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# Physical and psychological challenges faced by military, medical and public safety personnel relief workers supporting natural disaster operations: a systematic review

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## Abstract

Natural disasters, including floods, earthquakes, and hurricanes, result in devastating consequences at the individual and community levels. To date, much of the research reflecting the consequences of natural disasters focuses heavily on victims, with little attention paid to the personnel responding to such disasters. We conducted a systematic review of the challenges faced by military, medical and public safety personnel supporting natural disaster relief operations. Specifically, we report on the current evidence reflecting challenges faced, as well as positive outcomes experienced by military, medical and public safety personnel following deployment to natural disasters. The review included 382 studies. A large proportion of the studies documented experiences of medical workers, followed by volunteers from humanitarian organizations and military personnel. The most frequently reported challenges across the studies were structural (i.e., interactions with the infrastructure or structural institutions), followed by resource limitations, psychological, physical, and social challenges. Over 60% of the articles reviewed documented positive or transformative outcomes following engagement in relief work (e.g., the provision of additional resources, support, and training), as well as self-growth and fulfillment. The current results emphasize the importance of pre-deployment training to better prepare relief workers to manage expected challenges, as well as post-deployment supportive services to mitigate adverse outcomes and support relief workers' well-being.

**Keywords** Systematic review · Natural disaster · Relief worker · Challenges · Mental health · Wellbeing

## Introduction

Natural disasters, defined as severe negative alterations in the functioning of a community resulting from hazardous physical events and social conditions (e.g., wildfires, floods, hurricanes, infectious disease outbreaks; Intergovernmental Panel on Climate Change [IPCC], 2012; Sahil & Sood, 2021), have been increasing in frequency throughout the past several decades (Banholzer et al., 2014; IPCC, 2012). Military, medical, and public safety personnel are often deployed as relief workers to mitigate adverse societal impacts associated with natural disasters and assist with humanitarian efforts. Deployment examples include providing medical assistance and resources (e.g., food and water) to the community, evacuation, search and rescue efforts, repairing infrastructure or environmental damage, and maintaining public safety. There are many benefits related to personnel deployment in response to natural disasters, including increased resources and response efficiency

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(Mamuji, 2012); however, the benefits and support offered to local communities during deployments may be contrasted by the interpersonal and individual challenges experienced by military, medical, and public safety personnel.

### Challenges faced by military, medical, and public safety personnel in the context of natural disasters

Natural disasters have often been studied in relation to the devastating consequences on the victims. Examples of common short- and long-term adverse outcomes for victims include negative psychological impacts (Garbern et al., 2016; Makwana, 2019; Novia et al., 2020), physical health problems (Freedy & Simpson, 2007), property damage (Vardy & Atkinson, 2019), and mortality (Dulski et al., 2011). Despite a large research focus on the victims of natural disasters, the physical, psychological, resource, structural, and interpersonal challenges faced by personnel responding to such disasters cannot be overstated. Military, medical, and public safety personnel are thrust into unfamiliar, dangerous, and potentially psychologically traumatic situations that include exposure to numerous physical and psychological risks (Garbern et al., 2016). For example, disaster response personnel may encounter death and human remains (Shih et al., 2002), environmental contaminants and infectious diseases (Gallanter & Bozeman, 2002; O'Leary et al., 2002), lack of medical or human resources (Sloand et al., 2012), and damaged infrastructure (Li & Zheng, 2014). The exposures to disasters place military, medical, and public safety personnel at risk for developing diverse posttraumatic stress injuries (Carleton et al., 2019; Hourani et al., 2003), including, but not limited to, posttraumatic stress disorder (e.g., PTSD; Chang et al., 2003; Wang et al., 2011), as well as physical injuries and/or illnesses (Alntas & Delooz, 2004). The adverse outcomes of disaster exposures can be acute or chronic with variable onsets (Khatri et al., 2018).

Understanding the challenges associated with disaster deployments is imperative for mitigating negative impacts on the mental and physical well-being of military, medical, and public safety personnel. Cataloguing the diversity in challenges related to disaster responses should help to identify opportunities to mitigate adverse physical or mental health outcomes (e.g., suicide attempts; Belik et al., 2009) and facilitate collaboration and communication between units for more efficient responses (Mamuji, 2012; Phillips et al., 2011; Ridzuan et al., 2018). One systematic review assessing mental and physical health challenges in the context of disasters has been conducted (Garbern et al., 2016); however, the review was limited to physical and mental health conditions associated with disasters, including war, and did not examine potential challenges associated with structural, resource, or social factors. Moreover, the review did not describe potential positive

or transformative outcomes associated with deployments to natural disasters (e.g., self-fulfillment, resilience; posttraumatic growth; Brooks et al., 2020; Clukey, 2010), nor did it delineate challenges associated with natural disasters versus man-made (e.g., war-related) disasters, each of which involves distinct responses with multidimensional impacts (Sawada et al., 2019). If researchers can identify and understand the most prominent challenges associated with natural disaster deployments extending beyond physical and mental health challenges, then governing bodies and clinicians can more effectively prepare for outcomes faced by military, medical, and public safety personnel. For example, understanding a multitude of challenges will allow for therapeutic interventions for personnel to be implemented proactively. This is especially important, as previous research has shown that psychological interventions provided to personnel following disaster deployments are insufficient due to, for example, lack of certainty pertaining to lack of optimal allocation of funding, issues with effectiveness, and delivery format (McCall & Salama, 1999; Søvold et al., 2021).

### The current study

In view of addressing these gaps, a comprehensive systematic review of the literature was conducted based on current evidence reflecting challenges faced and positive outcomes experienced by military, medical, and public safety personnel serving as relief workers during and following natural disasters. Specifically, the purpose of this systematic review is to evaluate the most commonly-reported challenges faced by military, medical and public safety personnel supporting natural disaster relief operations. We also aimed to investigate which challenges were most frequently encountered by each of the different occupational groups, as well as for distinct types of natural disasters.

### Method

The systematic review was conducted using Cochrane's (2022) guidelines. Steps of the review included: 1) developing a search strategy; 2) conducting the search across multiple databases for published and unpublished research; 3) two levels of screening search outputs against inclusion and exclusion criteria (title and abstract, then full text); 4) resolving conflicts following both levels of review; and 5) data extraction, analyses, and synthesis. We used SWIFT-Active Screener, a web-based collaborative citation screening software, to increase screening efficiency (Howard et al., 2020).

