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Abstract: Social vulnerability approaches seek to identify social, economic, and political drivers that exacerbate environmental risks, and inform adaptation strategies that redress uneven vulnerabilities. Social Vulnerability Indices (SVIs), one such approach, have exponentially increased in use since their inception in 2003. This paper contributes the most comprehensive and rigorous systematic assessment of SVIs to-date, as applied in hazard and disaster contexts. We evaluate how 246 peer-reviewed articles, published online between 2003–2021, conceptualized, constructed, and applied SVIs across 20 distinct hazard and disaster contexts in 91 countries. Our review extends previous assessments, not only by analyzing a larger diversity and volume of burgeoning scholarship, but by *linking* the content, method, and objectives of SVIs to synthesize their strengths and limitations for addressing social vulnerability. Three overarching results are reported. First, we find indicators used to assess social vulnerability across hazards, spatial scales, and geographical contexts, were relatively homogenous. Most articles (81%) drew indicators and theories from already existing SVIs. While such replication is not inherently problematic, and to some extent, reflects established risk factors associated with hazards globally, the epistemological and methodological processes through which SVIs are readily reproduced and replicated warrant serious deliberation. Second, and relatedly, articles commonly used deductive, *a priori* approaches to identify indicators from secondary datasets, often at the expense of inductively-derived representations of vulnerability. Most articles exclusively relied upon quantitative and/or spatial methods (94%) and used secondary or tertiary data alone (80%), without validation and ground- truthing processes (76%). Together, the replication of previous SVIs through deductive research approaches, and their wide application across diverse hazards and geographies, undermines the ability to capture vulnerability as a place-based and context-specific phenomena. Third, and compounding potential ineffectiveness, SVIs appear most often as reactive and post-hazard risk- mitigation instruments, with data and findings rarely applied for policy change to address socio-economic and political causes of vulnerability. Overall, SVIs are an increasingly used instrument; however, their replication without evolving epistemic and methodological approaches, combined with their constrained focus on reactive policy measures, hamper novel and necessary research for countering social vulnerability to increasingly severe socio-environmental and public health risks.

Keywords: Social Vulnerability Index; vulnerability; natural hazards; disasters; systematic scoping review

1. Introduction

The interaction of climatic- and non-climatic hazards pose enormous, and increasing, health, well- being, and livelihood risks for communities (Pörtner et al. 2022). For example, in the United States, the combined cost of the 219 "billion-dollar" weather and climate-related disasters from 1980 – 2015 is estimated under $1.5T USD (NOAA 2023).[1] By comparison, 122 such events have occurred over the last seven years alone (2016 – 2022) with a combined cost of *over* $1T USD (*ibid*). Tragically, these last seven years account for almost one-third (5,169) of the estimated mortalities (15,821) from billion-dollar weather- and climate disasters over the last 42 years (*ibid*). Impacts like these are amplified by human-caused climate change, which has unequivocally increased the frequency and intensity of weather- and climate hazards (Intergovernmental Panel on Climate Change 2021; Pörtner et al. 2022). Additionally, for decades human dimensions of environmental change research have emphasized climate-related risks are mediated by interacting social, economic, and political systems, including of marginalization, and are therefore experienced unevenly (Liverman 1990; Bohle et al. 1994; Blaikie et al. 1994; Pelling 2003; Cutter et al. 2003; Adger 2006; O'Brien et al. 2007; Ribot 2010; Ribot 2014; Sultana 2014; Thomas et al. 2018). These risks are often associated with "social vulnerability" (*ibid*). Thus, climate change impact reduction involves steep emission cuts, on the one hand, and research and policy capable of identifying and addressing the multi-causal drivers of social vulnerability, on the other.

One dominant approach for conceptualizing, measuring, and mitigating social vulnerability occurs through the Social Vulnerability Index (SoVI), as developed by Cutter et al. in 2003, which emerged from earlier research on the connections between people, place, and hazard vulnerability (Morrow 1999; Cutter et al. 2000; *see* Eakin and Luers 2006 for an in-depth overview). Other versions of the Social Vulnerability Index have since emerged, wherein different social dimensions of hazard-risk are emphasized. For example, the Centers for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry's (CDC/ATSDR) "SVI" was developed by Flanagan et al. (2011; Flanagan et al. 2018)[2], and is commonly adopted in research and practice, including by Federal U.S. agencies, state and local government, emergency planners, public health officials, and non-state actors (ATSDR 2022). Formation and use of social vulnerability indices have spread globally, and today, the Social Vulnerability Index, in its multiple forms, represents one of the most widely recognized and used methods for characterizing and assessing hazard and disaster vulnerability. This is, in part, because of their potential to conduct rapid vulnerability assessments using publicly available data, and subsequently communicate risk and allocate resources to mitigate the most severe social, health, and economic impacts (*ibid*). Such an observation is well-reflected in scholarly publishing – one venue in which these indices are applied. The study and use of Social Vulnerability Indices have rampantly increased since 2003 (**Figure 1**), with much of this recent growth representing the application of the CDC/ATSDR's SVI to mitigate public health risks attributable to the ongoing COVID-19 pandemic.

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[1] These calculations are inflation-adjusted (NOAA 2023).

[2] For more information, see: CDC/ATSDR 2020 documentation. Accessed March 18, 2023: https://www.atsdr.cdc.gov/placeandhealth/svi/documentation/SVI_documentation_2020.html

Unsurprisingly then, several conceptual and empirical assessments aim to synthesize the contributions and limitations of this burgeoning scholarship to address social vulnerability more effectively in the wake of environmental hazards (*see* e.g.: Rufat et al. 2015; Fatemi et al. 2017; Tate 2012; Tate 2013; Fekete 2019; Spielman et al. 2020; Drakes and Tate 2022; Wood et al. 2021). Although crucial in their own regards, these assessments often document drivers of social vulnerability in a single hazard or place-based context (Rufat et al. 2015; Fatemi et al. 2017), or focus on methodological, empirical, or validation limitations associated with existing applications (Tate 2012; Tate 2013; Spielman et al. 2020). There is yet to be a major systematic evaluation of the literature across hazards and geographical contexts; this remains especially important given the recent exponential growth of published articles related to the Social Vulnerability Index (*see* **Figure 1**). Ultimately, our paper aims to understand the evolution and current state of social vulnerability research through index creation and application, accomplished through a *systematic scoping review* (Peters et al. 2020). Systematic reviews and systematic scoping reviews each follow well-defined, replicable, and systematic assessment protocols; however, the former commonly evaluates hyper-specific disciplinary research questions, whereas the latter adopts wider knowledge production objectives centered around mapping and synthesizing interdisciplinary themes and shortcomings (Peters et al. 2020; Aromataris and Munn 2020; Munn et al. 2022). Extending the work of the authors cited above, our systematic assessment makes three contributions to scholarship on Social Vulnerability Indices.

First, we contribute the most comprehensive systematic assessment of the Social Vulnerability Index to date, as applied in hazard and disaster contexts. Our analysis reveals Social Vulnerability Indices have been applied in at least 20 different hazard and disaster contexts across 91 countries, since 2000. Therefore, we characterize the Social Vulnerability Index as, potentially, the most widely applied vulnerability assessment methodology globally. The exponential growth of this instrument in academic scholarship (**Figure 1**) must be matched with assessments that evaluate its potential efficacy, particularly in an era of increasingly severe socio-environmental and public health risks – a major contribution we advance here.

Second, and relatedly, we extend existing evaluations by *linking* the content, method, and objectives of analyzed Social Vulnerability Indices to synthesize their limitations and develop integrative approaches for re-approaching vulnerability assessment and reduction strategies. Said differently, we do not assess the strengths and limitations of the Social Vulnerability *within* fixed categories of content, method, and application *per se*. Rather, we holistically analyze the linkages between theorization and content; methodology and content; content, hazard, and place; and methodology, content, and policy recommendations. This comprehensive approach helps advance an integrative set of recommendations for enhancing the theorization, method, and application of the Social Vulnerability Index for harm reduction.

Last, our interdisciplinary co-authorship team draw from varied research traditions in vulnerability, including political-ecology, environmental justice, human geography, sociology, political science, and other cognate disciplines, to assess how key systems of oppression and marginalization are, or are not, evident in the construction of Social Vulnerability Indices. This

enables an interdisciplinary analysis capable of deepening the conceptualization, methodology, and policy application of future Social Vulnerability Indices. To be clear, we recognize the SVI was created as a quantitative analytic instrument for assessing social vulnerability across generalizable hazard contexts. Calling attention to the need for advancement of SVIs, however, does *not* ignore their original intent, but does offer novel ways the instrument could be broadened and expanded to reflect other considerations in the social vulnerability field that have developed since its inception.

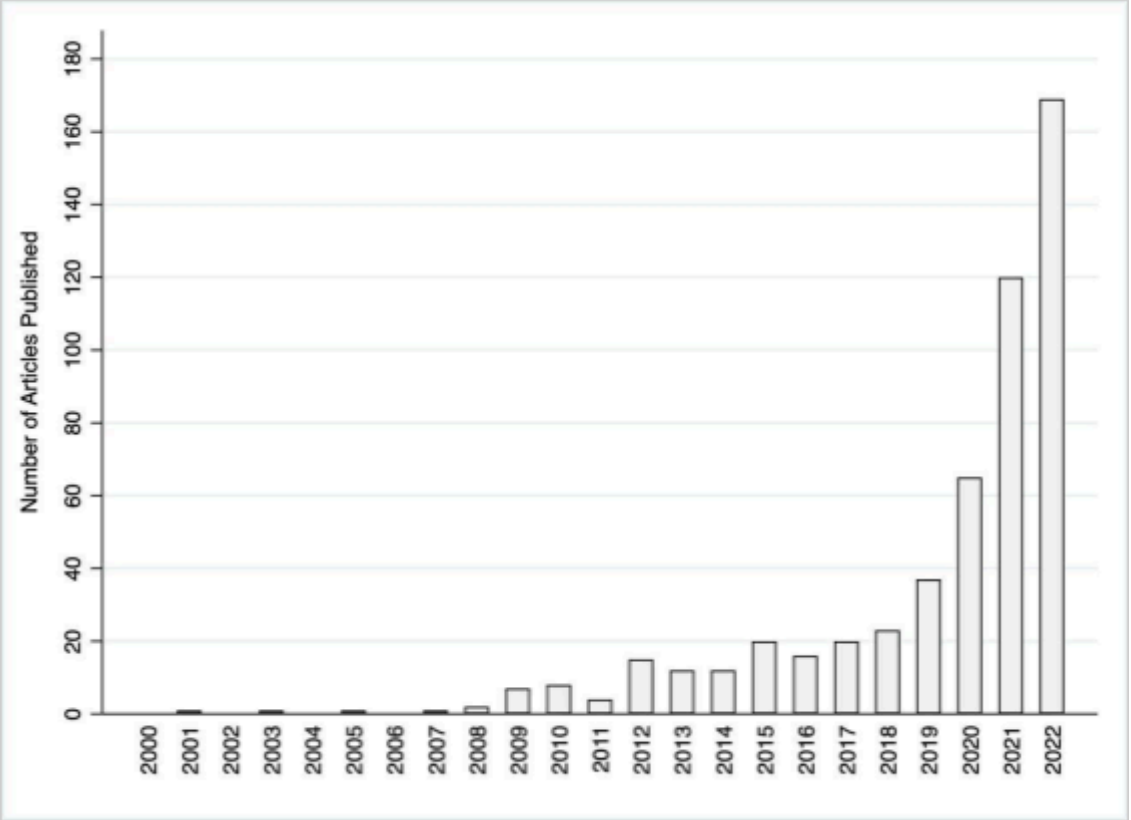

Figure 1: Exponential growth in the number of articles (n = 534; 2000-2022) with "Social Vul* Index" or "Social Vul* Indice*" in the Title, Abstract, Keywords, and Keywords Plus®. Source: Data extracted from the Web of Science Core Collection.

