[22,27-34] six following hurricanes, typhoons, or cyclones;[8,9,11,35-37] three following tsunamis;[19,38,39] one following landslide;[40] one following release of mercaptan gas;[41] and the rest following floods[42] [Table 2].

Discussion

In a majority of the studies (n = 18), a questionnaire was used to collect information. However, in nine studies, a questionnaire was first designed and used for the survey. The WHO questionnaire on health status assessment in crises was used just in one study and validity of the questionnaires was not stated in all of the studies.

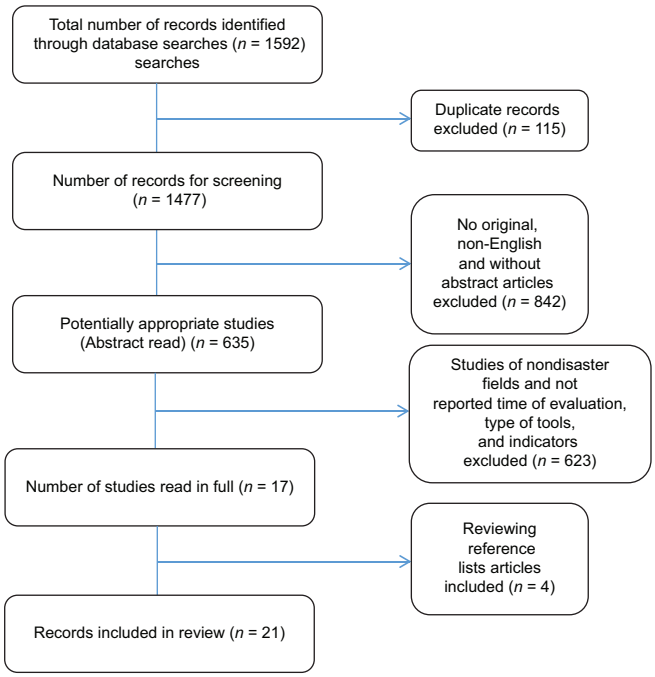

Figure 1: Flowchart of articles selection process

Although for rapid health and needs evaluation, time is crucial, the preparation of a questionnaire is time-consuming. The results of this review show an apparent lack of the available questionnaires in the context of health surveys in time of crisis. For example, in Iran, until the time of this study, just one questionnaire on health status assessment developed by a research team was found, but its reliability had not been estimated.

The preferred method for completing questionnaires in reviewed studies was structured or semi-structured interviews with displaced or affected people, health managers, key informants, and local dignitaries. In a number of the studies (n = 8), direct observation (from the air or during a comprehensive walk around the community) and group discussion were used simultaneously with the interviews.

In three studies, software-based and smartphone-based methods (mobile phone data) were used for data collection.

For example, in Japan in 2016, the Rapid Assessment System of Evacuation Center Condition featuring Gonryo and Miyagi application was developed to solve the difficulties in converting handwritten data to digital data and avoiding mistakes in digitally converting, sorting, and saving handwritten data on assessment after earthquakes.

This application included three screens: the "data entry screen," containing 19 evaluation questions such as shelter, living, and sanitary conditions; the "relief team screen," to record information on response teams; and finally the "data tabulation screen," for classification and arrangement of the data from a central computer.

Simulations confirmed that, although users of this system would be able to quickly and correctly evaluate lots of information from multiple regions following a disaster, but this application had some limitations such as the need to permanent connection to local area networks like a satellite-based mobile phone.[29]

In Nepal and Haiti, mobile phone data were used to track the flows of the population following the earthquake.[22,30] In Nepal, immediately following the earthquake and in Haiti, from 42 days before until 158 days after the earthquake, population movements were tracked. Results showed that this method was very effective for investigating the effects of an earthquake on forced displacement and estimating of damages. Other more intensive methods may be on the horizon. For example, Ben-Ezra *et al*.[43] used Facebook to recruit Japanese citizens for mental health screening after the Fukushima disaster. Their study results showed that the increased use of apps on smartphones as well as web-based interactive questionnaires provide quick assessment options for psychosocial symptoms, with the additional possibility to obtain and provide users with immediate feedback.