Because this is a systematic review, no interactions with human subjects occurred in the study. We have depended on the authors of the articles that we've reviewed to seek and obtain ethics approval from their institutions and informed

consent from subjects. We have also relied on them to adhere to the 1964 Declaration of Helsinki and its later addenda.

### Search terms

The literature search was conducted on February 14, 2022 without date restrictions across the following databases: PsycINFO & Medline (OVID), ProQuest Dissertations & Theses, and SCOPUS (see Supplementary Material for full search strategy).

### Inclusion and exclusion criteria

The inclusion criteria consisted of articles involving military, medical, or public safety personnel serving as relief workers in response to a natural disaster. Articles must have discussed the challenges and/or potential positive or transformative outcomes relief workers experienced as a result of responding to natural disasters. The exclusion criteria consisted of non-human studies, review studies (e.g., meta-analyses), books, and book chapters.

### Study selection

Two independent reviewers reviewed each article at each stage. In total, 13 reviewers completed the screening process. Interrater reliability (IRR; calculated as percent agreement) was high for the titles and abstracts (85%), as well as the full-text reviews (78%). Conflicts were resolved at each stage by the study leads until consensus was reached.

### Data extraction

The following information was extracted from each article: study information, relief worker characteristics, natural disaster information, and the identified challenges or positive outcomes relief workers experienced from their deployment to the natural disaster. Extractable challenges or outcomes had to be explicitly stated within the article as an obstacle, difficulty, or challenge relief workers experienced from their deployment (see Table 1 for a description of each extracted variable). Challenges and outcomes were not mutually exclusive categories, and all information applicable to each category was extracted and documented (e.g., a combat medic sample would be documented as both a military and medical personnel sample). The final sample consisted of 382 articles involving 382 independent samples (see Fig. 1; see Supplementary Material for raw data and reference list of included articles).

### Data analyses

Data were thematically organized to provide descriptive and contextual information reflecting the challenges and outcomes experienced by relief workers during their deployments to natural disasters. The analyses enabled us to identify emerging themes within the data. Analyses of contextual information surrounding the challenges and outcomes relief workers experienced when deployed to natural disasters were cross-examined with reported types of relief workers and natural disaster information. Multiple data sources were used (e.g., academic articles, news reports, commentaries) due to the descriptive nature of the review. Accordingly, evaluations of article quality or rigour were unfeasible and not conducted.

### Results

The final articles used qualitative data ( $n=260$ , 68%), quantitative data ( $n=105$ , 27%), or mixed data sources ( $n=17$ , 4%). The data included were related to natural disasters occurring between 2001 to 2010 ( $n=215$ , 56%), 2011 to 2021 ( $n=93$ , 24%), 1991 to 2000 ( $n=29$ , 8%), unknown/multiple years ( $n=26$ , 7%), or before 1991 ( $n=19$ , 5%). The most common time periods for deployment initiation were post-natural disaster ( $n=211$ , 55%), during an active natural disaster ( $n=92$ , 24%), mixed ( $n=67$ , 18%), or unknown ( $n=12$ , 3%; see Table 2 for descriptive statistics of the other characteristics of included studies).

### Examinations of challenges across contexts

The challenge type most commonly identified across all studies was structural, which consisted of interactions with larger infrastructural or structural institutions throughout the relief work process. Structural challenges focused on infrastructural issues (e.g., unable to reach site due to collapsed roads), communication issues (e.g., individuals unsure whom to contact), organization/documentation issues (e.g., unable to keep track of the victims), inadequate number of trained personnel, and geopolitical issues (e.g., issues dealing with government bodies). The second most commonly-described challenge type was resource-related, which included difficulties such as not having proper equipment or materials needed to complete the mission and support communities affected by the natural disaster. The most common resource-related themes were, in descending order of frequency: lacking medical resources, lacking human resources (e.g., not enough staff), lacking food and water, lacking space (e.g., limited space to help effectively), and lacking transportation. The third most mentioned challenge

**Table 1** Characteristics of included studies

Variable	Examples
Type of Data	
Qualitative	Non-numerical data (e.g., interviews)
Quantitative	Numerical data (e.g., self-report)
Mixed	Non-numerical and numerical data
Year of Natural Disaster	
Before 1991	–
1991–2000	–
2001–2010	–
2011–2021	–
Unknown / Multiple Years	–
Phase of Deployment	
Active	Deployed to an active natural disaster
Post	Deployed after the natural disaster
Mixed	–
Unknown	–
Type of Relief Workers	
Medical	Nurses, physicians
Volunteer / Humanitarian	Humanitarian aid workers
Military	Active-duty personnel, Veterans
Firefighters	–
Paramedics	–
Police	–
Type of Natural Disaster	
Earthquake	–
Hurricane/Typhoon/Cyclone/Tropical Storm	–
Tsunami	–
Wildfire	–
Flood	–
Infectious Disease	–
Tornadoes	–
Volcano	–
Avalanche	–
Blizzard/Winter Storm	–
Reason for the Relief Workers' Deployment	
Medical Assistance	Provide medical help
Search and Rescue	Search for lost or missing victims
Provide Resources	Food, water, supplies
Evacuation	Move victims from dangerous to safer areas
Environmental Concerns	Damage to infrastructure, containing fires
Public Safety	Prevent crime
Unspecified	–
Proximity	
Domestic	Workers residing in the same country as disaster
International	Workers residing in a different country from disaster
Both	Relief workers from domestic and international communities
Unknown	–
Location of Natural Disaster	Country
Citizenship of Relief Worker	Country
Structural Challenges	
Infrastructural Issues	Roads/building collapse, electricity outage

