International Journal of Disaster Risk Reduction 16 (2016) 53–67

Contents lists available at ScienceDirect

International Journal of Disaster Risk Reduction

journal homepage: www.elsevier.com/locate/ijdrr

Social determinants of mid- to long-term disaster impacts on health: A systematic review

Shuhei Nomura [a,b,*], Alexander J.Q. Parsons [b], Mayo Hirabayashi [b], Ryo Kinoshita [b], Yi Liao [b], Susan Hodgson [a,c]

[a] Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, Norfolk Place, London W2 1PG, United Kingdom
[b] Department of Global Health Policy, Graduate School of Medicine, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan
[c] MRC-PHE Centre for Environment and Health, Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, Norfolk Place, London W2 1PG, United Kingdom

ARTICLE INFO

Article history:
Received 29 September 2015
Received in revised form
22 January 2016
Accepted 24 January 2016
Available online 6 February 2016

Keywords:
Social determinants of health
Disaster impact
Long-term impact
Systematic review

ABSTRACT

Disasters cause a wide range of health impacts. Although there remains a need to understand and improve acute disaster management, a stronger understanding of how health is affected in the medium and longer term is also required to inform the design and delivery of measures to manage post-disaster health risks, and to guide actions taken before and during events which will also lead to reduction in health impact. Social determinants exert a powerful influence on different elements of risk, principally vulnerability, exposure and capacity, and thus, on people's health. As disaster health data and research has tended to focus on the short-term health impacts, no systematic assessment of the social determinants of the mid- to long-term health impacts of disasters has been identified. We assessed the chronic health impacts of disasters and explored the potential socioeconomic determinants of health impact through a systematic review. Our findings, based on 28 studies, highlighted that regardless of health outcomes and event types, the influence of disasters on chronic heath persists beyond the initial disaster period, affecting people's health for months to years. Using the World Health Organization's conceptual framework for the social determinants of health, we identified a total of 35 themes across the three conceptual domains (determinants related to the socioeconomic and political context, structural determinants, and intermediate determinants) as potentially influencing disaster impact. Investment to tackle modifiable underlying determinants could aid disaster risk management, improve medium and long-term health outcomes from disasters, and build community resilience.

1. Introduction

Our global community's vulnerability to disaster risks is growing faster than our ability to increase resilience [1]. As a result of underlying risk factors, such as widespread poverty, rapid and unplanned urbanization and the risks associated with a changing climate, the frequency of disasters is increasing both within and between countries, and the threats of multiple hazards, as well as persistence of impact, add an even greater sense of urgency to hasten our efforts for disaster preparedness both in developed and developing countries [2]. The 2010 World Bank report on the economics of disaster risk reduction estimated that the number of people living under the threat of earthquakes and cyclones would double by 2050 (from 680 million in 2000 to 1 · 5 billion in 2050) [3]. The least developed countries (LDCs) and small island developing states (SIDS) suffer the most from disasters [4]. Urgent global attention has been paid to disaster risk reduction [5], but the current tough economic situation has made our strategic investments in risk reduction a matter of spending wisely in an evidence-informed manner, rather than spending more [1].

Effective emergency and disaster risk management entails specific health and multi-sector measures to reduce the overall risk to health from different types of hazards. These measures include prevention, preparedness, response and recovery. The health measures to manage the risks of disasters include measures to reduce risks and build resilience of communities before disasters as well as preparedness, response and recovery measures. The design and delivery of measures to reduce risks and enable better health outcomes can be achieved by better understanding of the health impact of disasters and the potential risk factors that influence the disaster related health burden [6]. Past catastrophic disasters have demonstrated that socioeconomic factors have the potential to influence the likelihood and/or severity of disaster

* Corresponding author at: Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, Norfolk Place, London W2 1PG, United Kingdom.
E-mail address: s.nomura13@imperial.ac.uk (S. Nomura).

http://dx.doi.org/10.1016/j.ijdrr.2016.01.013
2212-4209/

impacts on health [7,8], Most post-disaster evidence on social determinants of health relates only to the first few months after the disaster (i.e., the acute phase), where health care needs focus on emergency treatment for injuries, obstetric and neonatal care, infectious diseases and mental health care. For example, Raschky (2008), Toya et al. (2007), Rasmussen et al. (2004), and Albala-Bertand (1993) demonstrated that per capita income, education attainment and social inclusion were significant indicators of a society's vulnerability to disasters (in terms of the immediate number of people killed and affected) [9–12]. The consideration of the socioeconomic factors associated with health, which are often collectively referred to as social determinants of health (SDH), in disaster risk management planning and programmes could accelerate the capacities of communities and government to effectively manage and reduce risk and improve health and other outcomes for people at risk. Parvin et al. (2013) reported that the community's disaster risk reduction strategy with a focus on socioeconomic factors, including the expansion of microfinance and support to enhance water and sanitation facilities, yielded success in that the clients of microfinance services reduced flood damage by 26% in Hatiya, Bangladesh [13].

Health outcomes and socioeconomic data on disaster affected people months or even years after the disaster events are often immeasurable or unknown because they are difficult to follow-up and/or attentions shift to new events as time passes. Therefore, information about disaster health impacts in the post-acute periods (i.e., mid- to long-term (months to years) periods), is particularly scarce, and the potential mechanisms through which socioeconomic factors may affect the disaster impact on long-term health are even less well evaluated.

The aim of this study was to enhance understanding of disaster-related stakeholders, including health practitioners, local leaders, civil societies, public/private sectors, and policy makers, with respect to the mid- to long-term health impact of disasters and social determinants of impact, in order to help identify entry points for action and develop strategic directions for health policy and practice on long-term disaster risk management. To achieve this aim, we investigated the existing literature in relation to disasters with two objectives: 1) to assess the mid- to long-term health impact of disasters with regard to the presence of persistent negative health consequences, and 2) to identify and appraise the social determinants associated with these impacts, as entry points for addressing disaster risk reduction. Building on this evidence, we also made practical recommendations for future disaster studies. To our knowledge, this is the first systematic review to assess the disaster impact on mid- to long-term health with a focus on social determinants of health.

2. Methods

Given that our specific objective was to assess the existing knowledge on health impacts of major disasters in the post-acute period, we exclusively assessed studies evaluating the period three months or more after the disaster [14]. To address potential social determinants of health in post-disaster situations, we considered the conceptual framework proposed by the World Health Organization's Commission on Social Determinants of Health (Fig. 1). As Solar et al. (2010) acknowledges, in the framework, individual health outcomes are considered as the result of the interaction of several determinants functioning at three different domains: determinants related to the socioeconomic and political context, structural determinants, and intermediate determinants [15]. To our knowledge, this is the first application of this framework to disaster situations.

The *socioeconomic and political context* is the highest level domain and refers to the wide spectrum of factors in society and the political context that cannot be directly measured at the individual level. These factors create social stratification and assign individuals to different social positions, which in turn generate differential exposure to health-compromising conditions and differential vulnerability in terms of health conditions and material

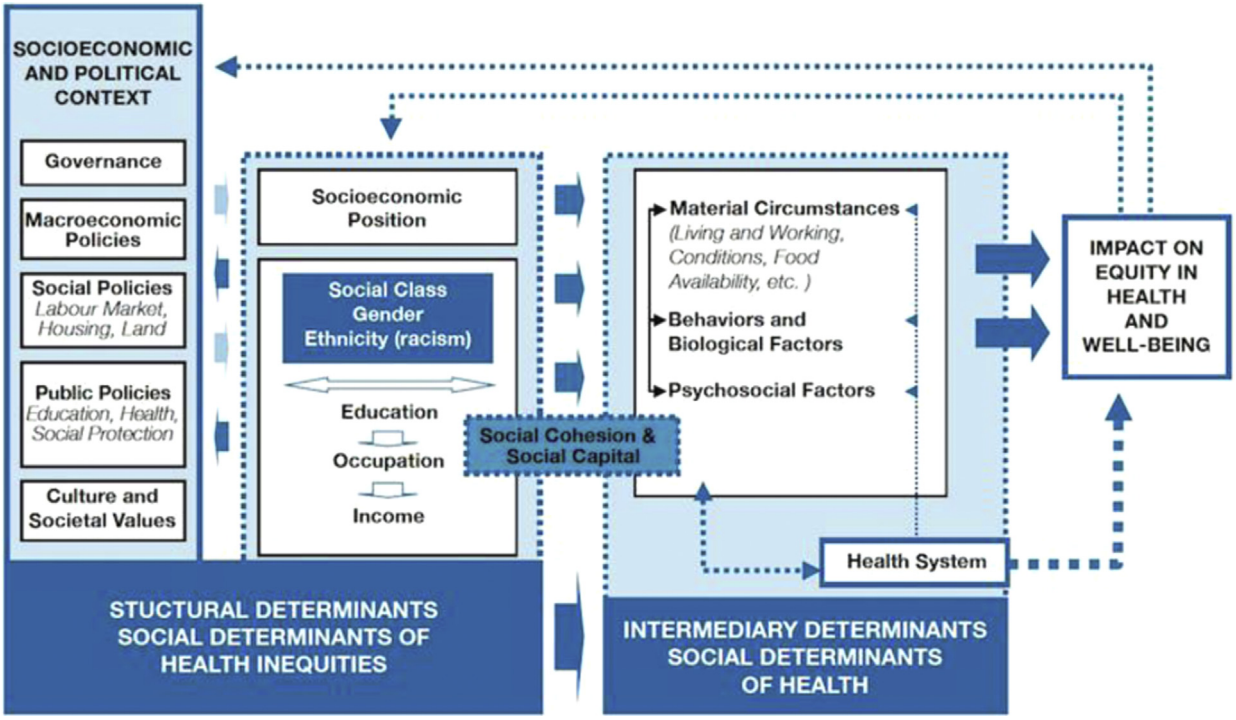

Fig. 1. Conceptual framework of the Commission on Social Determinants of Health (Solar and Irwin, 2010) [15].

resource availability, and thus, determine differential consequences on people's health. As stated by Solar et al. (2010), this domain is composed of at least six aspects: (1) governance, such as accountability/transparency in public administration; (2) macroeconomic policies, including monetary and trade policy; (3) social policies, affecting immigration, employment and housing patterns; (4) public policy in other relevant areas, e.g. education, healthcare and social work; (5) culture and societal values; and (6) epidemiological conditions [15]. *Structural determinants* refer to factors that generate social stratification (i.e., the interplay between the socioeconomic and political context described above, and the socioeconomic position of an individual). General examples of proxy indicators of the determinants of this domain include: income, education, occupation, social class, gender, and race/ethnicity [15]. *Intermediate determinants* refer to downstream factors, which determine individual-level differences in exposure and vulnerability to health-hazards. The main aspects of this domain comprise: (1) material circumstances; (2) behavioural and biological factors; (3) the health system itself as a social determinant; and (4) social-environmental or psychosocial circumstances [15].