Sampling method in most of the studies was cluster sampling either modified or two-stage in Community Assessment for Public Health Emergency Response (CASPER) method. But in eight studies, random sampling method was used (simple, stratified, or systematic sampling).

In CASPER that has been adopted by CDC to assess health status and community needs, household-level surveys provide information about health status and community needs in a quick, low-cost although sometimes labor-intensive manner that can be implemented within days of a disaster event. This methodology has been used previously to assess community needs and health status following natural disasters[35] and provides household-based estimates of specific needs, injuries, and illnesses after a disaster.[9,44]

However, since in disaster health evaluation, the burden of disaster victims and their lack of cooperation is one of the important issues, taking a representative sample in data collection is crucial. Regarding intensity of destruction and the importance of the moments to save lives in disaster situations, cluster sampling seems to be more effective than other sampling methods. However, for each specific disaster situation, the pros and cons need to be considered.

Table 2: Characteristics of reviewed studies

Author(s)	Year	Place	Tools	Investigation issues	Disaster type	Investigation time
Emily Y.Y. Chan and Sian Griffiths	2009	Pakistan	Semi-structured interviews	Demographic background, medical and drug history, self-reported health status, health-care access and utilization, and social/financial concerns	Earthquake	4 months after disaster
Eindra Aung and Maxine Whittaker	2013	Australia	Questionnaire	Aspects of health services and systems, water supply, sanitation, hygiene promotion, and nutrition	Cyclone	3 days after disaster
Guha Sapir D and van Panhuis WG	2009	Indonesia	Questionnaire	Cholera, tetanus, wounds and wound infections, acute respiratory infections, malaria, and dengue	Earthquake and tsunami	First 4 weeks after disaster
Ekta Choudhary, Tai-Ho Chen *et al*.	2012	United States	Household questionnaire	Medical needs; availability of medical care, food, drinking water, and clothing; and earthquake- and tsunami-related injuries, illnesses, and preexisting chronic conditions	Earthquake followed by tsunami	5 days and 3 weeks after disaster
Tadashi Ishii, Masaharu Nakayama *et al*.	2016	Japan	Web-based application on mobile (Mobile Shelter Assessment System)	Basic information: shelter name, shelter address, current shelter administrator, and name of assessing relief team headcount Information: Evacuee headcount and number of evacuees examined count of symptom sufferers: Fever, cough, nausea, diarrhea, influenza, respiratory complaints, and respiratory distress, ration supply, drinking water supply, amount of rations to request from administration, power utility status, blanket supply, heating status, sanitary conditions, water utility status, wastewater utility status, toilet conditions, human waste disposal conditions, pediatric medical needs, psychiatric needs, obstetric needs, dental needs, number of persons, requiring special assistance	Earthquake	Immediately after disasters
RobinWilson, Elisabeth zu Erbach-Schoenberg *et al*.	2016	Nepal	Mobile phone data	Population displacements	Earthquake	9 days after disaster
Ruth Alma Ramos, ab Vikki Carr de los Reyes *et al*.	2015	Philippine	Questionnaire	Number of toilets per evacuee, sanitation, drinking water, food supply source, and medical services	Hurricane	2 weeks after disaster
Linus Bengtsson, Xin Lu *et al*.	2011	Haiti	Mobile phone network data	Population movements following disaster	Earthquake	42 days before until 158 days after
Emily Y.Y. Chan and Jacqueline	2010	Pakistan	Questionnaire and face-to-face structured interview	Demographic characteristics, earthquake damage, self-reported health outcomes of study participants with regard to physical, mental, and social health status, and expressed needs postdisaster	Earthquake	4 months after disaster
Saleena Subaiya, Cyrus Moussavi *et al*.	2014	United States	Questionnaire and face-to-face structured interview	Regarding demographics, type of housing unit, current source of heat and electricity, and basic health information, transportation	Hurricane	3 weeks after disaster
Lynn M Atuyambe, Michael Ediau *et al*.	2011	Uganda	FGDs, questionnaire, interviews, and observations	Water use, sanitation, and hygiene practices in the camp	Landslide	13 days after disaster
Athena R. Kolbe, Royce A. Hutson *et al*.	2010	Haiti	Questionnaire	Demographic information: Including measures of socioeconomic, educational, employment, and housing status of each household member, history for sexual and physical assaults; basic needs: Including security, food, water, health services and housing date, and perceived cause of death	Earthquake	6 weeks after disaster
Chie Teramoto, Satoko Nagata *et al*.	2015	Japan	Comprehensive semi-structured interviews, questionnaire	Gender, age, extent of the damage to the predisaster residence, urgency of the assistance needed, and health problems requiring assistance mental health concerns, drinking concerns, maternal and child-related concerns	Earthquake	6 weeks after disaster