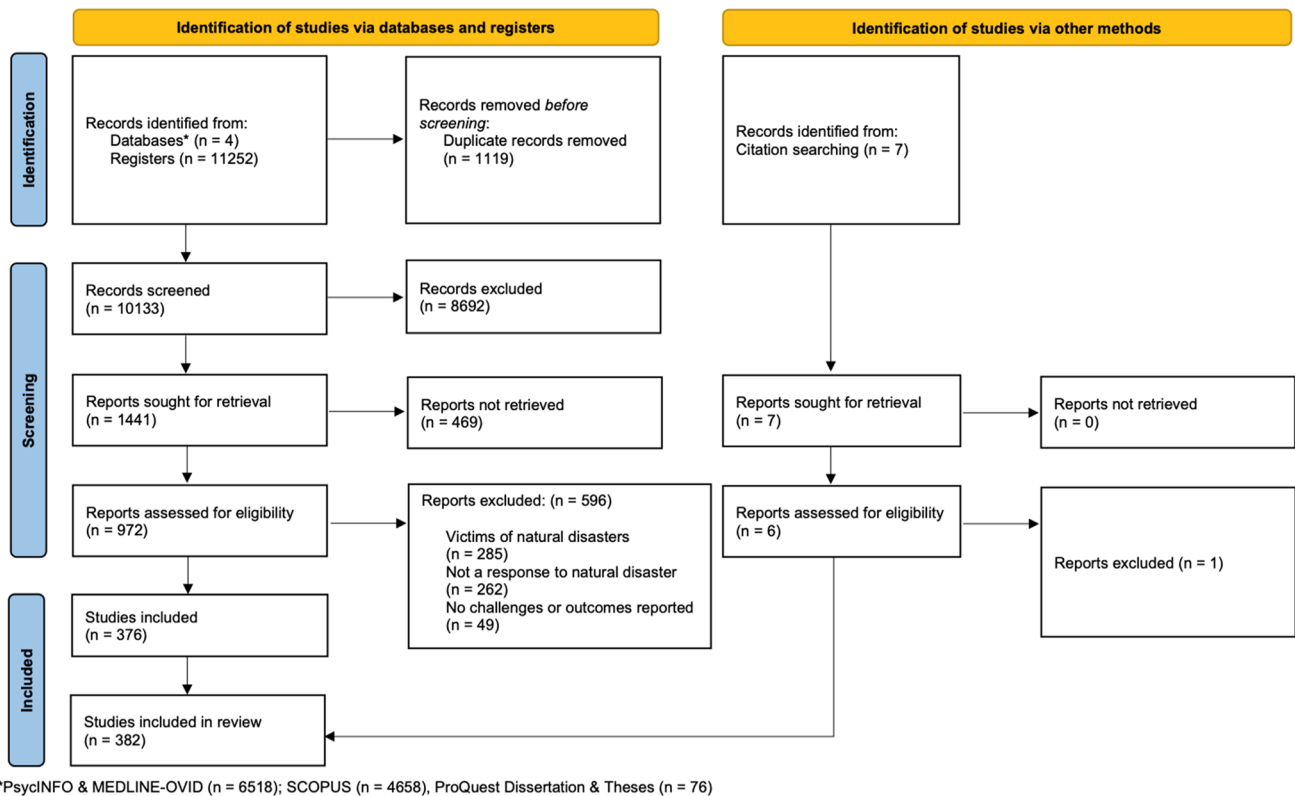
**Table 1** (continued)

Variable	Examples
Communication Issues	Whom to contact for information
Organization/Documentation	Tracking, record keeping
Not Enough Training for Personnel	Relief worker(s) did not have sufficient training to complete their task properly
Geopolitical Issues	Liaising with government/non-governmental organizations, legal
Encountering Deaths/Human Remains	–
Unable to Carry Out the Mission	Unable to reach/rescue victims
Technology Issues	Equipment (radios, medical gear) not functioning
Language Barriers	Relief worker(s) not speaking the same language as the victims/others
Duration/Time Spent in Mission	Extended stay, unable to leave
<b>Resource Challenges</b>	
Lack of Medical Resources	First aid kits, equipment
Lack of Human Resources	Staffing shortage
Lack of Food and Water	–
Lack of Space	Setting up camp
Lack of Transportation	Fuel shortage, lack of vehicles
Lack of Finances	Lack of funds to maintain operations
<b>Psychological Challenges</b>	At least one general mental wellness or diagnostic condition
<i>General Mental Wellness</i>	–
Stress	–
Anger/Hostility/Negative Emotions	–
Moral Injury	Loss of values, guilt, shame
Burnout / Brownout	Exhausted and unable to cope / withdrawn and lack of motivation
Quality of Life / Satisfaction with Life	–
Resiliency	Feeling less resilient
<i>Diagnostic Conditions/Symptoms</i>	–
Posttraumatic Stress Disorder	–
Depressive Disorders	–
Anxiety Disorders	–
Sleep–Wake Disorders	–
Substance-Related and Addictive Disorders	–
Suicidal Behaviours and Non-Suicidal Self-Injury	–
Obsessive–Compulsive and Related Disorders	–
<b>Physical Health Challenges</b>	
Acute Ailments / Injuries	Nausea/broken bones/fatigue/radiation
Infectious Diseases	Bacteria, viruses
Risk of Death	Mention of causalities
Environment Irritants	Smoke inhalation
Chronic Ailments / Injuries	Chronic pain, heart issues, cancer
<b>Social Challenges</b>	
Working with Victims and Locals	Difficulty working with others
Interpersonal Issues	Arguing with team members
Individual / Internal Consequences	Social isolation, loneliness, feeling trapped
Professional Consequences	Job loss
<b>Positive Outcomes</b>	
Posttraumatic Growth	Positive life changes
Meaning Making / Benefit Finding	Identifying benefits
Helping Others	–
Self-Fulfillment	Sense of fulfillment
New / Deeper Interpersonal Connections	Strong bond with coworkers
Resiliency	Feeling more resilient

**Table 1** (continued)

Variable	Examples
Spiritual / Religious	Stronger religious connection
Supportive Services	Counseling
Timing of Mission	Arriving on-time
Education/Training / Organization of Rescue Workers	Relief workers have proper training
Resource Support from Third Parties	Local/national government support

Note. Proximity = proximity of citizenship of the relief worker and location of the natural disaster