2.1. Literature search criteria

Peer-reviewed observational studies that both assessed disaster impacts on health in the $\geq$3-month period following a disaster by quantitatively comparing exposed- and less/unexposed- (or control) groups, and addressed associations between social determinants and the disaster impact in a quantitative or non-quantitative/descriptive manner or by reference to other literatures, were included. Studies with study periods crossing over the point of three months following the disaster were also included. Review articles were excluded. Disasters due to natural (including geological, hydrometeorological and biological), technological and societal hazards were included. Wars and conflicts were excluded from the scope of the study because the literature is vast and such disasters may have different characteristics from other events in terms of root causes, contexts, and challenges. As a consequence, the potential pathways linking social determinants of health to outcomes in individuals during wars/conflicts might be different. The general population, as well as specific target groups including elderly people, people with disabilities, nursing home residents, and school children were eligible for inclusion. Quantitative outcome measures indicating any health outcome, including chronic diseases, infections, physical trauma, and mental problems, were eligible for inclusion. Biometric data (e.g., body mass index (BMI), glycated haemoglobin (HbA1c), systolic blood pressure (SBP), and diastolic blood pressure (DBP)) related to health outcomes were also eligible. Health consequences of radiation damage were excluded because this is a complex phenomenon involving aspects associated with physiology and cell biology, and thus is difficult to fully address in the present study. No language restrictions were applied.

2.2. Literature search methods

The following electronic databases were searched from their dates of inception to August 2014: PubMed, Embase, POPLINE, LILACS, CINAHL and PsycINFO. The search strategy combined relevant general research terms with filter terms, expanded and appropriately modified depending on database. The search strategies are listed in Appendices (Table A.1–6). Key personnel and organizations working in disaster risk management for health, including members of the various networks of disaster researchers and policymakers, were contacted to identify additional references. The proceedings of major disaster conferences, such as The Asia Pacific Conference on Disaster Medicine, World Congress on Disaster and Emergency Medicine, and World Conference on Disaster Risk Reduction were also searched. The search strategy was iterative, in that bibliographies of the potentially eligible studies were also searched for additional articles.

The methods for data collection were based on guidance from the Cochrane Handbook for Systematic Reviews [16]. All identified studies were inspected independently and critically by two review authors to determine the potentially eligible studies for inclusion. Initially, titles and abstracts of the identified studies were independently screened and assessed against eligibility criteria. Potentially eligible studies were then further evaluated with review authors independently reviewing the full articles in regard of the criteria above. All disagreements were resolved by discussions between the reviewers. Note that we did not appraise the quality of the included studies as a part of inclusion/exclusion criteria because disasters occurs very rarely and often leave insufficient opportunity for anything other than opportunistic studies of impact. We considered that any insights generated following a disaster were likely valuable, regardless of the methodological quality of the study.

A standardized observation form was independently completed by the two review authors for each selected study. The extracted data included the following information: publication year, study title, first author, event type, event site, study objectives, study population, study period (of target group and control/reference group), sample selection methods, health outcome, outcome measures and measurement tool (if any), disaster impact (i.e., results of the comparison between target and control/reference groups), evidence of social determinants of impact, and type of evidence (i.e., quantitative, non-quantitative/descriptive, or reference to the literature). Discrepancies in abstracted data were resolved through discussion between the reviewers.

2.3. Synthesis approach

Owing to the nature of disaster studies, heterogeneity with respect to study population, study designs, and outcome measures was expected and observed amongst the selected studies. As such it was not possible to perform a meta-analysis. Therefore, we employed a narrative synthesis approach [17], which have recently been used in healthcare review studies [18–20]. Reporting methods were based on the recommendations provided by Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group [21], as well as Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) group [22].

2.4. Data analyses

We explored the characteristics of the studies by event type and by outcome, and examined the post-acute disaster impacts in terms of the presence of prolonged adverse health consequences. Major themes were identified as proxy indicators of the potential social determinants of the disaster impacts on health in accordance with the WHO's framework on SDH. The themes were stratified by domain (i.e., determinants related to socioeconomic and political context, structural determinants, and intermediate determinants) and types of evidence noted in order to enhance their application for disaster risk management policy and practice.

3. Results

3.1. Results of the search

A total of 1407 citations were obtained from our search of the databases. After excluding 321 duplicate manuscripts, we were left

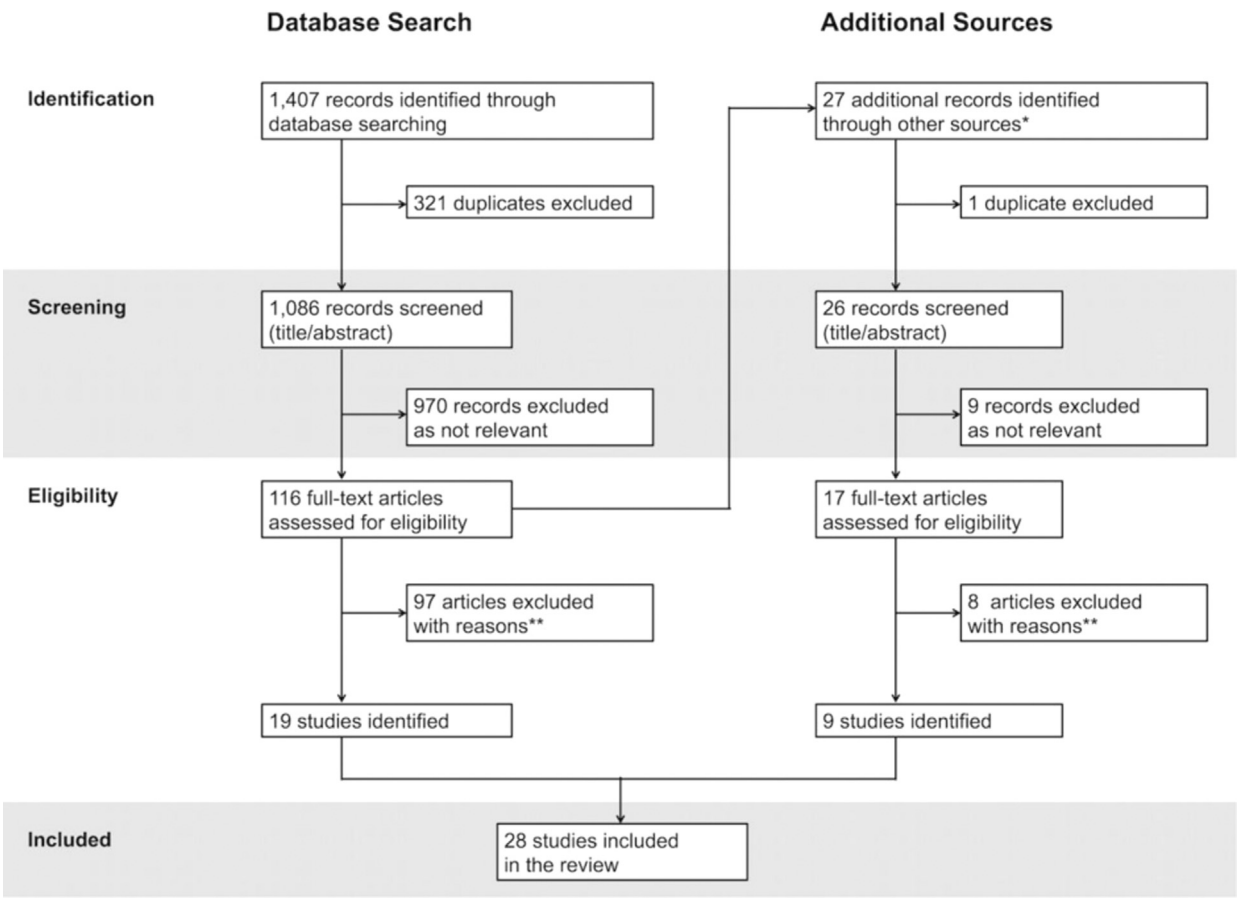

Fig. 2. Flowchart of review of disaster studies. * Other sources include bibliographies of the potentially eligible studyes. ** Reasons of exclusion included: no comparison with pre-disaster/other control population; review study; intervention study; not a disaster study; did not address health outcomes; short term/acute impact.

with 1086 studies for screening. The screening process identified 116 studies for full-text review. Of these, 19 studies were determined to meet the eligibility criteria. A further nine studies were found through other sources, including the bibliographies of the included studies. We then abstracted data and analysed a total of 28 studies. A full flowchart of the review process is available in Fig. 2.

3.2. Characteristics of the studies

Disasters evaluated in the 28 studies are summarized in Table 1. Most of the studies investigated a"major' disaster, where an internationally recognized name had been given ($n=27$: 96.4%). Major event sites were disaster-prone Pan-Pacific countries, including China, Colombia, Japan, and Taiwan (Chinese Taipei). The most frequently studied single type of disaster was earthquake ($n=16$: 57.1%), followed by cyclone/hurricane ($n=4$: 14.3%) and tsunami ($n=2$: 7.1%). Four studies addressed multiple-hazards, i.e., the 2011 Great East Japan Earthquake, subsequent tsunami and nuclear power plant incident [23–26], Post-disaster periods studied ranged from three months to 40 years, with a median of one year.

3.3. Mid- to long-term disaster impacts on health

In the 28 studies identified, the following health outcomes were addressed: 1) mortality (excluding suicide); 2) suicide death; morbidities from 3) mental and behavioural disorders, 4) diseases of the circulatory system, 5) infectious and parasitic diseases, and 6) nutritional diseases; and 7) outcomes based on biometric data (e.g., BMI, HbA1c, SBP, DBP). The most frequently studied outcome was mental and behavioural disorders ($n=15$, 53.6%), followed by mortality ($n=4$, 14.3%), and diseases of the circulatory system ($n=4$, 14.3%). The higher number of studies on mental health than other health disciplines may be due to a more active mental health research community, and public and service provider interests in understanding the mental health needs and targeting appropriate responses. Many post-disaster health outcomes were evaluated in comparison with pre-disaster populations (100% for mortality, diseases of the circulatory system, certain infectious and parasitic diseases, and nutritional diseases, and 80.0% for biometric data), while mental and behavioural disorders were studied by comparing with un- or less-exposed populations (70.6%). Among the outcomes evaluated in more than two studies (i.e., mortality, mental and behavioural disorders, diseases of the circulatory system, and biometric data), the median post-disaster follow-up period was 12 months, 10 months, 30 months, and 6 months respectively. Table 2 presents the range of post-disaster relative risks by health outcome. Except for suicide, all the health outcomes, evaluated by several outcome measures, demonstrated a statistically significant increase in risk in the post-acute (≥ 3 months) phase after the disaster in more than one study.

3.4. Social determinants influencing the disaster impact on health outcomes

Themes that emerged under the social determinants of health domains are detailed in Table A.7, and briefly described below.

Table 1
Disaster evaluated in included studies.

Event type and internationally recognised event name	Number of studies	Event time	Event site
Single hazard			
Earthquake ($n=16$, 57.1%)			
Agadir Earthquake	1	Feb 1960	Morocco
Spitak Earthquake	1	Dec 1988	Armenia
Great Hanshin-Awaji Earthquake	1	Jan 1995	Japan
Armenia-Colombia Earthquake	1	Jan 1999	Colombia
Athens-Greece Earthquake	1	Sep 1999	Greece
Chi-Chi Earthquake	3	Sep 1999	Taiwan
South Iceland Earthquake	1	Jun 2000	Iceland
Niigata-Chuetsu Earthquake	3	Oct 2004	Japan
L'Aquila Earthquake	2	Apr 2009	Italy
Great Sichuan Earthquake	1	May 2008	China
Great Chilean Earthquake	1	Feb 2010	Chile
Hurricane ($n=4$, 14.3%)			
Hurricane Katrina	4	Aug 2005	United States
Tsunami ($n=2$, 7.1%)			
Great Indian Ocean Tsunami	2	Dec 2004	Countries bordering the Indian Ocean
Flood ($n=1$, 3.6%)			
NA	1	Jul 1987	Bangladesh
Fire[a] ($n=1$, 3.6%)			
Volendam New Year's fire	1	Jan 2001	Netherlands
NA	1	Jul 2004	Belgium
Multiple hazards			
Earthquake and Tsunami ($n=1$, 3.6%)			
Great East Japan Earthquake and Tsunami	1	Mar 2011	Japan
Earthquake, Tsunami and Nuclear incident ($n=3$, 10.7%)			
Great East Japan Earthquake, Tsunami and Fukushima Daiichi Nuclear Power Plant Accident	3	Mar 2011	Japan

[a] One study covered two events.