2. Methodology

This section describes our systematic scoping review methodology, including search strategy (**Appendix A-B**), inclusion-exclusion criteria, data extraction and de-duplication processes, intercoder reliability assessments, and the standardized coding protocol (**Appendix C**) and analysis process.[3] The data used for this systematic scoping review is publicly available on the DesignSafe Cyberinfrastructure (Painter et al., 2023; https://doi.org/10.17603/ds2-jgdv-1w43).

2.1 Search criteria

[3] Our protocol is adapted from Shah (2021)

We designed our systematic methodology around the research question: *How has scholarly research developed and applied the Social Vulnerability Index to characterize, measure, and redress the social drivers of vulnerability to natural hazards and disasters?* The underlined concepts signify major components of our search string criteria, listed in short form in **Table 1**. The Social Vulnerability Index is a composite index used to measure the relative social vulnerability of socio-spatial areas to environmental hazards (Cutter et al. 2003). From here onwards, we use the acronym "SVI" to represent the broad suite of different Social Vulnerability Indices, even while recognizing the same acronym is often used to reference the CDC/ATSDR's index (Flanagan et al. 2011). Natural hazards and disasters are often defined as biophysical events with potential to destabilize life and livelihood (Ribot 2010). Our methodological design broadens this definition to reflect social vulnerability theory. First, the frequency and intensity of an environmental stressor is an incomplete assessment of risk (Adger 2006; Ribot 2010). The way stressors interact with peoples' "endowments," "entitlements," and "capabilities" (Sen 1981; Scoones 1998; Bebbington 1999) shape whether they constitute hazards or disasters – and accordingly, search criteria must reflect this. Second, the boundaries delineating "natural" and "human-made" disasters are increasingly artificial (Kumagai et al. 2006; Chmutina and von Meding 2019; Kelman 2020). To reflect this understanding, we characterize natural hazards as inclusive of epidemics and pandemics.[4] Both points above necessitate "natural" hazards and disasters be defined as *socio-ecological events*, where environmental stressors interact with historical and active social, economic, and political systems and relations to create and exacerbate vulnerability (Blaikie et al. 1994; Adger 2006; Ribot 2010). We used these underlined concepts to identify database search terms (*per* **Table 1**).

To reduce selection bias as well as increase the comprehensiveness of the search criteria, we incorporated "Related-Search Terms" (RSTs) and "Medical Subject Headings" (MeSH)[5] as synonyms into the search string by using the thesauri available within the scholarly databases searched (*see* **Appendix A**). This process enabled 57 different hazard and disaster terms to be included into the search string criteria. To further maximize the retrieval of potentially relevant publications for review, we structured our search criteria using a specific combination of optimized Boolean operators for each database (*see* **Appendix B** for reproducible search criteria). This included the operators '*' and 'NEAR' to embed flexibility into the nature of search terms identified by each database. The '*' operator enables the suffix of marked terms to vary (e.g., "Social Vulnerability Ind*" can retrieve Social Vulnerability Index, Indexes, Indices, etc.). The 'NEAR' operator enables flexibility in how criteria appeared in relation to each other (e.g., "Social Vulnerability" NEAR/5 Ind*" can retrieve "Indices of Social Vulnerability", "Index of Social Vulnerability", etc.). This dynamic and flexible search strategy enables a larger body of scholarship to be captured in database retrievals.

[4] The natural hazards community, in general, considers epidemics and pandemics as socio-environmental hazards (Kelman 2020; Simonovic et al. 2021; Wilhelmi et al. 2021).
[5] Medical Subject Headings (MeSH) are used by PubMed.

Table 1: Search criteria.

Component of Research Question	Search Criteria
Social Vulnerability Index	"Social Vulnerability Ind*"
Natural Hazards; Disasters	Hazard*; "natural hazard*"; disaster*; risk*; threat*; emergenc*; "climat* chang*"; "climat* vari*"; hurricane*; storm*; "extreme weath*"; "severe weath*"; earthquake*; tsunami*; volcan*; epidemic*; pandemic*; flood*; heat*; landslide*; fire*; wildfire*; "wild fire*"; geohazard*; "air qual*"; pollut*; **"global warming"; drought*; evacuation*; outbreak*; disease*; contaminat*; cyclon*; avalanche*; typhoon*; catastroph*; rockslid*; mudslid*; famine*; scarc*; crisis*; crise*; degrad*; "tidal wave*"; casualt*; "El Niño"; "La Niña"; tornado*; hail*; shock*; seismic*; coronavirus*; "COVID-19"; "SARS-CoV-2"; virus*; "forest fire*"; calamit***

Note: **Bold text** symbolizes RSTs or MeSHs identified using available thesauri.

2.2 Databases

We searched both generalist and specific databases to maximize the retrieval of scholarly articles. We searched six databases (**Table 2**) including the Web of Science Core Collection, PubMed, SocINDEX, Public Affairs Information Services, the Agriculture and Environmental Sciences, and Humanities International Complete. We searched for articles published online between January 01, 2000, to December 31, 2021, using the search criteria described in **section 2.1** (**Table 1** and **Appendix B**). These databases were selected with the intention of capturing a diversity of SVI applications across medical and emergency planning fields, rural and urban planning, livelihood studies, public health fields, and more. Google Scholar was omitted because of challenges in exporting citations in bulk, and the inability to use specific Boolean operators deemed essential for capturing literature relevant to our study (Boeker et al. 2013). We did not have institutional access to the Scopus database, and hence, it was not searched.

Table 2: Databases searched.

Scholarly Database	Database Focus
Web of Science (WoS) Core Collection	● Generalist and multidisciplinary
PubMed	● Life sciences, emergency services, and biomedical science
SocINDEX (EBSCO)	● Sociology

Public Affairs Information Services (PAIS)	• Public affairs, public policies, and international relations
Agriculture and Environmental Sciences Database (AESD)	• Interdisciplinary environmental studies, environmental sciences, and agriculture and natural resources
Humanities International Complete Database (EBSCO)	• Interdisciplinary humanities

2.3 Deduplication

We exported references from each database into a .csv, .xls, or .txt file. These combined records (n = 817) were subsequently imported into Rayyan Systems Inc. (Ouzzani et al. 2016; see https://rayyan.ai), an open-source online program for systematic review collaboration. We used a combination of automated (Rayyan Systems Inc.) and manual strategies (Microsoft Excel conditional formatting) to remove 399 duplicate publications. The final, de-duplicated set of records (n = 418) was imported into Rayyan Systems Inc. to determine their suitability for inclusion within the study (*see* **section 2.4**; **Appendix G** lists excluded articles).

2.4 Inclusion and exclusion

Following the protocol outlined in Shah (2021), we developed a multi-phased inclusion-exclusion criteria set to determine a publication's suitability for full-text assessment. **Phase 1** entailed a rapid assessment of the publication's Title, Abstract, and Keywords. A publication was included for full- text assessment (**Phase 2**) if published online in English between January 1, 2000, and December 31, 2021; peer-reviewed; and used, conceptualized, or applied a SVI within a hazard or disaster context (per our definition in **section 2.1**). Pandemics and epidemics have been referred to as "natural hazard[s]" and "natural disasters" because they interact with other "natural" hazards to produce a larger contexts of risk (qtd. Seddighi 2020: e42; elsewhere *see* Roque et al. 2022; Wilhelmi et al. 2021). Hence, we opted to include them in our review. Related to publications on epidemics and pandemics, we made inclusion-exclusion decisions based on their severity and urgency. We reason that the combination of not having the medical treatments to reduce or contain harm emerging from infectious epidemics and pandemics constitutes urgency and severity. While we recognize people die each year from certain contagious viruses and diseases, such as the flu, these events tend to be contained, have preventative measures, and the medical knowledge to mitigate harm. In contrast, the COVID-19 pandemic, at its current moment, demonstrates significant disparities in vaccine equity, and vaccine efficacy is waning with the evolution of new variants. Other pandemics and epidemics that reflect the uncertainties and lack of medical understanding that COVID-19 presents are considered part of the hazards literature for the scope of this review. In terms of social vulnerability and natural hazards, we included COVID-19 vaccination uptake literature if it reflected the structural factors that preclude vaccination for a particular community (e.g., vaccine inequality) and where individual choice is linked to structural factors (e.g., mistrust from communities exploited by medical testing programs). If the study

centered on individual choice, such as religious affiliation or low vaccine rates in general, we omitted these articles from the scope of the review.

The first, second, fourth, and fifth co-authors completed **Phase 1**. Following guidance from the JBI (formerly, *Joanna Briggs Institute*)[6], an inclusion or exclusion decision in **Phase 1** was independently rendered by at least two authors on every publication (n = 418).[7] To reduce coder bias, we used the "Blind ON" mode in Rayyan Systems Inc., which prevents each author from viewing others' inclusion-exclusion decisions. After all publications received at least two decisions, we removed "Blind ON" and resolved conflicting inclusion-exclusion decisions as a group (Peters et al. 2022). **Phase 1** yielded 289 articles (69%) for full-text appraisal in **Phase 2**. Of the articles excluded in **Phase 1** (n = 129), most were either unrelated to the scope of the study (62%); did not conceptualize, evaluate, or use a SVI (28%); or did not engage with a SVI in the hazards and disaster context (13%)[8]. In **Phase 2**, 43 publications were further excluded as deemed out-of-scope. Notably, we excluded publications that conducted reviews of the SVI literature and did not conceptualize or empirically apply it to a disaster or hazard context. Overall, 246 articles were included for assessment (*see* **Figure 2**; see **Appendix F** for the complete list).

2.5 Assessment

For the **Phase 2** full-text review, we randomly assigned two of the first six co-authors to review each article. This randomization process was completed using the "lpSolve" package in *R*, which uses a set of wrapper functions to create a matrix of randomly assigned numbers (Berkelaar 2023). Staggering the reading assignments reduced the frequency of the same co-author pairings analyzing a given article. We coded each of the 246 included articles using the questionnaire and codebook in **Appendix C**. This questionnaire and codebook were constructed as a *Qualtrics* survey to standardize inputs from the authors upon coding each article.