**Fig. 1** Preferred reporting items for systematic reviews (PRISMA) flow diagram (Page et al., 2021)

type reflected psychological challenges, which included general mental wellness and diagnostic conditions. The most common general mental wellness themes were, in descending order of frequency: stress, anger/hostility/negative emotions, moral injury (e.g., forced to say no or turning down patients for healthcare services), burnout (e.g., exhaustion and being unable to cope)/brownout (e.g., withdrawn and lack of motivation), and reduced quality of life. The most common diagnostic conditions identified by relief workers included self-reported or clinically diagnosed PTSD, depressive disorders, anxiety disorders, sleep-wake disorders, and substance-related and addictive disorders. The fourth most mentioned challenge type was the relief workers' physical health with the following themes identified: acute ailments/

injuries (e.g., cuts, scrapes, nausea, fatigue), infectious diseases, risk of death, environmental irritants (e.g., smoke inhalation), and chronic ailments/injuries (e.g., physical disability, asthma, cancer). The fifth most mentioned challenge type was social problems, such as interpersonal, relationship, and professional issues. The most common social themes focused on concerns related to working with victims or locals (e.g., not following relief workers' directions), interpersonal issues (e.g., fighting with team members), individual consequences (e.g., feeling trapped), and professional consequences (e.g., job loss). For each type of challenge, we reviewed the top five reported themes (see Table 3 for reported themes embedded within each challenge). The following characteristics were examined in



**Table 2** Characteristics of included studies (k=382)

Variable	N	%
<b>Relief Workers and Natural Disaster Information</b>		
<b>Type of Relief workers</b>		
Medical	266	70
Volunteer / Humanitarian	128	34
Military	93	24
<b>Public Safety Personnel</b>		
Firefighters	60	16
Paramedics	32	8
Police	27	7
<b>Type of Natural Disaster</b>		
Earthquake	200	52
Hurricanes / Typhoon / Cyclone / Tropical Storm	110	29
Tsunami	53	14
Wildfire	26	7
Flood	18	5
Infectious Disease	8	2
Tornadoes	5	1
Volcano	2	1
Avalanche	1	0
Blizzard / Winter Storm	1	0
<b>Reason for the Relief Workers' Deployment</b>		
Medical Assistance	272	71
Search and Rescue	89	23
Provide Resources	72	19
Evacuation	62	16
Environmental Concerns	59	15
Public Safety	17	4
Unspecified	19	5
<b>Proximity</b>		
Domestic	234	61
International	106	28
Both	25	7
Unknown	17	4
<b>Location of Natural Disaster</b>		
United States of America	103	27
Haiti	55	14
Japan	28	7
Indonesia	27	7
China	21	5
Iran	16	4
Pakistan	11	3
India	10	3
Australia	10	3
Nepal	9	2
Canada	9	2
Turkey	9	2
Taiwan	8	2
Puerto Rico	7	2
Philippines	7	2
Other <sup>a</sup>	70	18
N/S	4	1

**Table 2** (continued)

Variable	N	%
<b>Relief Workers and Natural Disaster Information</b>		
<b>Citizenship of Relief Worker</b>		
United States of America	175	46
China	32	8
Japan	28	7
Australia	18	5
Israel	10	3
Taiwan	10	3
United Kingdom	10	3
Canada	9	2
Iran	8	2
New Zealand	7	2
Turkey	7	2
Haiti	6	2
Puerto Rico	6	2
Other <sup>a</sup>	61	16
N/S	36	9

*Notes.* Proximity=proximity of the citizenship of the relief worker to location of the natural disaster. N/S=not stated. <sup>a</sup>Countries with a frequency count of less than 5 were categorized as “other”

relation to challenges experienced by relief workers: type of relief workers, type of natural disaster, reason for the relief workers deployment, proximity, and location of natural disaster. Citizenship of relief worker was not examined due to relief workers being deployed from multiple countries in a single study.

## Types of relief workers

### Medical relief workers

The current review included 266 studies focused on medical relief workers, including physicians and nurses deployed to a natural disaster to provide relief. Challenges identified by medical relief workers followed the overall trend found in Table 3 (see Table 4 for trends in challenges reported across study characteristics) with several minor deviations. Specifically, under general mental wellness challenges ( $n=107$ , 40%), moral injury ( $n=40$ , 37%) was the second most identified theme among medical workers, followed by anger/hostility/negative emotions ( $n=38$ , 36%). For diagnostic conditions challenges ( $n=46$ , 17%), a slightly higher number of studies reported on symptoms of anxiety disorders ( $n=15$ , 33%) relative to symptoms of depressive disorders ( $n=14$ , 30%). For physical health challenges, infectious diseases ( $n=45$ , 48%) was the most frequently cited theme, followed by acute ailments/injuries ( $n=43$ , 46%).

**Table 3** Challenges of included studies (k = 382)

Deployment Challenges		
<b>Structural Challenges</b>	298	78
Infrastructural Issues	143	37
Communication Issues	123	32
Organization / Documentation	80	21
Not Enough Trained Personnel	79	21
Geopolitical Issues	69	18
Encountering Deaths / Human Remains	68	18
Unable to Carry Out the mission	56	15
Technology Issues	51	13
Language Barriers	34	9
Duration / Time Spent in Mission	29	8
<b>Resource Challenges</b>	217	57
Lack of Medical Resources	129	34
Lack of Human Resources	86	23
Lack of Food and Water	67	18
Lack of Space	61	16
Lack of Transportation	58	15
Lack of Finances	19	5
<b>Psychological Challenges</b>	199	52
<i>General Mental Wellness</i>	167	44
Stress	121	32
Anger / Hostility / Negative Emotions	60	16
Moral Injury	52	14
Burnout / Brownout	33	9
Lowered Quality of Life / Satisfaction with Life	32	8
Lowered Resiliency	6	2
<i>Diagnostic Conditions/Symptoms</i>	106	28
Posttraumatic Stress Disorder	78	20
Depressive Disorders	40	10
Anxiety Disorders	38	10
Sleep–Wake Disorders	20	5
Substance-Related and Addictive Disorders	8	2
Suicidal Behaviours and Non-Suicidal Self-Injury	5	1
Obsessive–Compulsive and Related Disorders	2	1
<b>Physical Health Challenges</b>	143	37
Acute Ailment / Injury	79	21
Infectious Disease	61	16
Risk of Death	45	12
Environment Irritant	40	10
Chronic Ailment / Injury	12	3
<b>Social Challenges</b>	91	24
Working with Victims and Locals	50	13
Interpersonal Issues	36	9
Individual / Internal Consequences	25	7
Professional Consequences	7	2