Note that the WHO's conceptual framework of social determinants of health does not describe official indicators of the determinants, but instead provides some conceptual definitions of each domain that enable identification of themes associated with health.

3.4.1. Socioeconomic and political context

Only five studies (17.9%) addressed this domain, and from these studies we identified six themes: the insurance system ($n=1$), national and international societal attention ($n=1$), public security ($n=1$), cultural mentality ($n=1$), evacuation policy ($n=1$), and policy for vitamin A supplementation ($n=1$).

Burton et al. (2009) suggested that, in the case of the 2005 Hurricane Katrina, United States, a health insurance system that expanded coverage to include post-hurricane treatment by out-of-area healthcare providers (i.e., providers in areas originally not covered by the health insurance) might help displaced-victims access healthcare and attenuate health consequences [27]. Scott et al. (2003) assessed psychological functioning in adolescent victims of the earthquake that occurred in Armenia in 1999, and showed that eight months after the event no significant difference in the psychological status was observed among those who did versus those who did not experience the event [28]. The authors implied that this might be because the affected areas had been a focus of national and international attention, and external support gave the disaster victims a sense of optimism and reduced their psychological distress [28]. In addition, because of low public security in the affected area, adolescents had been commonly exposed to violent and threatening occasions prior to the earthquake, which built resilience against adversity and, as the author mentioned, might enable the adolescent victims to recuperate from disaster in a short period of time, resulting in no-significant mid- to long-term health effects [28]. As evaluated by Sawa et al. (2013), after Japan's 2011 Fukushima radiation-release nuclear incident, some caregivers evacuated from Fukushima prefecture, resulting in their own psychological distress at the thought that they caused substantial manpower shortage in the affected area. The authors suggested that this 'cultural mentality' might delay recovery from their psychological distress [25]. Nomura et al. (2013) demonstrated a significant increase of mortality in elderly evacuees after the 2011 nuclear incident in Japan, and argued this was due, to insufficient evacuation policy, including inadequate transportation arrangement and poor preparation for care-provision at evacuation sites [24]. Choudhury et al. (1993) described that the government policy of Vitamin A supply for 3–11 month-aged children in monsoon-prone areas might reduce the vulnerability to the effect of disasters on severe malnutrition [29].

3.4.2. Structural determinants

Fourteen studies (50.0%) were identified that included analyses of the impact of the structural domain, addressing nine themes:

Table 2
Disaster impacts evaluated in included studies ($n=28$).

Effect measure by health outcome (number of studies, and percentage)[a]	Follow-up period in months	Reference population[b]	Range of relative risk (RR)[c]	Statistical significance of RR ($p<0\cdot05$)			References
				YES	'Yes' in some group[d]	NO	
Mortality ($n=4$, 14.3%)							
Hazard rate	12	Pre-disaster	0·8–2·9		○		[24]
Incidence rate	12	Pre-disaster	0·8–1·1		○		[35]
	12	Pre-disaster	NA			○	[27]
Number of cases	3.5	Pre-disaster	1·5	○			[42]
Suicide ($n=1$, 3.6%)							
Incidence rate	36	Un-exposed	0·7–2·5			○	[47]
Mental and behavioural disorders[e] ($n=15$, 53.6%)							
Mean disease rating score	3	Un-exposed	1·0–1·6		○		[45]
	5	Pre-disaster	NA	○			[30]
	5	Pre-disaster	NA	○			[74]
	6	Un-exposed	1·4	○			[39]
	6–14	Less-exposed	1·3–3·8	○			[36]
	8	Un-exposed	NA		○		[28]
	9	Pre-disaster	1·1	○			[32]
	9	Un-exposed	1·5–2·4		○		[25]
	10	Un-exposed	NA		○		[33]
	12	Less-exposed	0·7–1·2		○		[44]
	15	Pre-disaster	1·1	○			[31]
	24	Un-exposed	NA		○		[37]
	40 years	Un-exposed	NA			○	[38]
Odds	14	Pre-disaster	0·9–12·5		○		[75]
Prevalence	9	Un-exposed	3·0–4·5		○		[25]
	12	Un-exposed	2·1	○			[34]
	40 years	Un-exposed	1·3			○	[38]
Diseases of the circulatory system[f] ($n=4$, 14.3%)							
Hospital admission rate	4	Pre-disaster	1·1	○			[76]
	24	Pre-disaster	3·1	○			[40]
	41	Pre-disaster	2·9	○			[41]
Mortality rate	36	Pre-disaster	1·13–1·15	○			[46]
Certain infectious and parasitic diseases[g] ($n=1$, 3.6%)							
Odds	16	Pre-disaster	2.2	○			[48]
Prevalence	16	Pre-disaster	2·2	○			[48]
Nutritional diseases[h] ($n=1$, 3.6%)							
Prevalence	6	Pre-disaster	1·5–6·8		○		[29]
Biometric data[i] ($n=3$, 10.7%)							
Measured value	4	Pre-disaster	NA		○		[23]
	4	Un-exposed	NA		○		[23]
	6	Pre-disaster	NA		○		[26]
	24	Pre-disaster	NA			○	[40]

[a] Burton et al. (2009) evaluated post-disaster all cause, but it was not included in this table because of its broad scope.
[b] The reference population refers to the comparator against which the target (i.e. affected population) is compared to evaluate the health impact
[c] If the relative risk was not available in the paper, it was calculated from the data reported in the paper. Confidence intervals were, then, not able to be estimated.
[d] The significance was dependent on sub-group characteristics (e.g., age and/or sex).
[e] Includes depression, post traumatic stress disorder, anxiety disorders, and behavioural disorders.
[f] Includes acute myocardial, cardiovascular diseases, and cerebrovascular diseases.
[g] Includes gonorrhoea.
[h] Includes malnutrition.
[i] Includes BMI, HbA1c, SBP, and DBP.

age ($n=8$), gender ($n=8$), marital status ($n=1$), education ($n=1$), immigrant background ($n=1$), social class ($n=1$), income ($n=1$), and occupation ($n=1$). Themes assessed in more than two studies (age and gender) are presented below.

3.4.2.1. Age. Age in general could be a potential determinant influencing the disaster impact on mental disorders. Toyabe et al. (2006) demonstrated that after the 2004 Niigata-Chuetsu Earthquake, Japan, psychological distress levels increased with increasing age ($p<0.001$) five months after the earthquake, while no pre-earthquake difference in age was observed. This result indicated that age might be a determinant influencing the earthquake impact on psychological distress [30]. Seplaki et al. (2006) suggested that after the 1999 Chi-Chi Earthquake, Taiwan, the near-elderly, aged 54–70, were more likely to be providing financial and other types of support to their children and relatives, and thus be facing financial challenges near retirement, which might lead to more psychological distress than that experienced by the elderly, aged more than 70 [31]. Chiu et al. (2012) and Dell'Osso et al. (2013) also indicated an age effect on health impact (i.e., the higher the age, the higher the risk), of the earthquake on mental and behavioural disorders [32,33]. Toukmanian et al. (2000) also suggested age as a determinant, but found the relationship somewhat inconsistent with other studies above, and showed interaction with marital status [34]. Here the authors demonstrated that all three age groups (17–30, 31–55, and 56+) showed increased depression levels one year after the 1988 Spitak Earthquake, Armenia, but among the three groups, those aged 31–55 and who were either single, widowed, or divorced had the highest post-earthquake depression level followed by single, widowed, or divorced people aged over 55. Meanwhile, amongst those who were married, it was the younger group (aged 17–30) that had the highest depression levels followed by those aged 31–55.

Other studies also suggested that age alone might have limited influence on mortality following disaster. Chan et al. (2003) showed that the mortality after the 1999 Chi-Chi Earthquake significantly decreased overall in the affected area, though amongst males over 45 years of age mortality increased in the 3rd and 7th month after the earthquake [35]. Burton et al. (2009) examined the sex and race/ethnicity adjusted relative mortality risk before and year after the 2005 Hurricane Katrina, and showed that the relative risk for a 1 year increase in age was 1·11 (95% CI: 1.10–1.11) before the event and 1.02 (95% CI: 1.02–1.03) after the event, indicating that age effect on mortality was lower following the hurricane [27].

3.4.2.2. Gender. Gender was also identified by several studies as a determinant of the disaster impact on post-disaster mental disorders. Seplaki et al. (2006) showed that women had significantly higher post traumatic stress disorder (PTSD) levels after the earthquake, than men, after adjusted for pre-earthquake PTSD levels ($p<0·05$) [31]. Toukmanian et al. (2000), Toyabe et al. (2006), Heir et al. (2011), Van Loey et al. (2012), and Dell'Osso et al. (2013) suggested the same gender effect (i.e., females having higher risk) of the disaster impact on mental and behavioural disorders [30,33,34,36,37]. On the other hand, Kadri et al. (2006) demonstrated that after the 1960 Agadir Earthquake, Morocco, there were no significant correlations between PTSD prevalence and gender in either exposed- or non-exposed populations ($p=0.44$, and $p=0.21$, respectively) [38]. Kolaitis et al. (2003), who evaluated the 1999 Athens-Greece Earthquake, Greece, came to a similar conclusion [39].

3.4.3. Intermediate determinants

This domain was addressed by 16 studies (57.1%), with a total of 20 themes identified. With regard to behavioural and biological factors, five studies addressed the themes of smoking, alcohol consumption, change in exercise, change in diet, and substance abuse. From five studies that addressed the health system as a social determinant, we identified the following five themes: insufficient sanitation, insufficient food supply, loss of medical records, lack of health insurance, and post-disaster psychosocial aftercare. Finally, from 14 studies that referred to social-environmental or psychosocial circumstances, 10 themes were identified: (lack of) social and community support/attention, displacement/living in a temporary housing, experience of life threat, financial loss (aid), insufficient litigation, living without family, loss of job, loss or injuries of family members or loved ones, property loss/damage, and social disruption. Themes assessed in more than two studies are presented below.

3.4.3.1. Behavioural and biological factors

3.4.3.1.1. Smoking. Gautam et al. (2009) indicated that two years after the 2005 Hurricane Katrina, among the people admitted to the hospital in the affected area with acute myocardial infarction (AMI), there was a significant increase in prevalence of smoking (58.1% vs. 39.3%, $p=0.001$) in comparison with two years before the hurricane. The authors suggested that this may reflect a change in the local population behaviour and health practices, resulting in the increased hospital admission rate from AMI in the two years following the hurricane [40], although the effect of change in the composition of the population in the affected areas cannot be ruled out. Jiao et al. (2012) updated this study by extending the follow-up period to three years, and echoed this conclusion [41].