We developed a multi-stepped quality-assurance and -control (QAQC) process to ensure the robustness of our results. This was critical because we shifted to non-randomized pairings and single-author coding later in the process due to the logistical and time-scheduling constraints associated with randomized pairings. To begin the process, 35% of the 289 articles included for full-text review in **Phase 2** (of which 43 were later excluded, **Figure 2**), were simultaneously read and analyzed by two *randomized* co-authors. Authors reading and coding the same articles collaborated on answers and discussed the best response for each question in the *Qualtrics* survey. This collaboration enhanced the accuracy of coded responses. Significant clarifications and questions that were applicable to the larger set of included studies were deliberated in the presence of a third author (Peters et al. 2022) – most often, the first or second author. These coding clarifications were applied upon analyzing later articles. Ultimately, this process, evaluated a

[6] See the full suite of JBI Scoping Review Network Group resources: https://jbi.global/scoping-review- network/resources

[7] Each author was assigned 209 articles in **Phase 1**, allowing each publication to be evaluated by two co- authors. Of the 418 de-duplicated publications, 100% (n = 418) received at least two decisions; 26% (n = 109) received at least three decisions; and 3% (n = 13) received at least four decisions in **Phase 1**.

[8] Articles can be assigned more than one theme and therefore the percentages will not add to 100%

diverse subset (35%) of articles, enhanced inter-coder reliability, and established the requisite learning for articles to be coded later in non-randomized pairs and, in certain cases, by the lead author alone. Overall, and from the initial 289 articles included for **Phase 2** full-text review, 64.7% were reviewed in pairs, 20.4% were reviewed by the lead author, and 14.9% were excluded. Even here, continual coordination and communication with a third co-author occurred to resolve any clarifications and questions on article coding.

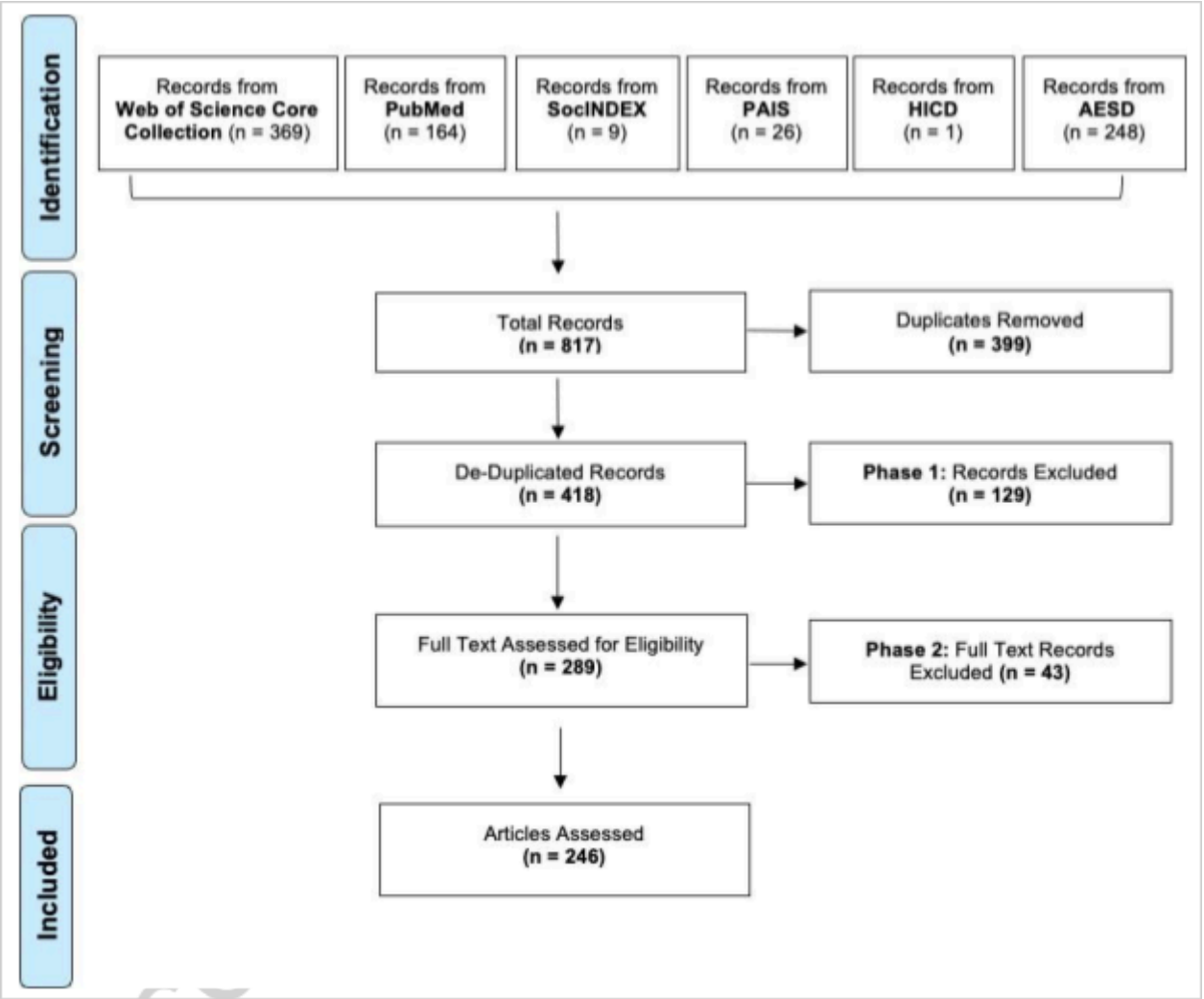

Figure 2: PRISMA Diagram. Source: Adapted from Moher et al. (2009).

4. Results

4.1 Metadata

Articles in this systematic scoping review included various places of knowledge production, journals, and dates of publication. The vast majority of first author affiliations are in the United States (47.97%), followed by China (10.16%), Brazil (4.07%), and Italy (4.07%). While publication outlets varied, several journals were well-represented. These included *Natural Hazards* (11.79%), *International Journal of Disaster Risk Reduction* (7.32%), and *Sustainability*

(5.69%) (*see* **Appendix D**). Last, the years of publication follow the exponential pattern of the broader SVI literature in **Figure 1**. 42.28% of articles were published in 2018 or before. Significant annual growth in SVI, relative to our studied context, is demonstrated in 2019 (10.16%), 2020 (18.29%) and 2021 (29.27%).

4.2 Defining Social Vulnerability

We found most articles (55.3%) do not define *social vulnerability*. Nevertheless, of these articles, many define *social vulnerability indices* or *vulnerability*, more broadly. Explained in our **Discussion**, the absence of a definition fails to establish the phenomena for which the metrics selected ultimately aspire to measure.

A handful of published authors inform the collective set of definitions for social vulnerability. These include definitions from Cutter and co-authors (2003, 2006, 2008), Blaikie et al. (1994), and Adger (1999; 2006). Of those that provided a definition, approximately 36% cited a work by Cutter, notably Cutter et al. (2003), Cutter and Emrich (2006), and Cutter and Finch (2008); 13% cited work by Wisner and co-authors (largely Blaikie et al. [1994][9]), and 8% cited Adger, such as Adger (1999) and Adger (2006).[10] **Table 3** provides common definitions of social vulnerability used in articles.

Table 3: Common definitions reflected in articles to define social vulnerability.

Author(s)	Definition
Cutter et al. (2003)	"Social vulnerability is partially the product of social inequalities—those social factors that influence or shape the susceptibility of various groups to harm and that also govern their ability to respond. However, it also includes place inequalities—those characteristics of communities and the built environment, such as the level of urbanization, growth rates, and economic vitality, that contribute to the social vulnerability of places" (p. 243).
Blaikie et al. (1994)	"[…] [T]he characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard (and extreme natural event or process)" (p. 11).
Adger (1999)	"Social vulnerability is the exposure of groups or individuals to stress as a result of social and environmental change, where stress refers to unexpected changes and disruption to livelihoods" (p. 249).

All social vulnerability definitions in the literature include the factors that limit certain groups' ability to mitigate risk in the face of natural hazards, including the inability to prepare, respond, or recover (Adger 1999; Cutter et al. 2003; Cutter et al. 2008). Additionally, certain definitions

[9] Several authors refer to this citation as Wisner as the first author and cite the 2nd edition of *At Risk: Natural Hazards, People's Vulnerability and Disasters* (2004).

[10] Alternative definitions of social vulnerability cite other studies, including but not limited to, Füssel (2010) and Turner et al. (2003).

highlight the "[…] limited access to resources and political power, lack of social capital, divergent beliefs and customs, physical limitations of the population, and characteristics of the environment" (Vo et al. 2020: 203, citing Cutter et al. 2003), while others recognize the specific sensitivity of socially vulnerable groups to natural hazards (Zhou et al. 2014: 615, citing Brooks 2003; Adger 1999; Cutter et al. 2003; Cutter et al. 2008) or disproportional degree at which hazards and disasters harm certain populations (Lotfata and Ambinakudige 2019: 132, citing Cutter et al. 2003; Adger and Winkels 2007; Susman et al. 1984; Ambinakudige 2009).

We find that most of the publications (93%) focus on social vulnerability as their primary conceptualizing framework, which center topics such as individual decision-making, urban or rural planning, and anchor indicators as characteristics and not system processes. We categorize very few publications (7%) as adopting a political-economy or political-ecology framework, focusing on colonial and capitalist systems of oppression. Unsurprisingly then, we found definitions often highlighting the characteristics of populations who were disproportionately harmed in the wake of hazards, while not always identifying the underlying systemic causes productive of elevated risks. For instance, the definition above by Vo et al. (2020) recognizes the role of political power and social capital but does not explicitly identify the histories and on-going systems of racism, colonialism, sexism, ableism, and other sources of marginalization that render these groups disproportionately vulnerable. Moreover, in several articles we found wording used strips out causes of why populations are vulnerable and highlights their demographic characteristics as intrinsic to vulnerability, rather than focusing on systems that produce harm. For example, Islam et al. (2021) writes that "[…] Wayne County has a higher proportion of [B]lack residents and thus had worse COVID-19 outcomes including death and hospital utilization […]" (8; but cf. Gaynor and Wilson 2020: 835, for a systemic explanation). This language, without an in-depth follow-up on anti-Black racism in the United States ignores how policies of the past and present place Black, Indigenous and people of color in harm's way in a pandemic or other natural hazard. While theorizing the systemic roots of oppression and disproportionate exposure of marginalized communities to risk is not often the aim of these studies, the lack of recognition of the systemic roots of social vulnerability contributes to individualist understandings of marginalization and limits the scope of policy ideas to address vulnerability. We return to this point in our **Discussion**.

4.3 SVI Adaptation

Articles vary in their use of existing SVIs, the level of adaptation of these indices, and the indicators incorporated into measures of social vulnerability. Of the articles in the review, 81% were influenced by or used existing SVIs (e.g., Cutter et al. 2003; Flanagan et al. 2011; or other existing indices) that were either unmodified or had varying levels of modification (*see* **Table 4**). This statistic further includes authors who used an existing SVI in whole or in part as a *theoretical basis* for indicator inclusion for an entirely self-created SVI. Minor modification includes articles where only a few variables were omitted, added, or changed, or if one section of indicators changed. Significant modifications include articles where several to most variables were omitted, added, or changed. To this end, "significant modification through addition" or "significant

modification through omission" includes articles where several variables were added or removed from existing SVIs. "Significant modification through change" includes articles where variables are replaced or changed for other indicators. This number includes those who constructed an entirely new SVI, but who still referenced literature for individual choices of indicators.