*Note.* Documentations of values were extracted from data observed and were not always mutually exclusive. Challenges of Deployment = challenges relief workers experienced from their deployment to the natural disaster

### Volunteer/humanitarian relief workers

The current review included 128 studies focused on volunteer relief workers or humanitarian organization relief workers deployed to natural disasters. Challenges identified by volunteer/humanitarian relief workers followed the overall trend found in Table 3 with some exceptions (see Table 4). Specifically, for structural challenges, the most common themes were communication issues ( $n = 50, 49\%$ ), followed by infrastructural issues ( $n = 45, 44\%$ ), not having enough trained personnel ( $n = 37, 36\%$ ), geopolitical issues ( $n = 33, 32\%$ ), and organization/documentation issues ( $n = 26, 25\%$ ). Under general mental wellness ( $n = 60, 47\%$ ), burnout/brownout ( $n = 11, 18\%$ ) and quality of life ( $n = 11, 18\%$ ) were equally common.

### Military personnel relief workers

The current review included 93 studies focused on military personnel relief workers deployed to a natural disaster. Challenges identified by military personnel were often consistent with the overall trend found in Table 3 (see Table 4) with some deviations. Regarding structural challenges, geopolitical issues ( $n = 26, 33\%$ ) was the third most common theme, followed by organization/documentation issues ( $n = 21, 27\%$ ) and not having enough trained personnel ( $n = 21, 27\%$ ) which were equally common. For resource challenges, the second most common theme was lacking space ( $n = 21, 37\%$ ), followed by lacking human resources ( $n = 19, 33\%$ ), lacking transportation ( $n = 18, 32\%$ ), and lacking food and water ( $n = 17, 30\%$ ). For general mental wellness challenges ( $n = 39, 42\%$ ), quality of life issues ( $n = 11, 28\%$ ) were more common than burnout/brownout ( $n = 8, 21\%$ ). For diagnostic conditions ( $n = 22, 24\%$ ), sleep–wake disorders ( $n = 2, 9\%$ ) and substance related and addictive disorders ( $n = 2, 9\%$ ) were equally common. For social challenges, interpersonal issues ( $n = 6, 26\%$ ), and individual/internal consequences ( $n = 6, 26\%$ ) were most common.

### Public safety personnel relief workers

The current review included 89 studies focused on public safety personnel relief workers, exclusively including firefighters, paramedics, and police officers who were deployed to a natural disaster. Challenges identified by public safety personnel deviated from the overall trend found in Table 3 (see Table 4). Specifically, for general mental wellness challenges ( $n = 44, 49\%$ ), quality-of-life issues ( $n = 8, 18\%$ ) were more common than burnout/brownout ( $n = 6, 14\%$ ). For structural challenges, the third most common theme was not having enough trained personnel ( $n = 14, 24\%$ ), followed by geopolitical issues ( $n = 10, 17\%$ ), and organization/documentation issues ( $n = 9, 16\%$ ). For physical health challenges,

**Table 4** Characteristics of included studies with challenges

	<i>k</i>	Structural <i>n</i> (%)	Resources <i>n</i> (%)	Psychological <i>n</i> (%)	Physical <i>n</i> (%)	Social <i>n</i> (%)
<b>Type of Relief workers</b>						
Medical	266	231 (87)	188 (71)	120 (45)	93 (35)	66 (25)
Volunteer / Humanitarian	128	103 (80)	<b>67 (52)</b>	<b>70 (55)</b>	56 (44)	35 (27)
Military	93	79 (85)	57 (61)	42 (45)	39 (42)	23 (25)
Public Safety Personnel	89	<b>58 (65)</b>	<b>31 (35)</b>	<b>60 (67)</b>	<b>49 (55)</b>	20 (22)
<b>Type of Natural Disaster</b>						
Earthquake	200	161 (81)	116 (58)	111 (56)	71 (36)	49 (25)
Hurricanes etc	110	92 (84)	65 (59)	59 (54)	40 (36)	32 (29)
Tsunami	53	46 (87)	34 (64)	20 (38)	18 (34)	9 (17)
Wildfire	26	<b>6 (23)</b>	<b>3 (12)</b>	<b>13 (50)</b>	<b>17 (65)</b>	2 (8)
Flood	18	12 (67)	<b>7 (39)</b>	<b>8 (44)</b>	<b>6 (33)</b>	<b>6 (33)</b>
<b>Reason for Deployment</b>						
Medical Assistance	272	234 (86)	191 (70)	125 (46)	93 (34)	67 (25)
Search and Rescue	89	69 (78)	<b>38 (43)</b>	<b>57 (64)</b>	37 (42)	20 (22)
Provide Resources	72	64 (89)	49 (68)	29 (40)	26 (36)	23 (32)
Evacuation	62	57 (92)	53 (85)	29 (47)	25 (40)	12 (19)
Environmental Concerns	59	<b>32 (54)</b>	<b>22 (37)</b>	<b>31 (53)</b>	<b>34 (58)</b>	10 (17)
<b>Proximity</b>						
Domestic	234	171 (73)	<b>106 (45)</b>	<b>141 (60)</b>	96 (41)	56 (24)
International	106	89 (84)	76 (72)	43 (41)	31 (29)	25 (24)
Both	25	24 (96)	23 (92)	<b>8 (32)</b>	<b>11 (44)</b>	<b>8 (32)</b>
<b>Location of Natural Disaster</b>						
United States of America	103	76 (74)	56 (54)	55 (53)	44 (43)	26 (25)
Haiti	55	46 (84)	42 (76)	27 (49)	18 (33)	16 (29)
Japan	28	22 (79)	<b>10 (36)</b>	<b>20 (71)</b>	<b>11 (39)</b>	2 (7)
Indonesia	27	22 (81)	17 (63)	<b>11 (41)</b>	<b>11 (41)</b>	3 (11)
China	21	<b>11 (52)</b>	<b>9 (43)</b>	<b>18 (86)</b>	<b>9 (43)</b>	8 (38)

*Note.* Hurricanes etc.=Hurricanes / Typhoon / Cyclone / Tropical Storm. Challenges columns are presented in descending order from left to right following the overall general trend found in Table 3 (most prevalent to least prevalent [structural, resources, psychological, physical, and social]). Bolded values represent deviations from the overall general trend found in Table 3

the second most common theme was risk of death ( $n = 20$ , 41%), followed by environmental irritants ( $n = 17$ , 35%), and infectious diseases ( $n = 11$ , 22%). For resource challenges, lacking medical resources ( $n = 14$ , 45%) or lacking food and water ( $n = 14$ , 45%) were equally common, followed by lacking transportation ( $n = 13$ , 42%), lacking human resources ( $n = 9$ , 29%), and lacking space ( $n = 9$ , 29%). For social challenges, the most common theme identified was individual/internal consequences ( $n = 11$ , 55%) followed by working with victims and locals ( $n = 9$ , 45%) and interpersonal issues ( $n = 9$ , 45%).