Contd...

Table 2: Contd...

Author (s)	Year	Place	Tools	Investigation issues	Disaster type	Investigation time
Kimberly A. Cullen, BS and Louise C. Ivers	2014	Haiti	Interview, questionnaire	Questions were designed to serve as "key indicators" for the Sphere Project minimum standards for access to health care and water, food, shelter, sanitation, and security	Earthquake	12 weeks after disaster
David F. Zane, Tesfaye M. Bayleyegn *et al*.	2010	United States	A one-page questionnaire Interviews CASPER method	General demographic, household type, and extent of damage questions regarding hurricane-related, self-reported injuries and illness, medication availability, generator and gas/charcoal grill use, and access to basic utilities	Hurricane	12 days after disaster
Richard J Brennan and Kamaruddin Rimba	2005	Indonesia	Direct observations, interviews, a single focus group discussion, town mapping, a review of medical records, questionnaire	Ongoing hazards, demographics, population distributions, access to essential services, environmental health, shelter and existing relief efforts. Interviews with key informants for obtaining pre-Tsunami demographic and public health data, information regarding security, current health conditions, access to essential services, and sociopolitical issues. A single focus group discussion with local women in Calang to identify the specific concerns and needs of women. A brief mapping exercise in Calang to identify the main population centers, the nearest villages, roads and water routes, and the major sources of drinking water and health care. Health facility assessments in Calang and Rigah, including a review of medical records, provided information concerning major causes of morbidity, and the availability of medical services.	Tsunami	14 days
Tesfaye Bayleyegn, Amy Wolkin *et al*.	2005	United States	A questionnaire was developed jointly with the Florida Department of Health	Demographic factors, type of housing structure, extent and type of damage to the structure, access to basic utilities, access to health services, health status, and immediate needs	Hurricane Ivan	6 days
Behrooz Behbod; Erin M. Parker *et al*.	2014	United States	Questionnaire	Self-reported mercaptan odor exposure, physical and mental health outcomes, and medical-seeking practices	Leak of tert-butyl mercaptan	4 years
Tista S. Ghosh, Jennifer L. Patnaik Richard L. Vogt	2007	United States	The interview questionnaire was designed	Evacuee demographics, self-reported acute and chronic medical conditions, service needs	Hurricane Katrina	1 week
Fernando guerena-burgueno, krisada jongsakul *et al*.	2006	Thailand	WHO questionnaire	Hospital characteristics, damage to buildings and communication, electrical, water, sewage systems, health-care supplies, medical needs	Tsunami	4 days
Johannes Schnitzler, Justus Benzler *et al*.	2007	Germany	Standardized and pretested questionnaire	The extent to which the household has been affected by the flood, undertaken evacuation, consumption of floodwater contaminated food source of information, the provision of help in securing buildings, need and provision of medical and psychological help, fear of infections, demand for and receipt of vaccination, diarrhea in relation to the flood, demographics of the respondent	Flood	3 months after disaster

FGDs=Focus group discussions, WHO=World Health Organization

In all but two studies, the demographic status of samples including the number of people affected, age, sex, and the household type and in 18 studies, condition of diseases, water sterilization, shelters and temporary accommodation, health concerns, food shortages, mortality rate, and existing medical services were investigated.

In one study, heart diseases and intestinal and pulmonary problems were examined, and in two studies, population displacement flows were studied.