Table 4: Adaptation level of existing SVIs across articles in the systematic review.

Degree of SVI Adaptation	Prevalence
Entirely Self-Created **May be informed by previous theoretical studies.*	33.74%
No Modification	28.05%
Minor Modification (e.g., one section)	4.47%
Significant Modification through Addition (e.g., significant sections or questions added)	0.81%
Significant Modification through Change (e.g., new categories and/or proxies)	14.63%
Significant Modification through Omission (e.g., significant sections or questions removed)	18.29%

Of the 49 articles that looked solely at COVID-19, 76% used a non-modified SVI, all of which used the CDC/ATSDR SVI (Flanagan et al. 2011) apart from three articles which analyzed COVID-19 and social vulnerability in Brazil.[11]

4.4 SVI Methodology

In the construction, validation, and analysis of SVIs, much of the critiques and debates in the studies examined focus on methodological arguments of weights, index validation, or uncertainty analysis. The usage of weights is split across articles, with 49% using weights in their SVI construction, while 51% do not. Tate (2013) found, in performing an uncertainty analysis in Sarasota County, that the weighting stage drives uncertainty in hierarchy models of social vulnerability, later finding empirical evidence for differential weights (Tate et al. 2015). Rufat et al. (2019) calls for further empirical validation in assessing SVIs and cautions against using weights for policy decisions without a holistic understanding of construct validity. Spielman et al. (2020) furthers this work, finding that the Cutter et al. (2003) SoVI "lacks internal consistency because relative vulnerability rankings for counties within a specific state were volatile and failed to converge when other, external counties were added to the index construction" (p. 433), meaning that rankings are not consistent across levels of measure. Beyond internal consistency, Spielman et al. (2020) argues the SoVI lacks theoretical consistency, showing that it fails to measure what it aspires to through its empirical construction and included indicators. Overall, researchers like Tate

[11] Studies in Brazil that were unmodified from other citations are Martins-Filho et al. (2020), Andrade et al. (2021), and Castro et al. (2021).

(2013; Tate et al. 2015), Rufat et al. (2019), and Spielman et al. (2020) lay out robust critiques for what indicators are included in SVIs (e.g., Spielman et al. 2020), and what methodological processes are most valid (e.g., Schmidtlein et al. 2008; Holand and Lujala 2013; Tate 2013; Tate et al. 2015; Rufat et al. 2019).

In moving beyond these nuanced deliberations, 5.69% of analyzed articles use a qualitative approach (only, or as a mixed-methods approach). These studies use interviews and focus groups of individuals or households in communities, first responders, emergency managers, or experts on social vulnerability measures. Some of these interviews are part of the construction of a SVI, while others are used to check or inform these measures. Lack of validation, in the statistical sense, has been the focus of validation critiques. However, there is also a gap in a qualitative sense through the lack of community-centered research and mixed-methodologies, which are severely underrepresented. This gap demonstrates the need to prioritize qualitative work as a method of knowledge production and validity assessment, particularly salient given communities are experts in their own experiences of natural hazards, and in the systematic causes of everyday risk they encounter.

4.5 SVI Indicators and Hazard Contexts

Per **section 4.3**, the vast majority of analyzed SVIs (81%) were theoretically or empirically influenced by prior SVIs. As such, the SVIs we analyzed consistently included certain indicators of vulnerability (*see* **Table 5**). Several indicators that fall into the categories of socioeconomic status, education, and age are used frequently (> 65%). Mentions of race and ethnicity are also commonly included in SVIs (65.45%). Not as frequently, but still widespread, are categories of gender, language barriers, population density and change, household composition (single-parent households, disability), transportation, and housing and housing structure. Authors incorporate other categories far less frequently, such as technology and utilities, community infrastructure (nursing homes, schools, hospitals, etc.), and employment types (*see* **Table 5**).[12] The consistency of indicators varies across disaster contexts (*see* **Table 6**).

"General hazards", or publications without a specific hazard, comprise the largest share of studies (30.08%). Beyond "general hazards" and COVID-19 (20.33%) above, flooding (21.54%), hurricanes (11.79%), and earthquakes (7.32%) were most studied. All other disasters fall under 5% of the included articles, including wildfires, heat hazards, tsunamis, drought, and others.

As it relates to the relationship between social vulnerability indicators, and hazard and disaster context, some indicators are consistent across hazards (*per* **Table 6**). Age (median age, elderly, children, etc.) was incorporated at very high rates (> 83%). Socioeconomic status indicators, such as poverty, income, or unemployment, are prevalent across hazard contexts. Even when one indicator in the socioeconomic status is not strongly prevalent (as low as 35%), another will be used quite frequently (upwards of 75%). Other indicators vary more. For example,

[12] Given the authors evaluated over 4,000 indicators or elements of SVI frameworks, each without standardized terms, it should be expected a normal error range of (2 – 5%) applies to the statistics presented in **Tables 5** and **6**.

transportation is present in analyses that study hurricanes at a rate of 51.72%, while for earthquakes transportation is only present at 16.67%. This variability in transportation is likely due to reliance on transportation in survival of a particular hazard. However, we find in this research that many of these differences in variables are due to the data availability and adaptability of existing indices to geographical contexts outside of the United States.

Overall, indicators vary little across hazard contexts. There are shared systems of inequality that amplify population vulnerability across many contexts. However, we highlight that the need for adaptability to certain locations due to the experiences of different hazard conditions across place is absent from much of the SVI analyses. This "one size fits all" production of vulnerability assessment could dilute the differing experiences of people and place.

Table 5: Dominate indicators prevalent in SVI construction across literature.

Indicator Theme	Dominant Indicators	Update
Socioeconomic Status	Poverty Status	50.00%
	Income and/or Wealth	65.04%
	Unemployment	67.07%
Education	Educational Attainment	75.20%
	Literacy Rate or Illiteracy	20.73%
Age	Age, Elderly, Children, Dependents	87.40%
Gender	Gender, Sex, Women, and "Female" (includes "Female-Headed Households")	52.85%
Transportation	Transportation, Access to a Vehicle, Vehicle Ownership, Car Ownership, Road Access	46.75%
Language Barriers	Language Barriers, Speak Dominate Language as Second Language (e.g. "English as a Second Language")	32.93%
Population	Population Density, Population Change	33.74%
Household Composition	Disability	46.75%
	Single-Parent Household	33.74%
Technology and Utilities	Water	18.70%
	Technology, Telephone, Television, Radio, Internet, Computer	11.79%
	Electricity, Power, Energy	10.98%
	Sewage, Toilet, Sanitation, Garbage Collection	13.01%
Housing and Housing Structure	Mobile Homes, Informal Housing, "Slums", Low Qualities Walls	39.02%

	Rooms, Crowding, Household Size	38.62%
Community Aspects	Nursing Homes and Nursing Home Residents	7.72%
	Schools, Students, and Universities	6.10%
	Hospitals, Hospital Beds, Physicians, and Doctors	23.58%
Employment Type	Tourism and Tourists	3.25%
	Primary, Secondary, and Tertiary Industry, and Industry Generally	22.76%
Racial and Ethnic Minorities	Measures of Racial and Ethnic Minorities	65.45%

Table 6: Dominate indicators prevalent in SVI construction across literature and hazard context. For the percentages of hazard contexts in the review, refer to **Appendix E**.

Dominant Indicators	General	Flooding	Hurricane	Earthquake	Other
Poverty Status	40.54%	39.62%	68.97%	44.44%	34.69%
Income and/or Wealth	54.05%	64.15%	75.86%	61.11%	46.94%
Unemployment	71.62%	58.49%	62.07%	66.67%	44.90%
Educational Attainment	77.03%	64.15%	75.86%	88.89%	61.22%
Literacy Rate or Illiteracy	33.78%	22.64%	13.79%	38.89%	14.29%
Age, Elderly, Children, Dependents	83.78%	96.23%	93.10%	94.44%	83.67%
Gender, Sex, Women, and "Female" (includes "Female-Headed Households")	66.22%	67.92%	55.17%	94.44%	55.10%
Transportation, Access to a Vehicle, Vehicle Ownership, Car Ownership, Road Access	29.73%	50.94%	51.72%	16.67%	32.65%
Language Barriers, Speak Dominate Language as Second Language (e.g. "English as a Second Language")	17.57%	22.64%	31.03%	0.00%	18.37%
Population Density, Population Change	51.35%	28.30%	31.03%	61.11%	36.73%
Disability	35.14%	39.62%	55.17%	38.89%	30.61%
Single-Parent Household	16.22%	24.53%	34.48%	11.11%	20.41%
Water	32.43%	15.09%	10.34%	27.78%	20.41%

Technology, Telephone, Television, Radio, Internet, Computer	20.27%	7.55%	6.90%	16.67%	8.16%
Electricity, Power, Energy	21.62%	7.55%	3.45%	27.78%	12.24%
Sewage, Toilet, Sanitation, Garbage Collection	25.68%	9.43%	6.90%	11.11%	10.20%
Mobile Homes, Informal Housing, "Slums", Low Qualities Walls	29.73%	35.85%	48.28%	11.11%	22.45%
Rooms, Crowding, Household Size	27.03%	30.19%	48.28%	22.22%	18.37%
Nursing Homes and Nursing Home Residents	8.11%	11.32%	13.79%	5.56%	10.20%
Schools, Students, and Universities	5.41%	15.09%	3.45%	0.00%	4.08%
Hospitals, Hospital Beds, Physicians, and Doctors	37.84%	22.64%	24.14%	44.44%	22.45%
Tourism and Tourists	5.41%	5.66%	0.00%	0.00%	4.08%
Primary, Secondary, Tertiary Industry, and Industry Generally ("Employed In" Included)	39.19%	20.75%	27.59%	33.33%	24.49%
Measures of Racial and Ethnic Minorities	59.46%	64.15%	72.41%	61.11%	44.90%

Note: "Other" category does not include COVID-19 contexts.

4.6. Geographic Focus

In the 246 articles analyzed, SVIs were conceptualized and or applied in 91 different countries. This finding illustrates the vast distribution and reach of the SVI as a core methodology for vulnerability assessment. Unsurprisingly, however, nearly half of the studies examined (n = 115; 46.7%) occurred in the United States. Additionally, China (n = 24; 9.8%) and Brazil (n = 11; 4.5%) were well-represented. At a regional-scale, southern countries in South America, the northern, western, and eastern African continent, and countries in Europe and Central Asia were relatively underrepresented. **Figure 3** illustrates this distribution. Further, the geographical contexts within the countries studied was heterogenous. Multiple geographic contexts (46.3%), coastal ocean (26.4%), and urban settings (25.2%) were the most prominent across the 246 articles examined. Other contexts included coastal (rivers, lakes) (9.8%), rural (8.5%), mountainous (2.9%), peri- urban / sub-urban / ex-urban (2.9%) and desert (0.41%).