3.4.3.1.2. Change in diet. Ogawa et al. (2012) described that after the 2011 Great East Japan Earthquake and Tsunami, Japan, fresh foods, such as vegetables and fish, were in short supply in refugee camps, and therefore, refugees mostly subsisted on preserved foods, including sweets, pastries, canned products, cup noodles and boil-in-the-bag foods [23]. The authors suggested that this inappropriate diet might affect blood pressure control through, for example, an increased salt intake via instant noodles. Kario et al. (1997) described that after the 1995 Great Hanshin-Awaji Earthquake, Japan, many people had to abandon their homes and live in shelters, and as a result, the composition of their diet also drastically changed. The authors suggested that this change in diet might be one of the reasons that the total number of coronary heart diseases deaths increased after the earthquake [42]. Tsubokura et al. (2013) also suggested that changes in diet after the disasters of Japan in 2011 might be associated with the change in biometric parameters [26].

3.4.3.2. The health system

3.4.3.2.1. Lack of health insurance. Two years after the 2005 Hurricane Katrina, as Gautam et al. (2009) indicated, a significant increase was observed in prevalence of un-insured people among those who were admitted with AMI to the hospital at the heart of the hurricane (18.3% vs. 6.0%, $p=0.0001$), although there were no significant difference in the pre- and post-hurricane subjects with regard to medical conditions, such as, hypertension, hyperlipidemia, and diabetes mellitus [40]. Jiao et al. (2012) updated this figure to 15.6% three years after the hurricane [41]. These authors suggested that the lack of health insurance might affect a person's ability to maintain close healthcare follow-up, resulting in the increased rate of AMI admissions after the hurricane.

3.4.3.3. Social-environmental or psychosocial circumstances

3.4.3.3.1. (Lack of) social and community support/attention. Li et al. (2011) discussed that after the 2008 Great Sichuan Earthquake, China, students who were in severely exposed areas (i.e., Pengzhou city, where the majority of the residents lost their homes) received more public attention and had more social resources and supports than students in less exposed areas (i.e., Chongqing city, where a minority of residents lost their homes) [43,44]. The authors suggested that this might result in their trauma levels being lower in severely exposed students than students who were less exposed to the earthquake. Van Loey et al. (2012) also suggested that the survivors of the 2001 Volendam New Year's fire in the Netherlands, received significant social support and attention because of the companionship between the victims, which might have reduced their post-event stress levels [37].

3.4.3.3.2. Displacement/living in a temporary housing. Bodvarsdottir et al. (2004) showed that three months after the 2000 South Iceland Earthquake, Iceland, the experience of having to relocate was associated with increased post-earthquake psychological problems in adults [45]. Sawa et al. (2013) also suggested a relationship between living in temporary housings and impaired post-disaster psychological recovery nine months after the Japan disasters in 2011 [25]. On the other hand, Seplaki et al. (2006) observed no associations between displacement and stress levels 15 months after the Chi-Chi earthquake [31].

3.4.3.3.3. Financial loss (aid). Nakagawa et al. (2009) suggested that financial loss due to the 2004 Niigata-Chuetsu Earthquake, might result in increased mortality due to AMI three years after the earthquake [46], and Hyodo et al. (2010) suggested that temporary financial aid from the government following this earthquake might have decreased the earthquake impact on suicide in the three years following the earthquake [47].

3.4.3.3.4. Living without family. As Nsuami et al. (2009) described, there were a sizeable number of students not living with their parents 15 months after the 2005 Hurricane Katrina, instead living with neighbours with whom they might not feel socially connected. The authors suggested that this might result in poor health care situations, leading to the increase in infections of Gonorrhoea [48]. Sawa et al. (2013) also suggested a relationship between living without family and delayed recovery from psychological distress nine months after the Japan disasters in 2011 [25].

3.4.3.3.5. Loss of job. Gautam et al. (2009) and Jiao et al. (2012) showed that after the 2005 Hurricane Katrina, the percentage of unemployed among the AMI patients increased from 2.0% to 13% in two years and to 15% in three years following the hurricane [40,41]. These authors suggested that the loss of job might be associated with the post-hurricane increase in AMI admission rate.

3.4.3.3.6. Loss or injuries of family members or loved ones. The impact of the loss of a family member was addressed by Sawa et al. (2013) and Seplaki et al. (2006) and suggested to be a determinant of impaired post-disaster psychological recovery 9 and 15 months after the earthquake, respectively [25,31].

3.4.3.3.7. Property loss/damage. Bodvarsdottir et al. (2004) showed that damage to property, including a house, during the earthquake was associated with the increased post-earthquake psychological disorders in adults three months after the earthquake [45] and Kolaitis et al. (2003) demonstrated that children whose families had property damage by the earthquake had significantly higher distress levels six months after the earthquake than those who did not ($p=0.02$) [39]. In addition, Seplaki et al. (2006) showed that those who reported that their house was damaged in the earthquake had higher psychological distress levels than those reporting no damage after adjusted for demographic characteristics ($p<0.05$) 15 months after the earthquake [31]. Sawa et al. (2013) and Chiu et al. (2002) also suggested property loss or damage due to the earthquake was a determinant of disaster impact on psychological disorders [25,32].

4. Discussion

We systematically reviewed the observational studies that assessed the disaster impact on mid- to long-term health and that also considered the social determinants of health. Seven health outcomes were addressed across the 28 studies reviewed. Studies reported a statistically significant negative mid- to long-term impact of the disasters for all the health outcomes, except suicide. These results indicate that the health impacts of most major disasters may persist over months/years regardless of event types and health outcomes assessed. We also identified a total of 35 themes across the three conceptual domains of the social determinants of health as potentially influencing the disaster impacts on health.

Our study findings have important practical implications for academia, scientific and research entities. The studies included in this review most frequently addressed earthquakes, followed by hurricanes (Table 1). However, this focus of the studies can be contrasted with the severity of disaster types in terms of occurrences and/or death toll. The Centre for Research on the Epidemiology of Disasters (CRED), a research institute based at the School of Public Health of the Universite Catholique de Louvain, Belgium, maintains an emergency events database (EM-DAT) since1990. The disaster events are recorded in this database if they meet at least following criteria: 10 or more people dead, 100 or more people affected, declaration of a state of emergency, or call for international assistance, thus there are many small-scale disasters that are not recorded as they do not exceed any one of these thresholds [49]. According to CRED, the most frequent disaster meeting their criteria as of the end of 2014 was transport accident ($n=5247$: 24.7%), followed by flood ($n=4382$: 20.6%), with earthquake, hurricane, tsunami, and fire representing just 6·0%, 9·4%, 0.3%, and 3.9% of disasters, respectively [49]. In terms of death toll, drought accounted for the highest proportion of deaths (30.5% of a total of 38 million), followed by infectious epidemics (24.9%), with earthquake, hurricane, tsunami, flood, and fire accounting for 6.6%, 3.4%, 0.7%, 18.1%, and 0.1%, respectively [49]. In addition, in terms of mean death toll per incident, drought was the highest with 17,829, followed by infectious epidemic of 7052, with earthquake, hurricane, tsunami, flood, and fire accounting 1995, 643, 4547, 1585, and 45 deaths per incident, respectively [49]. These data suggest the number of studies included in our review for each event type do not necessarily reflect the frequency or severity of the event. Nonetheless, regardless of event types and health outcomes assessed, it appears that the health impacts of most major disasters persist over months/years (Table 2). More research attention with regard to the mid- to long-term health impacts should be given to events including transport accident, infectious epidemics, and drought as well as more diverse health impacts, such as chronic diseases, and their social determinants, which are not well covered in the literature.

People's health remains a key imperative for effective disaster risk management. Communities that are vulnerable to disasters and unprepared for them experience large-scale and prolonged negative health consequences more readily than do communities that are

better prepared [50]. With the economic losses from disasters expected to double by 2030 and the number of people affected and health losses expected to rise, the burden of disasters falls most heavily on communities where effective risk reduction policy is not in place and/or not working well [3]. On 14 to 18 March, 2015 in Sendai, Japan, the Third United Nation's World Conference on Disaster Risk Reduction was held, representing a unique opportunity for member states to consider the experience gained through the regional and national strategies and plans for disaster risk reduction [50]. Delegates from every state in the world agreed that a substantial progress in reducing disaster risk and building resilience requires a more explicit focus on people's health with a better understanding of the scale of disaster impacts on health and the determinants that influence this impact [50]. Such knowledge can be leveraged for the development and implementation of adequate prevention, preparedness and effective response to health emergencies [50], and to ensure that public and private investments for disaster risk reduction are cost effective to save lives [50].

No country, regardless of culture, religion, or economy, is immune from disaster resulting from various (and sometimes multiple) hazards [14]. It is critical to plan for and reduce disaster risk in all settings to more effectively protect persons, their health and assets, and strengthen their resilience. More dedicated investment should focus on underlying determinants of health/vulnerability to identify entry points for more effective action. Such a focus would also support the development of meaningful strategic directions for health policy work on post-disaster recovery, including long-term disaster risk reduction. In this context, our study provides invaluable insight of these determinants of disaster health impact. Note that stakeholders share responsibility for reducing disaster risk. In particular, academia, scientific and research entities are encouraged to: focus on the determinants of disaster risk not only in the acute term, but also in the mid- to long-term; increase research for regional, national and local application; support action by local communities and stakeholders; and support the interface between policy and research/science for decision-making [50].

This study had several limitations. First, our review was constrained by potential reporting bias. It is widely acknowledged that statistically significant outcomes were more likely to be reported than non-significant outcomes [51–53], and severe cases are more likely to be reported, which might lead to an overestimation of the disaster impact [16]. This potential bias also made it meaningless to compare the number of studies with positive and negative results within/between disaster type and/or by health outcome. Second, because we restricted the eligibility criteria for inclusion to those studies which assessed both the disaster impact and the social determinants influencing this impact, some studies that evaluated only the disaster impact will have been missed in this study. Third, because many ‘themes’ of the social determinants of health were assessed by a single study only ($n=23$: 65.7%), these may be specific to a disaster event, or be very location- and/or hazard-specific. Finally, it should also be noted that most studies evaluated in this systematic review came from high- and middle-income countries. Given that low income countries often face heightened risks of disasters, strategies to increase studies in these countries are required to provide evidence of the risks and impacts for the design and development of risk management strategies and the associated investments.

5. Conclusion

Our findings, based on 28 studies identified through the systematic database searching, highlighted that the health impacts of most major disasters may persist over months/years regardless of event types and health outcomes. According to the World Health Organization's conceptual framework for the social determinants of health, we identified a total of 35 themes across the three conceptual domains (determinants related to the socio-economic and political context, structural determinants, and intermediate determinants) as potentially influencing disaster impact on health. More dedicated investment should focus on modifiable underlying determinants of health/vulnerability, which could enable disaster risk management to be effective, improve medium and long-term health outcomes from disasters, and build strong community resilience.

Contributors

SN, JA, and SH initiated and oversaw the project. All authors were responsible for the study concept and design. SN acquired the data. SN, AP, MH, RK, and YL conducted the independent study screening and data extraction. The manuscript drafted by SN was discussed and critically revised by JA, and SH. SH gave administrative and technical support, and supervision. All authors approved the final draft of the manuscript.

Funding

This study was in part supported by Department of Global Health Policy, The University of Tokyo, Japan. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. No additional external funding was received for this study.