### Types of natural disasters

The majority of studies included in this review (52%) focused on relief workers responding to earthquakes. Challenges reported by relief workers pertaining to earthquake deployments followed the overall trend found in Table 3.

The second most common type of natural disaster was hurricane/typhoon/cyclone/tropical storm (29%). Among studies focused on such disasters, the challenges followed the overall trend found in Table 3. The third most cited natural disaster type was tsunami (14%), which also followed the overall trend found in Table 3. The fourth most common natural disaster was wildfire (7%), which showed many deviations from the overall trend found in Table 3. The fifth most common natural disaster type was flood (5%), which also showed several deviations from the overall trend found in Table 3 (see Table 4 for trends).

### Reason for deployment

The most common reason for deploying relief workers to a natural disaster was to provide medical assistance (71%). Challenges reported by relief workers pertaining to medical assistance followed the overall trend found in Table 3. The

second most common reason for deploying relief workers to a natural disaster reflected helping with search and rescue efforts (23%), which showed many deviations from the overall trend found in Table 3. The third most common reason for deploying relief workers to a natural disaster was providing resources (19%), followed by assistance with evacuation efforts (16%), which were consistent with the overall trend found in Table 3. The fifth most common reason for deploying relief workers to a natural disaster was to assist with environmental concerns (15%; e.g., managing damaged infrastructure, containing fires), and it showed many deviations from the overall trend found in Table 3 (see Table 4 for trends).

### Proximity of relief workers' citizenship to the natural disaster

Most studies (61%) indicated that relief workers were deployed to domestic natural disasters, and such studies showed minor deviations from the overall trend found in Table 3. Studies where international relief workers were deployed to natural disasters (28%) followed the overall trend found in Table 3. For studies in which both types of relief workers were deployed to natural disasters (7%), there were some deviations from the overall trend found in Table 3 (see Table 4 for trends).

### Location of natural disaster

Most of the studies (27%) indicated that the relief workers were responding to natural disasters located in United States of America. Challenges reported by this location followed the overall trend found in Table 3. The second most common disaster location was Haiti (14%), which followed the overall trend found in Table 3. The third most common location was Japan (7%), which followed the overall trend found in Table 3; however, there were some deviations. The fourth most common location was Indonesia (7%), which followed the overall trend found in Table 3 with some deviations. The fifth most common location was China (5%) which showed many deviations from the overall trend found in Table 3 (see Table 4 for trends).

### Examinations of positive outcomes associated with disaster relief

Most studies ( $n = 234$ , 61%) indicated that relief workers reported at least one positive outcome during deployment. The most common positive outcome reflected resource support from third parties ( $n = 103$ , 27%), such that the relief workers received help either locally or internationally from other organizations and/or government bodies. The second most common positive outcome was education/training/

organization of relief workers ( $n = 81$ , 21%), which included having an adequate number of trained personnel or a well-executed mission plan. Satisfaction surrounding helping others ( $n = 59$ , 15%) was the third most common outcome, followed by making new or deeper connections as a team ( $n = 54$ , 14%), supportive services provided to relief workers ( $n = 36$ , 9%), making meaning/benefit from the experience ( $n = 34$ , 9%), higher resiliency ( $n = 29$ , 8%), self-fulfillment from the experience ( $n = 26$ , 7%), mission timing (i.e., arriving on time;  $n = 18$ , 5%), creating a spiritual/religious connection as a result of the experience ( $n = 8$ , 2%), and post-traumatic growth ( $n = 6$ , 2%).

## Discussion

Natural disasters can have an immense impact on the mental and physical well-being of military, medical and public safety personnel. Understanding the nature of the challenges associated with disaster deployments can help to maximize effective humanitarian deployment experiences and minimize negative mental and physical health outcomes. Over half of the natural disasters in the literature reviewed for this study occurred between 2001 and 2010, including, for example, the 2010 Haiti earthquake, Hurricane Katrina in 2005, and the 2004 Indian Ocean tsunami. This was followed by disasters that occurred between 2011 and 2021. Most studies examined earthquakes, followed by hurricanes/typhoons/cyclones/tropical storms, and focused on medical relief workers deployed to provide medical assistance, followed by search and rescue operations. The number of natural disasters worldwide has increased over the past 50 years due to climate change (World Meteorological Organization, 2021), but risk mitigation, early disaster warnings, and management plans have become increasingly effective, decreasing the number of associated deaths (World Meteorological Organization, 2021). The enhanced disaster planning in recent years suggests relief workers, including military, medical, and public safety personnel, are increasingly involved in rescue operations and disaster management.

### Challenges related to natural disaster deployments reported across all samples

Results of the current systematic review suggest that the most common challenges encountered by relief workers during disaster deployments are structural and resource-related challenges. Structural challenges included, for example, being unable to reach the site due to infrastructural damage, communication issues (e.g., uncertainty in terms of whom to contact), organization/documentation issues (e.g., unable to keep track of the victims), insufficient training for personnel, and geopolitical issues.