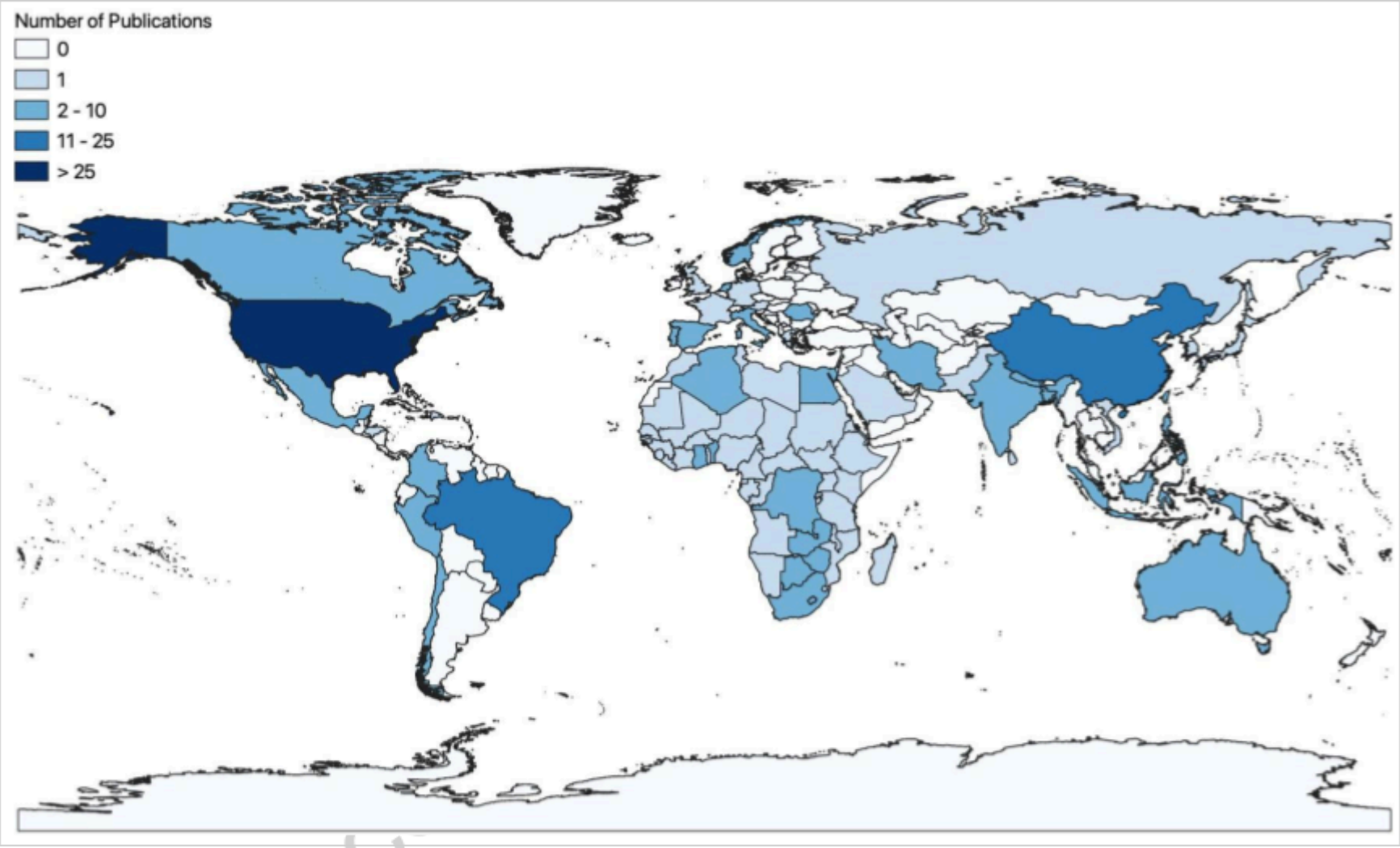

Figure 3: Geographic focus of the articles analyzed.

4.7 Policy Implications

Policy implications are an important component of social vulnerability analyses. Most articles (82.52%) include some sort of policy recommendation, further showing how critical SVIs are to government action around protecting vulnerable populations from disaster risk. Policy recommendations from researchers tend to fall into seven overarching categories: disaster planning and management, hazard education, mapping and map use, information distribution and informing, resource allocation and distribution, disaster mitigation, and COVID-19 risk mitigation policies. Disaster planning and management recommendations (54.90%) often suggest policymakers and emergency managers use the authors' study on, or construction of, the specific SVI when making disaster plans. Information distribution and informing, along with disaster mitigation and resource allocation take up a smaller percentage (29.41%, 22.55%, and 18.63% respectively) but are still considered in many policy recommendations. COVID-19 policy recommendations are prevalent (19.12%) mostly due to the rise in COVID-19 social vulnerability research in 2020-2021.

Even with the prevalence of policy recommendations across articles, often these policy recommendations are made for *during* or *after* the disaster cycle (warning systems, resource allocation, etc.). Policy tends to not show up until the conclusion section of articles, and then, only briefly, and at times obliquely, address policy implications. In this sense, we observe policy implications are additive, or "tagged on" to the focus of applying the SVI.

To be clear, this finding does not mean that there are not robust policy recommendations for both during and after hazards, and outside of the hazard context, which include addressing the social inequities that come from political and economic systems of oppression. Yellow Horse et al. (2020), in their analysis on social vulnerability and racism against Indigenous people, call for the recognition of Tribal sovereignty, place-based research and solutions, including research that does not aggregate Indigenous peoples within aggregated racial data, and policy solutions directly shaped by Indigenous knowledge frameworks. Others point to generalized policy solutions outside of hazards. Ge et al. (2019) suggest that policy makers should promote economic growth or improve public welfare allowances for the urban poor to reduce inequalities. Saldajeno et al. (2012) argue for focusing on higher education and social capital to mitigate social vulnerability. Wigtil et al. (2016) promote long-term solutions of assessing land-use policies, as well as economic and political incentives that contribute to wildfire vulnerability. Some researchers caution against using SVIs in policy without further investigation (Spielman et al. 2020).

Even while we highlight specific policy recommendations outside of "times of hazard," most policy recommendations are not the core of analysis. We find policy solutions are either highly general and or are focused on immediate risk reduction during or after hazards. The application of SVIs, not for radical policy change but for SVI replication, typifies the literature. As stated in the **Introduction**, SVIs were developed to identify socially vulnerable populations, such that risks could be addressed by government agencies or other organizations. Hence, one of the principal uses of SVIs involves their implications for policymaking and resource allocation to mitigate hazard related risks.

5. Discussion

The development and application of SVIs constitute one important method for operationalizing the social vulnerability paradigm. The last two decades saw researchers apply SVIs across 20 distinct hazard and disaster contexts in 91 countries, with the intention of delivering risk mitigation information and measures for policymakers. Our systematic scoping review has identified three overarching deficiencies and limitations across content, method, and application, which hampers more effective application of the SVI. These three areas, described below, lead us to conclude that the practice of SVI development and use has not experienced significant evolution or novelty since its inception in 2003.

5.1 Limitations and *Deficiencies of Existing Approaches*

The three connected insights below reflect our general findings.

Insight #1 - *SVIs reflect deductive and a priori determinations of risk without place-based rigor.* We found most articles (81%) drew social vulnerability indicators and theory from previously developed SVIs. While such replication is not inherently negative, and likely reflects, to a certain extent, established risk factors associated with hazards across multiple contexts, we find the *epistemological and methodological processes* through which indicators are reproduced warrants concern. Through our review, we found articles largely used deductive, *a priori* approaches to determine risk indicators, at the expense of inductively derived representations of vulnerability. Even here, we found the depth of theoretical analysis determining these indicators was often surficial – and did not reflect place-based theorizations, citations, or knowledge of vulnerability as a relational concept (cf. Cutter et al. 2003). Further, this inadequate theorization extended beyond the selection of indicators, and into their operationalization. For instance, we found little evidence of incorporating theoretical justifications for weighting certain variables over others. Indicators were often weighted for statistical reasons (e.g., Principal Components Analysis [PCA] factor loadings) – not established theoretical understandings of processes that unevenly distribute risk (cf. Tate et al. 2015). Most articles exclusively relied upon quantitative and/or spatial methods (94%) and used secondary or tertiary data alone (80%), without validation and ground-truthing processes (76%). Qualitative, community-based, and mixed qualitative-quantitative methods approaches were few and far between. When indicators are inductively developed and operationalized through these methodologies, they can better reflect and incorporate the complexity of populations and local contexts. Based on these empirical findings, we suggest deductive and *a priori* approaches help explain the consistency of social vulnerability indicators used across diverse hazards and geographies. These research processes, while intended to provide a "snapshot" of vulnerability, risk undermining the ability to identify, measure, and validate vulnerability as a place-based and context-specific phenomena. Moving forward, SVIs require robust theorization, bottom-up learning processes, and validation of their efficacy.

Insight #2 – *SVIs reflect proxies of risk – and not underlying systemic causes*. Many definitions of vulnerability and social vulnerability used in articles recognize the role that political power plays in determining the disparities in harm within the disaster cycle (**section 4.2**). A central

factor influencing social vulnerability is how limited access to political power and representation can influence environmental risks (Cutter 2012). However, a discrepancy exists, whereby SVI indicators commonly reflect characteristics (outcomes) of people and communities, over the very systems that produce marginalization and risk (causes). There might be an apprehension of government agencies to use explicitly political variables; however, political variables can incorporate dimensions that are beyond partisan politics. These can include variables such as voter turnout, civic engagement, ties with government officials or agencies (vertical social capital), or trust in government. For example, variables that reflect problems of governance, representation, influence, or issues with existing governmental systems can reflect politics, not in the partisan sense, but in the ability for socially vulnerable populations to enact change to reduce their hazard risk. By focusing on characteristics and symptom-focused policies, many of these studies omit the causes of social vulnerability. Further, only 6.5% of articles included in this review construct and compare social vulnerability across different years, providing only a snapshot analysis. This ignores the fluidity of social vulnerability as it changes over time. As stated in *Insight #1*, few analyses incorporate qualitative data, such as discussions with communities and community leaders, historical contextual analyses, or other understanding of place, social, economic, and political dynamics outside of numerical data. These methods can bring much needed perspective on how communities view themselves and their own vulnerability, the historical context of disaster risk, and the needed responses as identified by marginalized populations for mitigating harm.

Insight #3 – *SVIs inform risk communication and hazard mitigation, not long-term social vulnerability reduction.* We find the methodology and content of SVIs are positioned to disseminate information around proactive hazard mitigation and disaster response for stakeholders, such as emergency managers or planners. Applications of the SVI are not well-positioned to provide guidance for application that leads to reducing harm to socially vulnerable populations over time. However, even government mandated assessments of vulnerability can fall short, including the ability to serve populations with the most need (Wood et al. 2021). The continued focus on proxies and indicators, instead of relations and systems, shapes the solution- space and set of policy recommendations for vulnerability reduction. We suggest that researchers develop indices for solutions to specific problems, and, further, use SVI development as an opportunity to focus on the causes of social vulnerability rather than the symptoms.[13] The intention of the SVI for locating and understanding socially vulnerable populations in hazard contexts can be further expanded through understanding and addressing issues that contribute to everyday vulnerabilities of these populations. We recognize that SVI publications have varying goals and audiences – such as immediate disaster response, early warning systems, risk communication, and resource allocation (ATSDR 2022); however, we maintain that an explicit set of root causes that shape vulnerability will inform policy planning to remove systemic barriers in the long-term.