Conflict of interest

We declare that we have no conflict of interests.

Acknowledgements

We would like to express our gratitude to The Cochrane Collaboration's Evidence Aid staffers for their useful and constructive recommendations on the study concept, and Mr. Tim Reeves for the assistance in database searching. We are also grateful for the assistance given by Mr. Jonathan Abrahams, Dr. Elena Chekmeneva, Ms. Natalia Przysiezna, Mr. Christophe Stevens, Ms. Tina Johnson, Mr. Hakim-Moulay Dehbi, and Ms. Monika Bednarek in the screening and data extraction processes for non-English papers, and Prof. Virginia Murray and Dr. Nathalie Röbbel in the identification of additional references. We would like to offer our special thanks to Prof. Kenji Shibuya. Without his sincere help and guidance, our study could not have reached its present form.

Appendix

See Table Tables A.1–A.7.

Table A.1
Search strategy for article selection on PubMed in August 7th, 2014.

Step	Search term
#1	"Social Determinants of Health"[MeSH] OR "social determinants of health" OR "social health determinants" OR "Socioeconomic Factors"[MeSH] OR "socioeconomic factors" OR "socioeconomic status" OR "socio economic factors" OR "socio economic status" OR "socioeconomics" OR "socio economics" OR " social economics" OR "social support" OR "social supports" OR "Social Conditions"[MeSH] OR "social condition" OR "social conditions" OR "social interaction" OR "social interactions" OR "Social Class"[MeSH] OR "social class" OR "social classes" OR "social mobility" OR "social mobilities" OR "Social Environment"[MeSH] OR "social environment" OR "social environments" OR "Educational Status"[MeSH] OR "educational status" OR "educational achievement" OR "educational achievements" OR literacy[tiab] OR "low income populations" OR "low income population" OR "Vulnerable populations" [Mesh] OR "vulnerable populations" OR "vulnerable population" OR "sensitive populations" OR "sensitive population" OR "Disadvantaged"[tiab] OR "Family Characteristics"[MeSH] OR "family characteristics" OR "marital status"[tiab] OR "Social Welfare"[MeSH] OR "social welfare" OR "elderly"[tiab] OR "Schools"[MeSH] OR schools[tiab] OR school[tiab]
#2	"Control Groups"[MeSH] OR "control group" OR "control groups" OR "control population" OR "control populations" OR "comparative"[tiab] OR "comparison"[tiab] OR "non-exposed"[tiab] OR "un-exposed"[tiab] OR "Cross-Cultural Comparison"[MeSH] OR "Cross-Cultural Comparison" OR "Cross-Cultural Comparisons" OR "reference group" OR "reference groups" OR "reference population" OR "reference populations" OR "pre and post" OR "before and after"
#3	"tsunami"[tiab] OR "tsunamis"[tiab] OR "Earthquakes"[MeSH] OR "earthquake"[tiab] OR "earthquakes"[tiab] OR "nuclear accident" OR "nuclear incident" OR "nuclear accidents" OR "nuclear incidents" OR "chemical hazard"[tiab] OR "chemical hazards"[tiab] OR"biological hazard"[tiab] OR "biological hazards"[tiab] OR "radiological hazard"[tiab] OR "radiological hazards"[tiab] OR "Landslides"[MeSH] OR "landslides"[tiab] OR "landslide"[tiab] OR "Floods"[MeSH] OR "flood"[tiab] OR "floods"[tiab] OR "Cyclonic Storms"[MeSH] OR "cyclone"[tiab] OR "cyclones"[tiab] OR "hurricane"[tiab] OR "hurricanes"[tiab] OR "typhoon"[tiab] OR "typhoons"[tiab] OR "volcanic"[tiab] OR "eruption"[tiab] OR "extreme temperature"[tiab] OR "extreme temperatures"[tiab] OR "heat wave"[tiab] OR "heat waves"[tiab] OR "cold wave"[tiab] OR "cold waves"[tiab] OR "wild fire"[tiab] OR "wild fires"[tiab] OR "Droughts"[MeSH] OR "drought"[tiab] OR "droughts"[tiab] OR "Epidemics"[MeSH] OR "epidemics"[tiab] OR "Pandemics"[MeSH] OR "pandemics"[tiab] OR "power outage"[tiab] OR "power outages"[tiab] OR "water disruption"[tiab] OR "water disruptions"[tiab] OR "water supply disruption"[tiab] OR "water supply disruptions"[tiab] OR "mass gathering"[tiab] OR "mass gatherings"[tiab] OR "displaced population"[tiab] OR "displaced populations"[tiab]
#4	#1 AND #2
#5	#3 AND #4

Table A.2
Search strategy for article selection on MEDLINE in August 29th, 2014.

Step	Search term
#1	(social determinants of health OR social health determinants OR socioeconomic factors OR socioeconomic status OR socio economic factors OR socio economic status OR socioeconomics OR socio economics OR social economics OR social support? OR social condition? OR social interaction? OR social class$ OR social mobility$ OR social environment? OR educational status OR educational achievement? OR literacy OR low income population? OR vulnerable population? OR sensitive population? OR Disadvantaged OR family characteristics OR marital status OR social welfare OR elderly OR school?).ti,ab.
#2	"Social Determinants of Health"/ OR Socioeconomics/ OR Social status/ OR Social Class/ OR Social Environment/ OR Educational Status/ OR Family size/ OR Social Welfare/ OR Schools/ OR Vulnerable populations/
#3	(control group? OR control population? OR comparative OR comparison OR non-exposed OR un-exposed OR Cross-Cultural Comparison? OR reference group? OR reference population? OR (pre adj2 post) OR (before adj2 after)).ti,ab.
#4	Control Group/ OR Cultural factor/
#5	(tsunami? OR earthquake? OR nuclear accident? OR nuclear incident? OR chemical hazard? OR biological hazard? OR radiological hazard? OR landslide? OR flood? OR cyclone? OR hurricane? OR typhoon? OR volcanic OR eruption OR extreme temperature? OR heat wave? OR cold wave? OR wild fire? OR drought? OR epidemics OR pandemics OR power outage? OR water disruption? OR water supply disruption? OR mass gathering? OR displaced population?).ti,ab.
#5	Earthquake/ OR Landslide/ OR Flooding/ OR Hurricane/ OR Drought/ OR Epidemic/ OR Pandemic/
#6	#1 OR #2
#7	#3 OR #4
#8	#5 OR #6
#9	#6 OR #7 OR #8

Table A.3
Search strategy for article selection on POPLINE in August 29th, 2014

Step	Search term
#1	Title= (tsunami OR earthquake OR "nuclear accident" OR "nuclear incident" OR "chemical hazard" OR"biological hazard" OR "radiological hazard" OR landslide OR flood OR cyclone OR hurricane OR typhoon OR volcanic OR eruption OR "extreme temperature" OR "heat wave" OR "cold wave" OR "wild fire" OR drought OR epidemics OR pandemics OR "power outage" OR "water disruption" OR "water supply disruption" OR "mass gathering" OR "displaced population")

Table A.4
Search strategy for article selection on LILACS in August 29th, 2014.

Step	Search term
#1	Words= ((social determinants) OR (social health determinants) OR (socioeconomic factors) OR (socioeconomic status) OR (socio economic factors) OR (socio economic status) OR socioeconomics OR (socio economics) OR (social economics) OR (social support) OR (social condition) OR (social interaction) OR (social class) OR (social mobility) OR (social environment) OR (educational status) OR (educational achievement) OR literacy OR (low income population) OR (vulnerable population) OR (sensitive population) OR Disadvantaged OR (family characteristics) OR (marital status) OR (social welfare) OR elderly OR school)
#2	Words= ((control group) OR (control population) OR comparative OR comparison OR (non-exposed) OR (un-exposed) OR (Cross-Cultural Comparison) OR (reference group) OR (reference population) OR (pre and post) OR (before and after))
#3	Abstract words= (tsunami OR earthquake OR (nuclear accident) OR (nuclear incident) OR (chemical hazard) OR (biological hazard) OR (radiological hazard) OR landslide OR flood OR cyclone OR hurricane OR typhoon OR volcanic OR eruption OR (extreme temperature) OR (heat wave) OR (cold wave) OR (wild fire) OR drought OR epidemics OR pandemics OR (power outage) OR (water disruption) OR (water supply disruption) OR (mass gathering) OR (displaced population))
#4	#1 AND #2 AND #3

Table A.5
Search strategy for article selection on CINAHL in August 29th, 2014

Step	Search term
#1	("social determinants of health" OR "social health determinants" OR "socioeconomic factors" OR "socioeconomic status" OR "socio economic factors" OR "socio economic status" OR socioeconomics OR "socio economics" OR "social economics" OR "social support*" OR "social condition*" OR "social interaction*" OR "social class*" OR "social mobility*" OR "social environment*" OR "educational status" OR "educational achievement*" OR literacy OR "low income population*" OR "vulnerable population*" OR "sensitive population*" OR Disadvantaged OR "family characteristics" OR "marital status" OR "social welfare" OR elderly OR school*).ti,ab.
#2	Social Determinants of Health/ OR Socioeconomic Factors/ OR Social Class/ OR Social Environment/ OR Educational Status/ OR Family Characteristics/ OR Social Welfare/ OR Schools/
#3	("control group*" OR "control population*" OR comparative OR comparison OR "non-exposed" OR "un-exposed" OR "Cross-Cultural Comparison*" OR "reference group*" OR "reference population*" OR "pre and post" OR "before and after").ti,ab.
#4	Control Group/
#5	(tsunami* OR earthquake* OR "nuclear accident*" OR "nuclear incident*" OR "chemical hazard*" OR"biological hazard*" OR "radiological hazard*" OR landslide* OR flood* OR cyclone* OR hurricane* OR typhoon* OR volcanic OR eruption OR "extreme temperature*" OR "heat wave*" OR "cold wave*" OR "wild fire*" OR drought* OR epidemics OR pandemics OR "power outage*" OR "water disruption*" OR "water supply disruption*" OR "mass gathering*" OR "displaced population*").ti,ab.
#6	Natural disasters/ OR Disease outbreaks/
#7	#1 OR #2
#8	#3 OR #4
#9	#5 OR #6
#10	#7 AND #8 AND #9

Table A.6
Search strategy for article selection on PsycINFO in August 29th, 2014

Step	Search term
#1	((social determinants of health OR social health determinants OR socioeconomic factors OR socioeconomic status OR socio economic factors OR socio economic status OR socioeconomics OR socio economics OR social economics OR social support? OR social condition? OR social interaction? OR social class$ OR social mobility$ OR social environment? OR educational status OR educational achievement? OR literacy OR low income population? OR vulnerable population? OR sensitive population? OR Disadvantaged OR family characteristics OR marital status OR social welfare OR elderly OR school?).ti,ab.
#2	Socioeconomic Status/ OR Social Class/ OR Social Environments/ OR Educational attainment status/ OR Schools/)
#3	((control group? OR control population? OR comparative OR comparison OR non-exposed OR un-exposed OR Cross-Cultural Comparison? OR reference group? OR reference population? OR (pre adj2 post) OR (before adj2 after).ti,ab.
#4	Cross-Cultural differences/
#5	((tsunami? OR earthquake? OR nuclear accident? OR nuclear incident? OR chemical hazard? OR biological hazard? OR radiological hazard? OR landslide? OR flood? OR cyclone? OR hurricane? OR typhoon? OR volcanic OR eruption OR extreme temperature? OR heat wave? OR cold wave? OR wild fire? OR drought? OR epidemics OR pandemics OR power outage? OR water disruption? OR water supply disruption? OR mass gathering? OR displaced population?).ti,ab.
#6	Natural disasters/ OR Epidemics/ OR Pandemics/)
#7	#1 OR #2
#8	#3 OR #4
#9	#5 OR #6
#10	#7 AND #8 AND #9

Table A.7
Themes that emerged related to the socio-economic and political context, structural, and intermediate domains, by outcomes and type of evidence (*Quantitative*/*Descriptive*/*Citations from relevant literatures*).