Resource-related challenges included, for example, lack of medical resources, lack of human resources (e.g., insufficient staffing numbers), lack of food and water, lack of space (e.g., limited space to help the victims), and lack of transportation. Despite being the most commonly-documented challenges, structural and resource challenges have scarcely been considered in past reviews focused on natural disasters (e.g., Benedek et al., 2007; Garbern et al., 2016). Without adequate consideration for infrastructural adaptations, as well as medical and personal resources, relief workers cannot effectively carry out their duties. In turn, this may increase mental health challenges and risks for posttraumatic stress injuries, such as PTSD (Almonte, 2009; Brooks et al., 2015; Soliman & Gillespie, 2011). Structural and resource-related challenges can be mitigated by humanitarian relief organizations and team leaders by prioritizing adequate disaster-response planning, access to robust technological and communication systems, sufficient medical resources, and transportation to disaster sites (Achour et al., 2016; Broz et al., 2009). Additional challenges identified included psychological challenges, physical health challenges, and social challenges. The health challenges may be mitigated, at least in part, by implementing adequate staff-to-work ratios. Granting relief workers time off throughout their deployment may also help them to remain both physically and psychologically resilient (Brooks et al., 2015; Norris et al., 2005).

It is important to note that although structural and resource-related challenges were the most commonly-identified challenges across the extant literature, psychological challenges were also commonly reported across all groups. PTSD was the most commonly-reported psychological disorder across the reviewed disaster studies. This is consistent with past research that identified a pooled worldwide PTSD prevalence of 10% among relief workers, which is comparatively higher than prevalence estimates of 1.3% to 3.5% in the general population (Berger et al., 2012). Natural disaster deployments inherently involve a high risk for psychological trauma, and an associated high risk for PTSD; as such, extensive evidence-based mental health supports should be offered to relief workers to mitigate posttraumatic stress injuries (Garbern et al., 2016).

### **Challenges related to natural disaster deployments by worker type**

Given their distinct roles across natural disaster deployments, it is plausible that military, medical, and public safety personnel may face distinct challenges depending on their proximity to the disaster, interaction with victims, and levels of training, among other factors. In this review, we found that medical and military relief workers deployed to natural disasters commonly reported structural

and resource-related issues, whereas volunteer/humanitarian relief workers reported structural and psychological issues. In previous studies, volunteer/humanitarian relief workers deployed to assist during and following man-made disasters (e.g., 9/11 terrorist attacks, various wars) largely reported psychological challenges (Benedek et al., 2007; Garbern et al., 2016; Hewison, 2003). For example, medical and volunteer/humanitarian relief workers deployed to war zones typically report experiencing burnout, reduced compassion satisfaction (Berger & Gelkopf, 2011), major depressive disorder (Garbern et al., 2016), PTSD (Benedek et al., 2007; Carson et al., 2000; Grieger et al., 2003), and increased substance use (Grieger et al., 2003). Psychological challenges often arise following a perceived threat to personal safety (Benedek et al., 2007; Garbern et al., 2016; Grieger et al., 2003). One example entails the medical relief workers deployed during the Syrian Arab Republic Civil War who were targeted for violence that resulted in many deaths (Sibbald, 2013). Thus, there are similarities in the challenges reported by different types of relief workers deployed to natural and man-made disasters, particularly regarding mental and physical health and safety.

Medical relief workers most commonly reported experiencing structural, resource, and psychological challenges, in line with the overall pattern of observed challenges for natural disaster deployments. Medical relief workers also commonly reported moral injury challenges. Moral injury, defined as outcomes associated with perpetrating, failing to prevent, or witnessing acts that transgress one's moral beliefs (Litz et al., 2009), is often studied in the context of medical professions (Čartolovni et al., 2021). For example, health care practitioners encounter situations in which they are required to choose who care is delivered to and who receives the limited available resources (i.e., a triage system), especially in a natural disaster context (Holt, 2008).

Volunteer/humanitarian relief workers most commonly reported structural, psychological, and resource challenges, with slight deviations from the overall pattern of observed challenges for disaster deployments. Communication issues (e.g., reporting uncertainty regarding who to contact) were the most common structural challenges, followed by infrastructure issues. Given the large number of volunteer relief workers participating in natural disaster relief, organized mobilizations become challenging (Liu & Robinson, 2013), thereby making it more difficult to adequately prepare all workers for their duties and maintain effective communication within and across groups. Unlike the general pattern of findings, volunteer/humanitarian relief workers reported experiencing psychological challenges across a greater number of studies than resource-related challenges. Compared to professional relief workers, such as military personnel and medical relief workers, individuals volunteering their time for humanitarian efforts do not possess the same high level

of training and experience related to natural disaster deployments (Thormar et al., 2013). Volunteer relief workers also often do not receive organizational supports following their deployments, such as counseling, as offered to those providing professional services (Thormar et al., 2013). This may contribute to the development or increased severity of symptoms of mental health conditions. Indeed, past research conducted following a man-made disaster showed that volunteer relief workers had greater odds of receiving a post-disaster mental health diagnosis, a diagnosis of chronic PTSD, or late-onset PTSD compared to professional relief workers, including firefighters, police, and other professionally affiliated emergency personnel (Debchoudhury et al., 2011).

Studies were most likely to report that military personnel who were deployed to natural disasters experienced structural and resource-related issues, in accordance with the overall pattern of observed challenges for disaster deployment. This is unsurprising, as the roles of military personnel in response to natural disasters involve provision and operation of vehicles (e.g., helicopters, off-road transportation) and technological equipment, as well as search and rescue efforts, damage assessments, and running mobile hospitals (Kapucu, 2011). Given that these duties necessitate adequate infrastructure, including accessible roads, electricity, record keeping, and technology, as well as adequate medical, human, transportation, and other resources, it is plausible that any infrastructural and resource-related issues would pose immense difficulty in the execution of military-related tasks.

Contrary to medical relief workers, volunteer/humanitarian relief workers, and military personnel, public safety personnel, including firefighters, paramedics, and police officers, most commonly identified psychological issues as a challenge, followed by structural, physical health, resource challenges. Natural disaster settings present dangerous situations (e.g., first on scene, evacuation, search and rescue, recovery of bodies, containing environmental contaminants, maintaining public safety, providing medical attention; Fisher, 2015; West et al., 2008) that place public safety personnel at risk for physical and mental health consequences (Chang et al., 2003; Guy et al., 1990; Hsiao et al., 2019; Pennington et al., 2018). Also, common reports of structural, physical health, and resources among public safety personnel may relate to the high-risk nature of their operations and proximity to physical dangers.

### Challenges related to natural disaster deployments by duty type

Relief workers are deployed to natural disasters to fulfill several duties, including provision of medical assistance, search and rescue, and resources to the affected community.