[13] Here, we suggest researchers focus on, for example, robust social policies to combat systems of oppression, such as expanding healthcare or providing public housing for low-income households

over solely focusing on issues of preparedness or response, such as Federal flood insurance programs.

5.2 Steps Forward: Towards a "Next Generation" of Social Vulnerability Indices

SVI research increased our collective understanding of social vulnerability through models and frameworks that study diverse hazard impacts. Although rare, innovation is happening. From our analysis, we find a "next generation" of SVIs is underway, with important works on inclusion of Indigenous knowledge (Yellow Horse et al. 2020), incorporating the elderly in "place audits" (Sun et al. 2017), and focus on strength-based measures and community partners (Ogie and Pradhan 2019). The COVID-19 pandemic produced social vulnerability analyses demonstrating the unequal risks and impacts experienced by marginalized communities (Gaynor and Wilson 2020; Yellow Horse et al. 2020; Freese et al. 2021; Karmakar et al. 2021; Zachrison et al. 2021), as well as work on the political dynamics of the pandemic (Page-Tan and Corbin 2021). Beyond an SVI context, calls for measuring processes of marginalization in addition to commonly used socio- demographic proxies (Carter 2009) extend indicator frameworks.

6. Limitations

This study comes with several important limitations. First, we assessed the SVI as a specific methodological and epistemological framework for measuring social vulnerability to hazard and disaster contexts. We recognize a plurality of indices or frameworks exist on social vulnerability, including the Livelihood Vulnerability Index (Hahn et al. 2007), Socio-Economic Vulnerability Index, and other indices used in public policy, such as FEMA's National Risk Index, the PESTEL Framework, the Baseline Resilience Index for Communities (BRIC), the Community Disaster Resilience Index (CDRI), the Community Resilience Index (CRI), the United States Environmental Protection Agency's Environmental Justice Screening and Mapping Tool (EJScreen), the Resilience Capacity Index (RCI), and the Rural Capacity Index. Thus, we believe a systematic review comparing the relevance of these indices with one another is an important future research objective to evaluate the compendium of social vulnerability research. Second, the literature examined are English-language documents. Multi-lingual assessments are crucial for de- centering English-language literature and concepts and will further serve crucial roles in understanding how vulnerability is understood and communicated. Additionally, we recognize that the specific variability indicators reflect a *specific method* of assessing vulnerability, which emerges from a distinctly U.S.-centric approach. By focusing on social vulnerability indices, we may miss important literature and assessments of social vulnerability that have emerged in different countries or contexts. This merits future research and analysis.

7. Conclusions

As we continue to better understand the state of social vulnerability scholarship using SVIs, researchers should assess the purpose of their analyses, epistemological and statistical reasoning and assumptions, and consider how systems and processes can be centered over individual characteristics to identify and respond to the risks associated with hazards and disasters. One approach to support this involves using quantitative and qualitative methodologies. As we stated in our **Introduction**, both methodologies are complementary in helping us understand and design

more effective measurement tools. Given the proliferation of SVIs, we believe these methods and the broader set of considerations identified (*per* our **Discussion**) related to conceptualizing and applying SVIs will better equip future research to evaluate determinants of vulnerability, and their root causes, across a range of different hazard contexts.

The findings above allow us to outline three major and necessary steps forward for SVI development. First, conventional methodological approaches must be expanded to include qualitative and community-based research designs. These approaches can significantly improve the conceptualization and policy recommendations in place-based and contextually specific manners. Second, indices must emphasize intersectional systems of oppression over individual and group-specific characteristics or proxies of vulnerability (low-income, race, gender, etc.). To do so otherwise hampers the ability for the very policies, politics, socializations, and economic systems productive of risk to be reformed. Last, problem-oriented, and solutions-focused research (Peek et al. 2020) can enhance the usability and impact of SVI research conducted. We call for researchers to continue to focus on hazard contexts but go further and *offer solutions outside of time of hazards.* These novelties, we argue, have the potential to counter the weak evolution and stagnation of the SVI for reducing social vulnerability in an era of severe socio-environmental and public health risks.

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Appendix A: RSTs and MeSH Terms from each database. Note: We do not provide RSTs or MeSH terms for the "Social Vulnerability Ind*" because we are concerned with this instrument. Some of the RSTs and MeSH Terms below reflect regressive language as indexed by the database.

Database	**Authors' Terms**	**RSTs or MeSHs** *A subset of terms was selected depending on relevance and whether they were already included.*
Web of Science Core Collection	N/A	• N/A – Thesauri not available.
SocINDEX	hazard*	• EMERGENCY management • DISASTER mitigation • HAZARDS mitigation • MITIGATION, Hazard • NATURAL hazard mitigation • NATURAL hazards mitigation
	"natural hazard*"	• HAZARD mitigation • NATURAL hazard mitigation • RIGHT to refuse hazardous work • NATURAL resources • RESOURCE exploitation • RENEWABLE natural resources • NATURE & nurture • CONSERVATION of natural resources • HEALTH risk assessment • NATURALISM • NATURAL disasters • ECOTOURISM • ANTHROPOGENIC effects on nature • NATURE therapy • NATURAL selection • RIGHT to natural resources control
	disaster*	• EMERGENCY management • DISASTER relief • CHURCH work with disaster victims • DISASTER medicine • INTERNATIONAL cooperation on disaster relief • DISASTER tourism

		• DISASTER psychology • WOMEN in disaster relief • HAZARD mitigation • EMERGENCY housing • EMERGENCY drills • VICTIMS • VICTIM assistance • VICTIM compensation • INSURANCE crimes • CHILD victims
	risk*	• N/A
	threat*	• N/A
	emergenc*	• PUBLIC safety • DISASTER relief • EMERGENCY drills • HAZARD mitigation • CIVIL defense • EMERGENCY housing • FIRST responders • CONSEQUENCE management (Emergency management) • DISASTER management • DISASTER planning • DISASTER preparedness • DISASTER prevention • DISASTER relief -- Management • DISASTER relief -- Planning • DISASTER response • DISASTERS -- Planning • DISASTERS -- Preparedness • DISASTERS -- Prevention • EMERGENCIES -- Management • EMERGENCIES -- Planning • EMERGENCY planning • EMERGENCY preparedness • EMERGENCY response planning

	“climat* chang*"	• GLOBAL temperature changes • GLOBAL warming • CHANGES, Climatic • CLIMATE changes • CLIMATE variations • CLIMATIC change • CLIMATIC changes • CLIMATIC changes -- Environmental aspects • CLIMATIC fluctuations • CLIMATIC variations • GLOBAL climate • GLOBAL climatic changes
	“climat* vari*"	• N/A: "Use Climate Change" above.
	hurricane*	• NATURAL DISASTERS • DROUGHTS • ENVIRONMENTAL degradation • HURRICANES • ENVIRONMENTAL policy
	storm*	• NATURAL DISASTERS • DROUGHTS • ENVIRONMENTAL degradation • HURRICANES • ENVIRONMENTAL policy
	"extreme weath*"	• N/A

	earthquake*	● EARTHQUAKES -- Social aspects ○ SOCIAL support
	tsunami*	● DISASTER relief ● EMERGENCY management ● HUMAN services ● CIVILIAN evacuation ● DISASTER medicine ● EMERGENCY housing ● PUBLIC shelters ● TSUNAMI relief ● WOMEN in disaster relief

		• DISASTER assistance • DISASTER recovery • EMERGENCY assistance in disasters • EMERGENCY relief • RELIEF, Disaster
	volcan*	• N/A

	epidemic*	• CHRONIC fatigue syndrome • INFLUENZA • HYSTERIA (Social psychology) • HYSTERIA • EPIDEMICS • NEUROMYASTHENIA, EpidemicUseCHRONIC fatigue syndrome • EPIDEMIC neuromyastheniaUseCHRONIC fatigue syndrome • EPIDEMIC myalgic encephalomyelitisUseCHRONIC fatigue syndrome • DISEASE outbreaks • COMMUNICABLE diseases • DISEASE clusters • DISEASE -- Outbreaks • DISEASES -- Outbreaks • OUTBREAK of diseases • OUTBREAKS of disease • PESTILENCES
	pandemic*	• PLAGUE • EPIDEMICS
	flood*	• FLOODS -- Social aspects • WEATHER -- Social aspects
	"heat*"	• NUCLEAR energy • CRIMES of passion
	landslide*	• N/A
	fire*	• N/A

	"wildfire*"	• N/A
	"wild fire*"	• N/A
	geohazard*	• N/A
	"air qual*"	• N/A
	"pollut*"	• AIR pollution • AIR pollution control • INDOOR air pollution • TOBACCO smoke pollution • ENVIRONMENTAL law • ENVIRONMENTAL crimes • ACID rain • HOUSEHOLD air pollutionUseINDOOR air pollution • CONTROL of air pollutionUseAIR pollution control • AIR pollution, IndoorUseINDOOR air pollution • AIR pollution control researchUseAIR pollution control • AIR pollution -- ControlUseAIR pollution control • AIR -- PollutionUseAIR pollution • POLLUTION • INDOOR air pollution • GLOBAL warming • AIR -- Pollution • ATMOSPHERE -- Pollution • ATMOSPHERIC pollution • NOISE pollution • TOBACCO smoke pollution • URBAN pollution • WATER pollution • ENVIRONMENTAL degradation • ENVIRONMENTAL engineering • ENVIRONMENTAL health

		• ENVIRONMENTAL medicine • ENVIRONMENTAL policy • ENVIRONMENTAL protection • POLLUTANTS • POLLUTION & economics • WASTE management • CHEMICAL pollution • CHEMICALS -- Environmental aspects • CONTAMINATION of environment • ENVIRONMENTAL pollution • POLLUTION -- Control • POLLUTION -- Environmental aspects
PubMed	hazard*	• N/A
	"natural hazard*"	• N/A
	disaster*	• Disaster Planning • Strategic Stockpile • Emergencies • Emergency Shelter • Mass Casualty Incidents • Medical Countermeasures • Natural Disasters • Avalanches • Cyclonic Storms • Droughts • Earthquakes • Floods • Landslides • Tidal Waves • Tornadoes • Wildfires • Relief Work • Rescue Work
	risk*	• Risks • Relative Risk • Relative Risks • Risk, Relative