Domain level and Outcome	Themes as proxy indicators of the potential social determinants of the disaster impacts on health
Domain 1: Socio-economic and political context	
Outcome: Mortality (two themes)	[Insurance system] *Descriptive*: Peoples Health (a health insurance career) contacted its enrolees who were displaced after the hurricane and assured out-of-network providers (i.e., those who were not part of the enrolees' preferred healthcare providers) of payment, which might make it easy for the displaced individuals to access to care and have attenuated worse health consequences. [Hurricane_Burton et al. 2009] [Insufficient evacuation policy] *Descriptive*: Insufficient nuclear incident response, such as, not-appropriate evacuation means and low preparedness at evacuation places, might be associated with the increased mortality in elderly people. [Earthquake, Tsunami and Nuclear incident_Nomura et al. 2013]
Outcome: Mental and behavioural disorders (three themes)	[National and international societal attention] *Descriptive*: As of external support systems in emergency settings, the area of Armenia, Colombia, is a focus of national and international attention. This situation might give the earthquake victims a sense of optimism and reduced their sense of helplessness. [Earthquake_Scott et al. 2003] [Public security] *Descriptive*: Adolescents may have been commonly exposed to situations of violence and aggression, which might desensitize them to catastrophic stress from the earthquake. [Earthquake_Scott et al. 2003] [Public security] *Citations from relevant literatures*: Miler et al. (1994) suggested that repeated traumatic events often permit individuals to recuperate from disaster, leading to less post-disaster psychopathology [54]. [Earthquake_Scott et al. 2003] [Cultural mentality] *Descriptive*: After the nuclear incident, some caregivers from the affected areas reported that they felt guilty because they left their professional position, which led to a shortage of manpower in the affected area. This mentality might be one of the potential reasons of the delayed recovery from the post-incident stress. [Earthquake, Tsunami and Nuclear incident_Sawa et al. 2013]
Outcome: Nutritional diseases (one theme)	[Policy for vitamin A supplementation] *Quantitative*: The odds ratio of severe malnutrition of post- and pre-flood period among children who had vitamin A supply was 1.74, and for those who were not supplied vitamin A, it was 3.52, showing a substantial difference by the intake of Vitamin A [Flood_Choudhury et al. 1993]
Domain 2. Structural determinants	
Outcome: Mortality (two themes)	[Age and Gender] *Quantitative*: The mortality risks of the earthquake were somewhat inconsistent. The mortality significantly increased only in males over 45 years of age in the 3rd and 7th month after the earthquake, while the mortality decreased after the earthquake for residents of all age groups and females over 45 years of age. [Earthquake_Chan et al. 2003] [Age] *Quantitative*: The relative risk of a 1-year increase in age to the incidence of death was 1.11 (95% CI: 1.10–1.11) for those who died before the hurricane and 1.02 (95% CI: 1.02–1.03) for those who died after the hurricane. This difference might indicate that the relative risk of mortality due to age alone was slightly lower following the hurricane after adjusting for sex and race/ethnicity. [Hurrican_Burton et al. 2009]
Outcome: Mental and behavioural disorders (six themes)	[Age] *Quantitative*: After the earthquake, psychological distress levels, measured in GHQ-12 scale, were increased with increasing age of people ($p < 0.001$) at five months after the earthquake, while no difference between age groups in GHQ-12 score before the earthquake was observed. This result indicated that age might be a determinant influencing the earthquake impact on the psychological distress. [Earthquake_Toyabe et al. 2006] [Age] *Descriptive*: After the earthquake, the near-elderly were more likely to be providing financial and other types of support to their children and relatives, and thus, to be facing financial challenges at an impending retirement, which might lead to more disaster induced psychological distress than the elderly. [Earthquake_Seplaki et al. 2006] [Age] *Citations from relevant literatures*: Some studies suggested that although post-disaster psychological stress may decline gradually as time passes, some vulnerable groups such as the elderly people with severe housing damage may be at a risk of prolonged psychological disorders [55–57]. [Earthquake_Chiu et al. 2002] [Age and Gender] *Quantitative*: In young population, males were more likely to maintain higher post-fire incident stress scores whereas in the older population group, female was a risk factor. [Fire_Van Loey et al. 2012] [Age and Gender] *Quantitative*: Although both earthquake-exposed female and male had significantly higher TALS-SR scores than non-exposed subjects, female were more likely to have the higher post-earthquake scores than men ($p < 0 \cdot 001$). Age differences in the scores only emerged among women ($p = 0.003$). [Earthquake_Dell'Osso et al. 2013] [Age and Gender] *Citations from relevant literatures*: Past studies suggested that elderly and females and subjects exposed to the earthquake are at higher risk for development of psychological distress [58–61]. [Earthquake_Toyabe et al. 2006] [Age and Marital status] *Quantitative*: All the three age groups (17–0, 31–55, and 56+) increased the depression levels after the earthquake, but among the three groups, those who were aged 31–55 and were either single, widowed, or divorced had the highest post-earthquake depression level followed by the single, widowed, or divorced elderly people aged over 55. Meanwhile, in the married group, it was the younger group aged 17–30 that had the highest depression level followed by those aged 31–55. [Earthquake_Toukmanian et al. 2000] [Gender] *Quantitative*: In children, males had significantly higher post-earthquake depression level than females after the earthquake ($p = 0.02$). [Earthquake_Kolaitis et al. 2003] [Gender] *Quantitative*: Women had a significantly higher post-earthquake depression levels than men. [Earthquake_Toukmanian et al. 2000] [Gender] *Quantitative*: Women had significantly higher post-earthquake CES-D scores than men, after adjusted for pre-earthquake CES-D scores, pre-earthquake health status, experience levels and socio-demographic factors ($p < 0.05$). [Earthquake_Seplaki et al. 2006] [Gender] *Quantitative*: For both the target and control group, there were no significant correlations between PTSD prevalence and gender ($p = 0.44$, and $p = 0.21$, respectively). [Earthquake_Kadri et al. 2006] [Gender] *Citations from relevant literatures*: Olff et al. (2007) suggested that female gender is a risk factor for post traumatic stress after disasters [62]. [Fire_Van Loey et al. 2012] [Gender] *Citations from relevant literatures*: Past reports suggested that women were more likely to have higher depression level than men after the disaster [63,64]. [Earthquake_Toukmanian et al. 2000] [Gender and Education] *Quantitative*: Female and low education were significantly associated with higher levels of post-tsunami PTSD symptoms (both for $p < 0.001$). [Tsunami_Heir et al. 2011] [Immigrant background] *Quantitative*: Immigrant children had significantly higher post-earthquake CDI scores compared to the native children ($p = 0.001$). The immigrant children also had significantly higher levels of symptoms related to "social phobia", measure in the SCARED scale ($p = 0.029$). [Earthquake_Kolaitis et al. 2003]

Table A.7 (*continued*)

Domain level and Outcome	Themes as proxy indicators of the potential social determinants of the disaster impacts on health
	[Social class and Income] *Quantitative*: Higher levels of social or economic status were associated with lower post-earthquake CES-D scores. Specifically, the higher an individual's subjective assessment of his/her relative social position ($p < 0.01$), individual's income ($p < 0.05$), or number of social ties ($p < 0.01$), the lower the depression levels. Similarly, individuals who had difficulty in meeting post-earthquake expenses had higher CES-D scores than those who did not experience the financial problems ($p < 0.01$). [Earthquake_Seplaki et al. 2006] [Other than education, income, and employment] *Quantitative*: After the earthquake, residents in highly affected areas had less education, lower income, and lower employment, and they lived in cheaper housing; however, these measured differences could be removed after adjustment, indicating that the higher Davidson Trauma Scale scores in the exposed-group might be explained by other factors. [Earthquake_Zubizarreta et al. 2013]
Outcome: Diseases of the circulatory system (one theme)	[Age] *Quantitative*: Only the elderly had a significant increase in the frequency of hospital admissions after the earthquake ($p < 0.01$). [Earthquake_Sofia et al. 2012]
Outcome: Biometric data (one theme)	[Occupation] *Descriptive*: After the nuclear incident, while local company employees resumed their jobs after their companies could recover their workplace, fishing and farming families could not restart their jobs due to concerns of radiation contamination. This difference of occupation and resulting employment status might be associated with the changes in health screening variables. [Earthquake, Tsunami and Nuclear incident_Tsubokura et al. 2013]
Domain 3. Intermediate determinants	
Outcome: Mortality (four themes)	[Displacement and Change in diet] *Descriptive*: The increase of earthquake-induced CHD death might be attributed to drastic changes in their lifestyle after the earthquake. Many had to abandon their homes and live in shelters, and the composition of their diet also drastically changed. [Earthquake_Kario et al. 1997] [Financial loss and Social disruption] *Descriptive*: Financial loss and social network disruption due to the earthquake might cause psychological stress, resulting in increased long-term mortality fro AMI. [Earthquake_Nakagawa et al. 2009]
Outcome: Suicide (one theme)	[Financial aid] *Descriptive*: Temporary financial aid from the government might contribute to the decrease of the earthquake impact on suicide. [Earthquake_Hyodo et al. 2010]
Outcome: Mental and behavioural disorders (nine themes)	[Community support] *Descriptive*: The community empowerment and companionship between the survivors of the fire increased social support, which might reduce their post-accident stress levels. [Fire_Van Loey et al. 2012] [Displacement] *Quantitative*: The experience of having to leave one's house was associated only with the increased post-earthquake arousal scale of HTQ in adult. [Earthquake_Bodvarsdottir et al. 2004] [Displacement and Loss of family members] *Quantitative*: Post-earthquake displacement and death of a family member were not significantly associated with the CES-D score. [Earthquake_Seplaki et al. 2006] [Experience of life threat] *Quantitative*: Those who experienced life threat during the tsunami, including loss or severe injury significantly increased the depression level after adjusted for demographic characteristics ($p < 0.001$). [Tsunami_Wahlstrom et al. 2009] [Insufficient litigation] *Descriptive*: The litigation process for the cafe´ fire was completed within the study period and the survivors of the cafe´ fire received financial compensation, while this process had not even started for the industrial fire, indicating that lingering litigation proceedings and resulting financial problems might be associated with the persistence of PTSD. [Fire_Van Loey et al. 2012] [Insufficient litigation] *Citations from relevant literatures*: Hickling et al. (1999) and Mayou et al. (2002) suggested that lingering litigation proceedings after an accident might cause the persistence of PTSD [65,66]. [Fire_Van Loey et al. 2012] [Living in a temporary housing without family, Property loss and Loss/injuries of family members or loved ones] *Descriptive*: The caregivers from Fukushima had to live in temporary apartments without their families. In addition, some caregivers evacuated from Fukushima prefecture lost their houses, loved ones, and had injured family members. These situations caused delayed recovery from stress. [Earthquake, Tsunami and Nuclear incident_Sawa et al. 2013] [Living in a temporary housing and Living without family] *Citations from relevant literatures*: Kuwabara et al. (2008) suggested that living with unfamiliar people and staying in a temporary housing might be associated with an impaired post-disaster psychological recovery [67]. [Earthquake, Tsunami and Nuclear incident_Sawa et al. 2013] [Post-disaster psychosocial aftercare] *Descriptive*: Two days after the cafe´ fire, the local authorities initiated a long-term psychosocial aftercare. Meanwhile, the needs for a regular psychosocial aftercare were not met in the industrial fire survivors. As a result, 42% of the industrial fire survivors did not return to work at 12 months after the event. This fact may suggest that the unmet-aftercare might be associated with the persistence of PTSD. [Fire_Van Loey et al. 2012] [Property damage] *Quantitative*: Damage to one's property was associated with the increased post-earthquake HTQ score in adult. [Earthquake_Bodvarsdottir et al. 2004] [Property damage] *Quantitative*: Children whose families had property damage (besides damage to the house) after the earthquake scored significantly higher in the CDI scale than those who did not have property damage ($p = 0.02$). [Earthquake_Kolaitis et al. 2003] [Property damage] *Quantitative*: Those who reported that their house was damaged in the earthquake had the higher CES-D scores than those reporting no damage after adjusted for demographic characteristics ($p < 0.05$). [Earthquake_Seplaki et al. 2006] [Property damage] *Citations from relevant literatures*: Some studies suggested that although post-disaster psychological stress may decline gradually as time passes, some vulnerable groups such as the elderly people with severe housing damage may be at a risk of prolonged psychological disorders [55–57]. [Earthquake_Chiu et al. 2002] [Social support/attention] *Descriptive*: Students who were severely exposed to the earthquake received more public attention and had more social resources and supports, resulting in that the trauma did not have severe affects compared to students exposed to mild earthquake. [Earthquake_Li et al. 2011]
Outcome: Diseases of the circulatory system (six themes)	[Loss of job, Smoking, Substance abuse, Living in a temporary housing, Lack of health insurance] *Quantitative*: After the hurricane there observed a significantly higher prevalence of unemployment (13% vs. 2%, $p = 0.0003$), smoking (58.1% vs. 39.3%, $p = 0.001$), substance abuse (15.4% vs. 6.7%, $p = 0.03$), people living in temporary housing (15.8% vs. 1.3%, $p = 0.0001$), and a lack of medical insurance (18.3% vs. 6.0%, $p = 0.0001$), than before the hurricane. These may reflect a change in the local population behaviour and health practices, resulting in the increased hospital admission rate due to AMI. [Hurricane_Gautam et al. 2009] [Loss of job, Lack of health insurance and Smoking] *Quantitative*: After the hurricane, unemployment rate and uninsured rate increased from 2.0% to 15.3% ($p = 0.0001$) and from 6.0% to 15.6% ($p = 0.001$), respectively. Smoking rates also increased from 39.3% to 56.9% ($p < 0.01$). These situations might contribute to the increased rate of AMI after the