Some survey items were designed depending on the type of hazards. For example, in situations where a high mortality rate is anticipated, such as a tsunami,

one of the main questions of the questionnaire was about the existence of enough fridges for the bodies of the victims. Likewise in long-term surveys after storms, initial facilities such as the loss of heat, electricity, and telephone were highlighted, and questions were specific for homes without restored electrical power, including sources for generating alternate power and the presence of working carbon monoxide detectors.

Eighteen studies focused on structural damages and resulting displacement, and in three studies, mental illness caused by disasters were investigated.

Only one study was conducted immediately following the incident[29] and the rest was done at least 72 h after disasters. In other words, five studies were carried out within 3 to 6 days, eight studies within 7 to 21 days and the rest were conducted after 21 days following the disasters.

In some excluded studies, often information was lacking about the period in which the evaluation took place and about its duration. However, the 72-h delay in performing assessment showed that local preparedness is crucial for disaster management in the initial phases. Health evaluation may be conducted periodically within days, weeks, or months after the disaster, depending on objectives. But for more effective management of disasters, the assessment should be carried out as expeditiously as possible following a crisis event in an attempt to quantify, categorize, and stratify disruption of basic human needs.[45]

Conclusions

This review shows that a majority of the studies ($n = 20$), actually were conducted longer than 3 days following the events and the earliest health evaluation surveys were implemented at least 72 h after the incidents. During this time, only local resources were available to meet the basic human needs. Furthermore, since these data suggest that logistic constraints may delay the arrival of an evaluation team in <3 days, local authorities or neighboring institutions or persons should be designated by local authorities to perform evaluations in the event of a disaster.

We also found that paper-based questionnaires were the most commonly used tools to evaluate health needs. Although some articles did not describe information on how a questionnaire was conducted, in a majority of the reviewed studies, the condition of the affected area was traditionally investigated utilizing a paper-based questionnaire and visiting the affected area. However, some studies used relatively new methods, including the use of mobile software and the CASPER method. For example, Ishii *et al*. in Japan showed that digital versions of questionnaires would expedite an evaluation process, but still, we cannot draw conclusions about the influence of digital tools on the accuracy of an evaluation.

Although digital- or web-based questionnaires and smartphone applications have some limitation for implementation in emergency situations, we recommend their development, because considering the importance of rapid assessment in early phases of disasters, they can rapidly evaluate health in affected people and accurately disseminate obtained information between stakeholders.

In addition, results from postdisaster questionnaires also show the difficulties in hand-tabulating, avoiding mistakes in digitally converting, sorting, and saving handwritten data. For example, following the Great East Japan Earthquake 2011 which resulted in 15,892 deaths and 2576 missing, the data were collected using the paper-based survey and data analysis was carried out by only 18 staff members.

The mean number of working hours per day for a single staff member was 8.39 h (standard deviation [SD] = 1.67 h) with a mean of 3.56 staff members (SD = 1.54 staff members) working per day. In addition, 10 members admitted to making some form of mistake when entering handwritten data and digitizing it and nine admitted to making a mistake when sorting or saving data after data conversion.

Such results show that health and needs evaluation following disasters is an extremely difficult task. Thus, to prepare for the next major disaster, an assessment system must be developed that can tabulate shelter assessment data correctly and efficiently.[29]

Web-based questionnaires and smartphone applications may create expanded opportunities to conduct assessments following disasters. Not every technological innovation is used by every population. However, the user's attitudes toward the effectiveness and limitations of the applications should be systematically determined.[46] According to reviewed articles, there is still a tendency to make old methods for assessing health aftermath of disasters. While need assessments and health evaluations have traditionally been conducted through questionnaires and interviews, new formats are emerging. In particular, social media and smartphones offer new opportunities for postdisaster assessment.

Limitations

The limitations of the methodology used and completeness of this review cannot be ruled out. One limitation of this review concerns the use of five electronic databases, even though they represent the main ones. No experts in the

field were consulted, to obtain any information about nonpublished studies. Another limitation is that despite the extended range of terms used to capture the relevant literature, the search strategy principally encompassed cited literature.

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Conflicts of interest

There are no conflicts of interest.

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