		• Risks, Relative
	threat*	• N/A
	emergenc*	• N/A
	“climat* chang*"	• Change, Climate • Changes, Climate • Climate Changes
	“climat* vari*"	• N/A
	hurricane*	• Cyclonic Storm • Storm, Cyclonic • Storms, Cyclonic • Cyclone • Cyclones • Hurricanes • Hurricane • Tropical Storm • Storm, Tropical • Storms, Tropical • Tropical Storms • Typhoons • Typhoon
	storm*	• Cyclonic Storm • Storm, Cyclonic • Storms, Cyclonic • Cyclone • Cyclones • Hurricanes • Hurricane • Tropical Storm • Storm, Tropical • Storms, Tropical • Tropical Storms • Typhoons • Typhoon

	"extreme weath*"	• Weather, Extreme • Extreme Cold Weather • Extreme Hot Weather
	earthquake*	• Earthquake
	tsunami*	• Tsunami
	volcan*	• Volcanic Eruption • Eruption, Volcanic • Eruptions, Volcanic • Volcanic Ash • Ash, Volcanic • Volcanic Gases • Gases, Volcanic
	epidemic*	• Opioid Epidemic • Pandemics
	pandemic*	• Pandemics
	flood*	• Flooding, Catastrophic • Catastrophic Floodings • Floodings, Catastrophic • Catastrophic Flooding
	"heat*"	• Hot Temperatures • Temperature, Hot • Temperatures, Hot • Heat
	landslide*	• Landslide • Rockslides • Rockslide • Mudslides • Mudslide
	fire*	• Fire
	"wildfire*"	• Wildfire • Wildland Fires

		• Brush Fires • Brush Fire • Fire, Brush • Fires, Brush • Forest Fires • Fire, Forest • Fires, Forest • Forest Fire • Wild Fires • Fire, Wild • Fires, Wild • Wild Fire
	"wild fire*"	• Wildfire • Wildland Fires • Brush Fires • Brush Fire • Fire, Brush • Fires, Brush • Forest Fires • Fire, Forest • Fires, Forest • Forest Fire • Wild Fires • Fire, Wild • Fires, Wild • Wild Fire
	geohazard*	• N/A
	"air qual*"	• Air Pollutions • Pollution, Air • Air Quality
	"pollut*"	• Pollution, Environmental • Soil Pollution • Pollution, Soil
Public Affairs Information Services (PAIS)	hazard*	• Accidents • Diseases • Facility Siting Disputes

		• Natural Disasters • Occupational Safety and Health • Risk • Safety • Threat • Toxic Substances • Waste Management
	"natural hazard*"	• Civil Defense • Disaster Relief • Famine • Hazards • Humanitarian Aid • Humanitarian Intervention • Reconstruction • Scarcity • Victims • Weather
	disaster*	• Crises • Disaster Preparedness • Disaster Relief • Fire • Human Security • National Guard • Social Problems • Victims
	risk*	• Chance • Decision Making • Game Theory • Hazards • Health Behavior • Insurance • Probability • Risk Assessment • Security • Sexual Behavior • Threat

	threat*	• Abuse • Aggression • Anxiety • Brinkmanship • Conflict • Crises • Hazards • Hostility • Human Security • Risk • Security • Stress
	emergenc*	• Accidents • Assistance • Civil Disorders • Crises • Human Security • National Guard • Public Services
	“climat* chang*"	• Global Warming • Air Pollution • Environmental Degradation • Environmental Policy • Weather • World Problems
	“climat* vari*"	• N/A
	hurricane*	• N/A
	storm*	• N/A
	"extreme weath*"	• N/A

	earthquake*	• Civil Defense • Disaster Relief • Famine • Hazards

		• Humanitarian Aid • Humanitarian Intervention • Reconstruction • Scarcity • Victims • Weather
	tsunami*	• N/A
	volcan*	• N/A
	epidemic*	• Diseases • Epidemiology • Public Health
	pandemic*	• N/A
	flood*	• Civil Defense • Disaster Relief • Famine • Hazards • Humanitarian Aid • Humanitarian Intervention • Reconstruction • Scarcity • Victims • Weather
	"heat*"	• N/A
	landslide*	• N/A
	fire*	• Accidents • Arson • Deforestation • Disasters • Safety
	"wildfire*"	• N/A

	"wild fire*"	• N/A
	geohazard*	• N/A
	"air qual*"	• Smog • Acid Rain • Climate Change • Human Ecology • Pollution Control • Urban Areas • Wastes
	"pollut*"	• Brownfields • Conservation • Diseases • Earth (Planet) • Ecology • Environment • Environmental Degradation • Environmental Law • Environmental Protection • Facility Siting Disputes • Health • Human Ecology • Industrialism • Land Use • Pollution Control • Public Health • Radiation • Toxic Substances • Waste Management • Wastes • Water Supply • Waterways • World Problems
Agriculture and Environmental Sciences	hazard*	• Accident insurance • Contamination • Safety

Database (AESD)	"natural hazard*"	• N/A
	disaster*	• Aftershocks • Avalanches • Earthquakes • Floods • Landslides • Mudslides • Tidal waves • Tsunamis • Black swan event • Catastrophes • Contingency planning • Disaster insurance • Disaster recovery • Disaster relief • Disaster studies • Emergencies • Emergency communications systems • Emergency preparedness • Emergency procedures • Explosions • Fatalities • Insured losses • Mass casualty incidents • Property damage • Shelter in place • State of emergency • Storm damage • Survivalists
	risk*	• N/A
	threat*	• Cyberbullying • Duress • Threat assessment • Violence

	emergenc*	• Civil defense • Contingency planning

		• Disaster studies • Disasters • Emergencies • Emergency medical care • Emergency procedures • Homeland Security Act 2002-US • Mass casualty incidents • Survivalists
	“climat* chang*"	• Biodiversity • Carbon footprint • Carbon sequestration • Climate science • Denialism • El Nino • Environmental history • Environmental policy • Environmental research • Geoengineering • Greenhouse effect • Ice ages • Ice sheets • Ice shelves • Paleoclimate science • Paris Agreement • Phenology • Urban heat islands • Weather
	“climat* vari*"	• N/A
	hurricane*	• • Cyclones • Storm damage • Tornadoes • Wind
	storm*	• Hail • Lightning • Precipitation

		• Rain • Storm damage • Tidal waves • Wind
	"extreme weath*"	• N/A
	earthquake*	• Aftershocks • Earthquake damage • Fault lines • Geology • Seismic engineering • Seismology • Tidal waves • Tsunamis
	tsunami*	• Earthquake damage • Earthquakes • Ocean waves • Propagation • Seismology • Tidal waves

	volcan*	• Geology • Geophysics • Igneous rocks • Lava • Magma • Mountains • Stratigraphy • Volcanology
	epidemic*	• Addictions • Antibodies • Avian flu • Coronaviruses • Disease • Disease control • Disease prevention • Disease transmission • Drug addiction

		• Drug resistance • Ebola virus • Global health • Health surveillance • Herd immunity • Infectious diseases • Middle East respiratory syndrome • Pandemics • Poliomyelitis • Public health • Quarantine • Serology • Severe acute respiratory syndrome • Social distancing • Swine flu • Tropical diseases • Virulence
	pandemic*	• American Rescue Plan Act 2021-US • Antibodies • Black swan event • Consolidated Appropriations Act 2021-US • Contact tracing • Coronavirus Aid Relief & Economic Security Act 2020-US • COVID-19 • COVID-19 diagnostic tests • COVID-19 vaccines • Defense Production Act 1950-US • Disease • Disease prevention • Disease transmission • Epidemics • Essential workers • Families First Coronavirus Response Act 2020-US • Global health • Health surveillance • Herd immunity • Hospital ships

		• Infectious diseases • mRNA vaccines • Multisystem inflammatory syndrome in children • Sanitizers • Serology • Severe acute respiratory syndrome coronavirus 2 • Shelter in place • Social distancing • Swine flu • Virulence • Wildlife trade
	flood*	• Flood damage • Floodplains • Rivers • Water • Weather
	"heat*"	• Cold • Differential scanning calorimetry • Energy dissipation • Heat conductivity • Heat detection • Heat engines • Heat exchangers • Heatstroke • Melting • Temperature • Thermal pollution • Thermodynamics • Thermogenesis • Urban heat islands
	landslide*	• Avalanches • Soil erosion control
	fire*	• Arson • Fire alarms • Fire departments

		• Fire extinguishers • Fire hazards • Fire insurance • Fire prevention • Firefighters • Flammable materials • Pyromania • Smoke detectors • Smoke inhalation
	"wildfire*"	• Forest management • Forests • Prescribed fire • Trees
	"wild fire*"	• Forest management • Forests • Prescribed fire • Trees
	geohazard*	• N/A
	"air qual*"	• Air pollution • Airborne particulates • Emissions • Environmental monitoring • Indoor air quality • Ozone • Smog
	"pollut*"	• Clean Air Act 1990-US • Clean Air Act-US • Clean Water Act-US • Contamination • Ecology • Environment • Environmental cleanup • Environmental conditions • Environmental crimes • Environmental impact • Environmental monitoring

		• Environmental risk • Hazardous substances • Human influences • Pollution control • Pollution studies • Sewage disposal • Toxicity
Humanities International Database	hazard*	• DANGER in literature • HAZARD in literature • PERIL in literature
	"natural hazard*"	• N/A
	disaster*	• DISASTERS • DISASTER survivors • NATURAL disaster victims • VICTIMS of disasters • VICTIMS of natural disasters • FAMINES in literature • NATURAL disasters in literature • NUCLEAR accidents in literature • CALAMITIES in literature • CATASTROPHES in literature
	risk*	• N/A
	threat*	• N/A

	emergenc*	• ACCIDENTS • DISASTERS • EMERGENCIES -- Law & legislation • FIRES • PLANNING • CONSEQUENCE management (Emergency management) • DISASTER management • DISASTER planning • DISASTER preparedness • DISASTER prevention

		• DISASTER relief -- Management • DISASTER relief -- Planning • DISASTER response • DISASTERS -- Planning • DISASTERS -- Preparedness • DISASTERS -- Prevention • EMERGENCIES -- Management • EMERGENCIES -- Planning • EMERGENCY planning • EMERGENCY preparedness • EMERGENCY response planning
	“climat* chang*"	• N/A
	“climat* vari*"	• N/A
	hurricane*	• N/A
	storm*	• N/A
	"extreme weath*"	• N/A

	earthquake*	• EARTHQUAKES in literature • EARTHQUAKES in motion pictures • GEOLOGY • EARTHQUAKE temblors • EARTHQUAKE tremors • QUAKES (Earthquakes) • TEMBLORS (Earthquakes) • TREMORS (Earthquakes)
	tsunami*	• N/A
	volcan*	• N/A
	epidemic*	• COMMUNICABLE diseases • EPIDEMICS in literature • DISEASE -- Outbreaks • DISEASES -- Outbreaks • OUTBREAK of diseases

		• OUTBREAKS of disease • PESTILENCES
	pandemic*	• ASIAN Flu Pandemic, 1957 • BLACK Death pandemic, 1348-1351, in literature • CHOLERA pandemic, 1892 • BLACK Death pandemic, 1348-1351 • PLAGUE • INFLUENZA Epidemic, 1918-1919 • HONG Kong flu, 1968 • INFLUENZA Pandemic, 1918-1919 • HONG Kong flu pandemic, 1968 • BLACK Death pandemic, 1348-1351 • ASIAN Flu Pandemic of 1957
	flood*	• N/A - Nothing Relevant
	"heat*"	• N/A
	landslide*	• N/A
	fire*	• CHEMISTRY • FIRES • ARSON • DISASTERS • FIRE in literature • FIRE walking
	"wildfire*"	• N/A
	"wild fire*"	• N/A
	geohazard*	• N/A
	"air qual*"	• N/A
	"pollut*"	• ENVIRONMENTAL policy • ENVIRONMENTAL protection • HARAI (Shinto)

		• MISOGI (Shinto) • POLLUTION in literature • CHEMICAL pollution • CHEMICALS -- Environmental aspects • CONTAMINATION of environment • ENVIRONMENTAL pollution • POLLUTION -- Control • POLLUTION -- Environmental aspects

Appendix B: Reproducible search criteria for each database.