Table A.7 (*continued*)

Domain level and Outcome	Themes as proxy indicators of the potential social determinants of the disaster impacts on health
	hurricane. [Hurricane_Jiao et al. 2012] [Smoking and Alcohol consumption] *Citations from relevant literatures*: Hamer et al. (2008) suggested that the association between psychological distress and cardiovascular disease risk might be largely explained by behavioural processes such as smoking, alcohol intake, and sedentary lifestyle [68]. [Hurricane_Gautam et al. 2009]
Outcome: Certain infectious and parasitic diseases (one theme)	[Living without family] *Descriptive*: There were still a sizeable number of students who were not living with their parents 15 months after the hurricane, and lived with neighbours with whom they may not feel socially connected. This might result in poor health care situations, leading to the increased infection of Gonorrhoea. [Hurricane_Nsuami et al. 2009]
Outcome: Biometric data (six themes)	[Insufficient food supply and Change in diet] *Descriptive*: Fresh foods, such as vegetables and fish were short supply after the disasters, and hence, refugees mostly subsisted on preserved foods, including sweets, pastries, canned products, cup noodles and boil-in-the-bag foods. Therefore, such the inappropriate diet in refuge life might affect blood pressure control through, e.g., an increased salt intake via instant noodles. Although medical supplies returned to pre-disaster levels three months after the disasters, utility services, such as, power, water and gas had not reached the pre-disaster levels, and therefore, the food-supply situation had still not completely recovered and it was difficult to ensure that refugees stuck to proper diet, which might influence their health condition. [Earthquake and Tsunami_Ogawa et al. 2012] [Insufficient sanitation] *Citations from relevant literatures*: Kumar et al. (2007), Ramachandra et al. (2006) and Prueksaritanond et al. (2007) demonstrated that women were more likely to develop blood pressure elevation after the earthquake because of the earthquake-induced stress due to the challenges of ensuring a hygienic environment, toilets, bathing, and supplies of female sanitary products [69–71]. [Earthquake and Tsunami_Ogawa et al. 2012] [Change of attending doctor] *Descriptive*: Four months after the disasters, medical supplies were already available in sufficient quantities in the affected areas, but due to the changes in the living environment, patients might have been examined by a physician other than their attending doctor, and been prescribed different less effective drugs, which might influence the post-disaster health condition. [Earthquake and Tsunami_Ogawa et al. 2012] [Change in exercise and Change in diet] *Citations from relevant literatures*: As Miller et al. (2002) and Garber et al. (2011) suggested, changes in exercise and meals in daily lives after the disasters might be associated with the change in Biometric data [72,73]. [Earthquake, Tsunami and Nuclear incident_Tsubokura et al. 2013] [Loss of medical records] *Descriptive*: Medical records of patients in the affected group were swept away by the tsunami as well as patient information previously stored in the hospital. This situation made it impossible to resume the same treatment they had received before the disasters, which might drastically worsen their glycaemic and blood pressure control. [Earthquake and Tsunami_Ogawa et al. 2012]

* Burton et al. (2009) studied a post-disaster 'morbidity', but it was not counted in any of the health outcomes in this table because of its broad scope.

References

[1] UNISDR, Opening statement by the secretary-general of the United Nations. Paper presented at: Proceedings of the Third Session of the Global Platform for Disaster Risk Reduction and World Reconstruction Conference 2011, Geneva.
[2] UNISDR, Official statements, Paper presented at: Proceedings of the Forth Session of the Global Platform for Disaster Risk Reduction and World Reconstruction Conference 2013, Geneva.
[3] World Bank, United Nations, Natural Hazards, Unnatural Disasters: The Economics of Effective Prevention, World Bank, Washington, D.C., 2010.
[4] M.E. Kahn, The death toll from natural disasters: the role of income, geography, and institutions, Rev. Econ. Statistics 87 (2) (2005) 271–284.
[5] V. Murray, Disaster risk reduction, health, and the post-2015 United nations landmark agreements, Dis. Med. Public Health Prep. 8 (4) (2014) 283–287.
[6] UNISDR, Development of the Post-2015 Framework for Disaster Risk Reduction: Zero Draft Submitted by the Co-chairs of the Preparatory Committee (20 October 2014), United Nations International Strategy for Disaster Reduction, Geneva, 2014.
[7] J. Padli, M.S. Habibullah, Natural Disaster Death and Socio-economic Factors in Selected Asian countries: A Panel Data Analysis, University Library of Munich, Munich, 2008.
[8] WHO, Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health : Commission on Social Determinants of Health Final Report, World Health Organization, Commission on Social Determinants of Health, Geneva, 2008.
[9] P.A. Raschky, Institutions and the losses from natural disasters, Nat. Hazards Earth Syst. Sci. 8 (4) (2008) 627–634.
[10] H. Toya, M. Skidmore, Economic development and the impacts of natural disasters, Econ. Lett. 94 (2007) 20–25.
[11] T.N. Rasmussen, Macroeconomic Implications of Natural Disasters in the Caribbean, International Monetary Fund, Washington, D.C, 2004.
[12] J.M. Albala-Bertrand, The Political Economy of Large Natural Disasters: With Special Reference to Developing Countries, Clarendon Press, United Kingdom, 1993.
[13] G.A. Parvin, R. Shaw, Microfinance institutions and a coastal community's disaster risk reduction, response, and recovery process: a case study of Hatiya, Bangladesh, Disasters 37 (1) (2013) 165–184.
[14] WHO, Emergency Response Framework (ERF), World Health Organiation, Geneva, 2013.
[15] O. Solar, A. Irwin, A conceptual framework for action on the social determinants of health. Social Determinants of Health Discussion Paper 2 (Policy and Practice), World Health Organization, Geneva, 2010.
[16] Cochrane handbook for dystematic reviews of interventions, in: J. Higgins, S. Green, (Eds.) Oxford: The Cochrane Collaboration, 2011: ⟨http://www.cochrane-handbook.org⟩.
[17] J Popay, H. Roberts, A. Sowden, et al., Guidance on the conduct of narrative synthesis in systematic Reviews. A Product from the ESRC Methods Programme Version 1, Economic and Social Research Council, Swindon, 2006.
[18] T.T. Hung, V.C. Chiang, A. Dawson, R.L. Lee, Understanding of factors that enable health promoters in implementing health-promoting schools: a systematic review and narrative synthesis of qualitative evidence, PloS One 9 (9) (2014) e108284.
[19] C. Schneider, A. Mohsenpour, S. Joos, K. Bozorgmehr, Health status of and health-care provision to asylum seekers in Germany: protocol for a systematic review and evidence mapping of empirical studies, Syst. Rev. 3 (2014) 139.
[20] E. Owusu-Addo, R. Cross, The impact of conditional cash transfers on child health in low- and middle-income countries: a systematic review, Int. J. Public Health 59 (4) (2014) 609–618.
[21] D.F. Stroup, J.A. Berlin, S.C. Morton, et al., Meta-analysis of observational studies in epidemiology: a proposal for reporting. Meta-analysis of observational studies in epidemiology (MOOSE) group, J. Am. Med. Assoc. 283 (15) (2000) 2008–2012.
[22] D. Moher, A. Liberati, J. Tetzlaff, D.G. Altman, P. Group, Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement, PLoS Med. 6 (7) (2009) e1000097.
[23] S. Ogawa, M. Ishiki, K. Nako, et al., Effects of the Great East Japan Earthquake and huge tsunami on glycaemic control and blood pressure in patients with diabetes mellitus, BMJ Open 2 (2) (2012) e000830.
[24] S. Nomura, S. Gilmour, M. Tsubokura, et al., Mortality risk amongst nursing home residents evacuated after the Fukushima nuclear accident: a retrospective cohort study, PloS One 8 (3) (2013) e60192.
[25] M. Sawa, Y. Osaki, H. Koishikawa, Delayed recovery of caregivers from social dysfunction and psychological distress after the Great East Japan Earthquake, J. Affect. Dsord. 148 (2–3) (2013) 413–417.
[26] M. Tsubokura, M. Takita, T. Matsumura, et al., Changes in metabolic profiles after the Great East Japan Earthquake: a retrospective observational study, BMC Public Health 13 (2013) 267.
[27] L.C. Burton, E.A. Skinner, L. Uscher-Pines, et al., Health of Medicare Advantage plan enrollees at 1 year after Hurricane Katrina, Am. J. Managed Care 15 (1) (2009) 13–22.
[28] R.L. Scott, R.L. Knoth, M. Beltran-Quiones, N. Gomez, Assessment of psychological functioning in adolescent earthquake victims in Colombia using the MMPI-A, J. Trauma Stress 16 (1) (2003) 49–57.
[29] A.Y. Choudhury, A. Bhuiya, Effects of biosocial variables on changes in nutritional status of rural Bangladeshi children, pre- and post-monsoon flooding, J. Biosoc. Sci. 25 (3) (1993) 351–357.
[30] S. Toyabe, T. Shioiri, H. Kuwabara, et al., Impaired psychological recovery in the elderly after the Niigata-Chuetsu Earthquake in Japan: a population-based study, BMC Public Health 6 (2006) 230.