The current review evidenced a common pattern of challenges reported by relief workers deployed to provide medical assistance and provide resources, the most common of which were structural challenges, followed by resource-related challenges. However, although individuals deployed for search and rescue missions most frequently cited structural challenges, an important distinction between search and rescue and other relief duties reflects the large proportion of samples reporting psychological challenges. Relief workers engaging in search and rescue duties may be more likely to be composed of volunteers who encountered death and human remains for the first time, or who unintentionally entered dangerous situations with insufficient training, collectively increasing their risk for posttraumatic stress injuries. For example, results of a past study found that individuals who handled human remains following a fire self-reported higher levels of PTSD symptoms compared to those who did not handle human remains (McCarroll et al., 1996). Other findings have shown that search and rescue personnel dealing with human remains may be at an especially elevated risk of developing mental health disorders if they identify with victims (e.g., “it could have been me”; Benedek et al., 2007; Cetin et al., 2005). Indeed, three of the five samples reporting suicide or suicide ideation involved search and rescue workers.

### Challenges related to natural disaster deployments for domestic and international relief workers

Most of the studies included in the current systematic review focused on domestic relief workers as opposed to international relief workers. Domestic and international relief workers most commonly identified structural factors (e.g., roads blocking rescue site; geopolitical issues; language barriers; technological issues) as a challenge. The second most commonly-identified challenge among domestic relief workers was psychological, compared to resource-related challenges among international relief workers. This distinction might be explained by personal victimization among domestic rescue personnel. Specifically, domestic personnel were typically also victims of the immense damage associated with the natural disaster, having experienced personal or property loss and financial insecurity themselves (Leiby, 2008). Many domestic relief workers reported losing their colleagues, friends, and family members because of the disasters (Hugelius et al., 2017; Liu & Robinson, 2013). The disaster experience and consequences immensely impacted the well-being of many domestic relief workers who reported loneliness, feelings of fear, powerlessness, and guilt for leaving their families to help their community (Hugelius et al., 2017).

## Positive outcomes associated with natural disaster relief activities

Despite the significant challenges related to natural disaster deployment, many relief workers reported positive outcomes associated with disaster relief, including receiving support from third-party organizations or personnel, helping others, establishing new or deeper connections with colleagues or the community, making meaning out of their work,

enhanced resilience, feelings of self-fulfillment, and deeper spiritual connections (Camacho-McAdoo, 2010; Sakuma et al., 2020; Shih et al., 2002; Stuhlmiller, 1991; VanDevanter et al., 2017). For example, a sample of Taiwanese nurses reported that their mission to support victims following the 1991 Taiwan earthquake allowed them to view themselves as more competent and valuable helpers, enhanced their perceptions of their own self-worth and appreciation for their positions, and provided them with a deeper understanding of victim needs (Shih et al., 2002). Thus, despite the difficulties associated with deployments to natural disasters, the insights gained from the experiences contribute to positive outcomes for the community and for relief workers.

## Implications and recommendations for future work

Results of our systematic review underscore the immense impact natural disasters can have on the mental and physical well-being of military, medical, and public safety personnel. Outlining steps to minimize these challenges may also mitigate the potential for poor health outcomes among relief workers. To reduce risks associated with structural challenges, such as poor or damaged infrastructure or the inability to rescue victims, it is important to provide relief workers with a physically safe environment (e.g., identifying safe locations, outlining clear policies or guidelines related to evacuations and safety procedures; Benedek et al., 2007). It is also important to support effective communication, organization, training, and adequate staffing. This will require adequate coordination between government bodies, professional relief personnel, and volunteer personnel (Liu & Robinson, 2013). Disaster management planning should be broadly communicated (e.g., via online mediums to ensure swift and effective organizational response; Liu & Robinson, 2013).

In addition to disaster management, planning, and organization, evidence-based mental health care should be offered to relief workers. Past research has shown that psychological interventions and support have been reported as insufficient by most organizations, often due to lack of funding and lack of certainty pertaining to optimal location, effectiveness, and delivery format (McCall & Salama, 1999; Søvold

et al., 2021). The prevalence of psychological challenges emphasizes the need for greater education and awareness surrounding mental health challenges (e.g., PTSD), as well as the implementation of evidence-based mental health interventions prior to and following participation in natural disaster relief efforts. Relief workers should also be supported and encouraged to engage in self-care (e.g., proper nutrition, sleep hygiene), in addition to connecting with colleagues, family, and friends (Liu & Robinson, 2013). Similarly, humanitarian workers should be encouraged to connect with peers to share their experiences related to the natural disaster, especially when formal mental health supports are unavailable (Heroux, 2006). Sharing experiences with peers may help to mitigate potential for the development of mental health conditions that arise as a result of the stressors experienced during the disaster relief process.

Future research should assess the effectiveness and frequency of various proactive and responsive activities (e.g., policy changes, resourcing changes, training) introduced to support the physical and mental health of relief workers. Doing so would involve measuring whether the challenges outlined in this systematic review are alleviated following the implementation of such activities, and establishing when it would be most helpful to implement each of these (e.g., pre-deployment, during deployment, post-deployment). Future research should also consider distinctions between challenges experienced during deployments to both natural disasters and man-made disasters to delineate whether different activities would be more effective for specific types of missions. Similarly, because the current systematic review covered a broad range of time periods, it would be useful as a future direction to identify whether there are differences in challenges between natural disasters that occurred throughout a specified range of years. This may be of interest to researchers who wish to evaluate trends in relative response efforts or types of personnel deployed over time.

Natural disasters present a series of unique challenges for military, medical and public safety personnel. The current results have helped identify challenges that military, medical and public safety personnel most commonly face when engaged in relief work for natural disasters, and thereby point to potential areas of focus in the development of policies and programs aimed at alleviating the negative impacts of natural disaster deployments by government bodies, humanitarian relief organizations, and researchers alike.

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**Data availability** All data generated or analysed during this study are included in this published article [and its supplementary information files].

## Declarations

**Conflict of interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

Because this is a systematic review, no interactions with human subjects occurred in the study. We have depended on the authors of the articles that we've reviewed to seek and obtain ethics approval from their institutions and informed consent from subjects. We have also relied on them to adhere to the 1964 Declaration of Helsinki and its later addenda.

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