[31] C.L. Seplaki, N. Goldman, M. Weinstein, Y.H. Lin, Before and after the 1999 Chi-Chi earthquake: traumatic events and depressive symptoms in an older population, Soc. Sci. Med. ((1982)) 62 (12) (2006) 3121–3132.
[32] T.Y. Chiu, W.Y. Hu, B.H. Lue, C.Y. Chen, B.S. Hsieh, Effects of a major earthquake on the status of pre-existing physical illness and levels of psychosocial distress in community inhabitants, J. Formos. Med. Assoc.=Taiwan yi zhi 101 (5) (2002) 322–328.
[33] L. Dell'Osso, C. Carmassi, G. Massimetti, et al., Age, gender and epicenter proximity effects on post-traumatic stress symptoms in L'Aquila 2009 earthquake survivors, J. Affect. Disord. 146 (2) (2013) 174–180.
[34] S.G. Toukmanian, D. Jadaa, D. Lawless, A cross-cultural study of depression in the aftermath of a natural disaster 2000/07/01, Anxiety, Stress, Coping 13 (3) (2000) 289–307.
[35] C.C. Chan, Y.P. Lin, H.H. Chen, T.Y. Chang, T.J. Cheng, L.S. Chen, A population-based study on the immediate and prolonged effects of the 1999 Taiwan earthquake on mortality, Ann. Epidemiol. 13 (7) (2003) 502–508.
[36] T. Heir, S. Rosendal, K. Bergh-Johannesson, et al., Tsunami-affected Scandinavian tourists: disaster exposure and post-traumatic stress symptoms, Nord. J. Psychiatry 65 (1) (2011) 9–15.
[37] N.E. Van Loey, R. van de Schoot, A.W. Faber, Posttraumatic stress symptoms after exposure to two fire disasters: comparative study, PloS One 7 (7) (2012) e41532.
[38] N. Kadri, S. Berrada, S. Douab, I. Tazi, D. Moussaoui, Post-traumatic stress disorder in survivors of the Agadir earthquake (Morocco) in 1960, L'Encephale 32 (2 Pt 1) (2006) 215–221.
[39] G. Kolaitis, J. Kotsopoulos, J. Tsiantis, et al., Posttraumatic stress reactions among children following the Athens earthquake of September 1999, Eur. Child Adolesc. Psychiatry 12 (6) (2003) 273–280.
[40] S. Gautam, J. Menachem, S.K. Srivastav, P. Delafontaine, A. Irimpen, Effect of Hurricane Katrina on the incidence of acute coronary syndrome at a primary angioplasty center in New Orleans, Dis. Med. Public Health Prep. 3 (3) (2009) 144–150.
[41] Z. Jiao, S.V. Kakoulides, J. Moscona, et al., Effect of Hurricane Katrina on incidence of acute myocardial infarction in New Orleans three years after the storm, Am. J. Cardiol. 109 (4) (2012) 502–505.
[42] K. Kario, T. Ohashi, Increased coronary heart disease mortality after the Hanshin-Awaji earthquake among the older community on Awaji Island. Tsuna Medical Association, J. Am. Geriatr. Soc. 45 (5) (1997) 610–613.
[43] China Earthquake Administration, Guidelines for grade evaluation of earthquake disaster areas (on trail), 2009.
[44] Li S-w, Yu H-y, Qian M-y, J. Gao, A comparative study on level of depression and PTSD severity between the earthquake severely-exposed and mildly-exposed middle school students, Chin. J. Clin. Psychol. 19 (1) (2011) 77–80.
[45] I. Bodvarsdottir, A. Elklit, Psychological reactions in Icelandic earthquake survivors, Scand. J. Psychol. 45 (1) (2004) 3–13.
[46] I. Nakagawa, K. Nakamura, M. Oyama, et al., Long-term effects of the Niigata-Chuetsu earthquake in Japan on acute myocardial infarction mortality: an analysis of death certificate data, Heart 95 (24) (2009) 2009–2013.
[47] K. Hyodo, K. Nakamura, M. Oyama, et al., Long-term suicide mortality rates decrease in men and increase in women after the Niigata-Chuetsu earthquake in Japan, Tohoku J. Exp. Med. 220 (2) (2010) 149–155.
[48] M.J. Nsuami, S.N. Taylor, B.S. Smith, D.H. Martin, Increases in gonorrhea among high school students following hurricane Katrina, Sex. Transm. Infect. 85 (3) (2009) 194–198.
[49] EM-DAT: the international disaster database. Centre for Research on the Epidemiology of Disasters, 2014. ⟨⟨http://www.emdat.be/advanced_search/index.html⟩⟩. Accessed (14.01.14).
[50] United Nations, 2015.
[51] A.W. Chan, D.G. Altman, Identifying outcome reporting bias in randomised trials on PubMed: review of publications and survey of authors, Br. Med. J. 330 (7494) (2005) 753.
[52] A.W. Chan, A. Hrobjartsson, M.T. Haahr, P.C. Gotzsche, D.G. Altman, Empirical evidence for selective reporting of outcomes in randomized trials: comparison of protocols to published articles, J. Am. Med. Assoc. 291 (20) (2004) 2457–2465.
[53] K.H. Jacobsen, Introduction to Health Research Methods, Jones Bartlett Learning, United States, 2011.
[54] T.M. Miller, R.F. Kraus, Natural and environmental disasters: psychological issues and clinical responses, Integr. Psychiatry 10 (1994) 128–132.
[55] A.K. Goenjian, L.M. Najarian, R.S. Pynoos, et al., Posttraumatic stress disorder in elderly and younger adults after the 1988 earthquake in Armenia, Am. J. Psychiatry 151 (6) (1994) 895–901.
[56] H. Nakamura, Overview of the Hanshin-Awaji earthquake disaster, Acta Paediatr. Jpn. 37 (6) (1995) 713–716.
[57] N. Tanida, What happened to elderly people in the great Hanshin earthquake, Br. Med. J. 313 (7065) (1996) 1133–1135.
[58] V.J. Carr, T.J. Lewin, R.A. Webster, J.A. Kenardy, A synthesis of the findings from the Quake Impact Study: a two-year investigation of the psychosocial sequelae of the 1989 Newcastle earthquake, Soc. Psychiatry Psych. Epidemiol. 32 (3) (1997) 123–136.
[59] V.J. Carr, T.J. Lewin, J.A. Kenardy, et al., Psychosocial sequelae of the 1989 Newcastle earthquake: III. Role of vulnerability factors in post-disaster morbidity, Psychol. Med. 27 (1) (1997) 179–190.
[60] V.J. Carr, T.J. Lewin, R.A. Webster, J.A. Kenardy, P.L. Hazell, G.L. Carter, Psychosocial sequelae of the 1989 Newcastle earthquake: II. Exposure and morbidity profiles during the first 2 years post-disaster, Psychol. Med. 27 (1) (1997) 167–178.
[61] R.A. Webster, R. McDonald, T.J. Lewin, V.J. Carr, Effects of a natural disaster on immigrants and host population, J. Nerv. Ment. Dis. 183 (6) (1995) 390–397.
[62] M. Olff, W. Langeland, N. Draijer, B.P. Gersons, Gender differences in post-traumatic stress disorder, Psychol. Bull. 133 (2) (2007) 183–204.
[63] G.L. Klerman, M.M. Weissman, Increasing rates of depression, J. Am. Med. Assoc. 261 (15) (1989) 2229–2235.
[64] J.W. Wetzel, Depression: women-at-risk, Social Work Health Care 19 (3–4) (1994) 85–108.
[65] E.J. Hickling, E.B. Blanchard, T.C. Buckley, A.E. Taylor, Effects of attribution of responsibility for motor vehicle accidents on severity of PTSD symptoms, ways of coping, and recovery over six months, J. Trauma Stress 12 (2) (1999) 345–353.
[66] R.A. Mayou, A. Ehlers, B. Bryant, Posttraumatic stress disorder after motor vehicle accidents: 3-year follow-up of a prospective longitudinal study, Behav. Res. Ther. 40 (6) (2002) 665–675.
[67] H. Kuwabara, T. Shioiri, S. Toyabe, et al., Factors impacting on psychological distress and recovery after the 2004 Niigata-Chuetsu earthquake, Japan: community-based study, Psychiatry Clin. Neurosci. 62 (5) (2008) 503–507.
[68] M. Hamer, G.J. Molloy, E. Stamatakis, Psychological distress as a risk factor for cardiovascular events: pathophysiological and behavioral mechanisms, J. Am. Coll. Cardiol. 52 (25) (2008) 2156–2162.
[69] M.S. Kumar, M.V. Murhekar, Y. Hutin, T. Subramanian, V. Ramachandran, M. D. Gupte, Prevalence of posttraumatic stress disorder in a coastal fishing village in Tamil Nadu, India, after the December 2004 tsunami, Am. J. Public Health 97 (1) (2007) 99–101.
[70] A. Ramachandran, C. Snehalatha, A. Yamuna, et al., Stress and undetected hyperglycemia in southern Indian coastal population affected by tsunami, J. Assoc. Physicians India 54 (2006) 109–112.
[71] S. Prueksaritanond, R. Kongsakol, Biopsychosocial impacts on the elderly from a tsunami-affected community in southern Thailand, J. Med. Assoc. Thailand=Chotmaihet thangphaet 90 (8) (2007) 1501–1505.
[72] E.R. Miller 3rd, T.P. Erlinger, D.R. Young, et al., Results of the diet, exercise, and weight Loss Intervention Trial (DEW-IT), Hypertension 40 (5) (2002) 612–618.
[73] C.E. Garber, B. Blissmer, M.R. Deschenes, et al., American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise, Med. Sci. Sports Exercise 43 (7) (2011) 1334–1359.
[74] J.R. Zubizarreta, M. Cerda, P.R. Rosenbaum, Effect of the 2010 Chilean earthquake on posttraumatic stress: reducing sensitivity to unmeasured bias through study design, Epidemiology 24 (1) (2013) 79–87.
[75] L. Wahlstrom, H. Michelsen, A. Schulman, M. Backheden, Psychological distress and sick leave in Swedish survivors of the 2004 tsunami: a comparison with a population sample, J. Nerv. Ment. Dis. 197 (12) (2009) 918–922.
[76] S. Sofia, A. Melone, L. Manzoli, et al., Cardiovascular and cerebrovascular events pre- and post-earthquake of 6 April 2009: the Abruzzo's experience, Am. J. Hypertens. 25 (5) (2012) 556–560.