Database	Search String
Web of Science Core Collection **TS = Title, Author, Abstract, Keywords and Keywords Plus®* N = 369 ***Filters*** **Publication Date Range:** January 01, 2000 - December 31, 2021 **Language:** English	**Original code** TS=((“social vulnerability ind*”) AND (hazard* OR “natural hazard*” OR disaster* OR risk* OR threat* OR emergenc* OR (climat* NEAR/5 chang*) OR (climat* NEAR/5 vari*) OR hurricane* OR storm* OR (weath* NEAR/5 extreme*) OR (severe NEAR/5 weath*) OR earthquake* OR tsunami* OR volcan* OR epidemic* OR pandemic* OR flood* OR heat* OR landslide* OR fire* OR wildfire* OR “wild fire*” OR geohazard* OR “air qual*” OR pollut* OR “global warming” OR drought* OR evacuation* OR outbreak* OR disease* OR contaminat* OR cyclon* OR avalanche* OR “tidal wave*” OR tornado* OR typhoon* OR catastroph* OR rockslid* OR mudslid* OR famine* OR scarc* OR crisis* OR crise* OR degrad* OR casualt* OR “El Niño” OR “La Niña” OR hail* OR shock* OR seismic* OR coronavirus* OR “COVID-19” OR “SARS-CoV-2” OR virus* OR “forest fire*” OR calamit*)) **Replicated code** "Social Vulnerability Ind*" (Topic) and (hazard* OR “natural hazard*” OR disaster* OR risk* OR threat* OR emergenc* OR (climat* NEAR/5 chang*) OR (climat* NEAR/5 vari*) OR hurricane* OR storm* OR (weath* NEAR/5 extreme*) OR (severe NEAR/5 weath*) OR earthquake* OR tsunami* OR volcan* OR epidemic* OR pandemic* OR flood* OR heat* OR landslide* OR fire* OR wildfire* OR “wild fire*” OR geohazard* OR “air qual*” OR pollut* OR “global warming” OR drought* OR evacuation* OR outbreak* OR disease* OR contaminat* OR cyclon* OR avalanche* OR “tidal wave*” OR tornado* OR typhoon* OR catastroph* OR rockslid* OR mudslid* OR famine* OR scarc* OR crisis* OR crise* OR degrad* OR casualt* OR “El Niño” OR “La Niña” OR hail* OR shock* OR seismic* OR coronavirus* OR “COVID-19” OR “SARS-CoV-2” OR virus* OR “forest fire*” OR calamit*) (Topic)
PubMed **Search conducted for all-*	**Original code**

text within a publication (i.e., not only Title, Abstract, Keywords). N = 164 ***Filters*** **Publication Date Range:** January 01, 2000 - December 31, 2021 **Language:** English	((“social vulnerability ind*”) AND (hazard* OR “natural hazard*” OR disaster* OR risk* OR threat* OR emergenc* OR “climat* chang*” OR “climat* vari*” OR hurricane* OR storm* OR “extreme weath*” OR “severe weath*” OR earthquake* OR tsunami* OR volcan* OR epidemic* OR pandemic* OR flood* OR heat* OR landslide* OR fire* OR wildfire* OR “wild fire*” OR geohazard* OR “air qual*” OR pollut* OR “global warming” OR drought* OR evacuation* OR outbreak* OR disease* OR contaminat* OR cyclon* OR avalanche* OR “tidal wave*” OR tornado* OR typhoon* OR catastroph* OR rockslid* OR mudslid* OR famine* OR scarc* OR crisis* OR crise* OR degrad* OR casualt* OR “El Niño” OR “La Niña” OR hail* OR shock* OR seismic* OR coronavirus* OR “COVID-19” OR “SARS-CoV-2” OR virus* OR “forest fire*” OR calamit*))
SocINDEX **Author’s abstract only* N = 9 ***Filters*** **Publication Date Range:** January 01, 2000 - December 31, 2021; *NOTE: EBSCO did not report results before 2003.* **Language:** English **Reviewed:** Peer-reviewed	**Original code** ((“social vulnerability ind*”) AND (hazard* OR “natural hazard*” OR disaster* OR risk* OR threat* OR emergenc* OR (climat* n5 chang*) OR (climat* n5 vari*) OR hurricane* OR storm* OR (weath* n5 extreme*) OR (severe n5 weath*) OR earthquake* OR tsunami* OR volcan* OR epidemic* OR pandemic* OR flood* OR heat* OR landslide* OR fire* OR wildfire* OR “wild fire*” OR geohazard* OR “air qual*” OR pollut* OR “global warming” OR drought* OR evacuation* OR outbreak* OR disease* OR contaminat* OR cyclon* OR avalanche* OR “tidal wave*” OR tornado* OR typhoon* OR catastroph* OR rockslid* OR mudslid* OR famine* OR scarc* OR crisis* OR crise* OR degrad* OR casualt* OR “El Niño” OR “La Niña” OR hail* OR shock* OR seismic* OR coronavirus* OR “COVID-19” OR “SARS-CoV-2” OR virus* OR “forest fire*” OR calamit*)) **Replicated code** AB (“social vulnerability ind*”) AND AB ((hazard* OR “natural hazard*” OR disaster* OR risk* OR threat* OR emergenc* OR (climat* n5 chang*) OR (climat* n5 vari*) OR hurricane* OR storm* OR (weath* n5 extreme*) OR (severe n5 weath*) OR earthquake* OR tsunami* OR volcan* OR epidemic* OR pandemic* OR flood* OR heat* OR landslide* OR fire* OR wildfire* OR “wild fire*” OR geohazard* OR “air qual*” OR

	pollut* OR "global warming" OR drought* OR evacuation* OR outbreak* OR disease* OR contaminat* OR cyclon* OR avalanche* OR "tidal wave*" OR tornado* OR typhoon* OR catastroph* OR rockslid* OR mudslid* OR famine* OR scarc* OR crisis* OR crise* OR degrad* OR casualt* OR "El Niño" OR "La Niña" OR hail* OR shock* OR seismic* OR coronavirus* OR "COVID-19" OR "SARS-CoV-2" OR virus* OR "forest fire*" OR calamit*))
Humanities International Complete Database **Author's abstract only* N = 1 ***Filters*** **Publication Date Range:** January 01, 2000 - December 31, 2021 **Language:** English **Reviewed:** N/A on HICD	**Original code** ((("social vulnerability ind*") AND (hazard* OR "natural hazard*" OR disaster* OR risk* OR threat* OR emergenc* OR (climat* n5 chang*) OR (climat* n5 vari*) OR hurricane* OR storm* OR (weath* n5 extreme*) OR (severe n5 weath*) OR earthquake* OR tsunami* OR volcan* OR epidemic* OR pandemic* OR flood* OR heat* OR landslide* OR fire* OR wildfire* OR "wild fire*" OR geohazard* OR "air qual*" OR pollut* OR "global warming" OR drought* OR evacuation* OR outbreak* OR disease* OR contaminat* OR cyclon* OR avalanche* OR "tidal wave*" OR tornado* OR typhoon* OR catastroph* OR rockslid* OR mudslid* OR famine* OR scarc* OR crisis* OR crise* OR degrad* OR casualt* OR "El Niño" OR "La Niña" OR hail* OR shock* OR seismic* OR coronavirus* OR "COVID-19" OR "SARS-CoV-2" OR virus* OR "forest fire*" OR calamit*)) **Replicated code** AB ("social vulnerability ind*") AND AB ((hazard* OR "natural hazard*" OR disaster* OR risk* OR threat* OR emergenc* OR (climat* n5 chang*) OR (climat* n5 vari*) OR hurricane* OR storm* OR (weath* n5 extreme*) OR (severe n5 weath*) OR earthquake* OR tsunami* OR volcan* OR epidemic* OR pandemic* OR flood* OR heat* OR landslide* OR fire* OR wildfire* OR "wild fire*" OR geohazard* OR "air qual*" OR pollut* OR "global warming" OR drought* OR evacuation* OR outbreak* OR disease* OR contaminat* OR cyclon* OR avalanche* OR "tidal wave*" OR tornado* OR typhoon* OR catastroph* OR rockslid* OR mudslid* OR famine* OR scarc* OR crisis* OR crise* OR degrad* OR casualt* OR "El Niño" OR "La Niña" OR hail* OR shock* OR seismic* OR coronavirus*

	OR “COVID-19” OR “SARS-CoV-2” OR virus* OR “forest fire*” OR calamit*))
Agriculture and Environmental Sciences Database (ProQuest) *NOFT:* Anywhere but the full text N = 248 ***Filters*** **Publication Date Range:** January 01, 2000 - December 31, 2021 **Language:** English **Reviewed:** Peer-Reviewed	**Original code** (noft(“social vulnerability ind*”)) AND (noft(hazard*) OR noft(“natural hazard*”) OR noft(disaster*) OR noft(risk*) OR noft(threat*) OR noft(emergenc*) OR noft(climat* NEAR/5 chang*) OR noft(climat* NEAR/5 vari*) OR noft(hurricane*) OR noft(storm*) OR noft(weath* NEAR/5 extreme*) OR noft(severe NEAR/5 weath*) OR noft(earthquake*) OR noft(tsunami*) OR noft(volcan*) OR noft(epidemic*) OR noft(pandemic*) OR noft(flood*) OR noft(heat*) OR noft(landslide*) OR noft(fire*) OR noft(wildfire*) OR noft(“wild fire*”) OR noft(geohazard*) OR noft(“air qual*”) OR noft(pollut*) OR noft(“global warming”) OR noft(drought*) OR noft(evacuation*) OR noft(outbreak*) OR noft(disease*) OR noft(contaminat*) OR noft(cyclon*) OR noft(avalanche*) OR noft(“tidal wave*”) OR noft(tornado*) OR noft(typhoon*) OR noft(catastroph*) OR noft(rockslid*) OR noft(mudslid*) OR noft(famine*) OR noft(scarc*) OR noft(crisis*) OR noft(crise*) OR noft(degrad*) OR noft(casualt*) OR noft(“El Niño”) OR noft(“La Niña”) OR noft(hail*) OR noft(shock*) OR noft(seismic*) OR noft(coronavirus*) OR noft(“COVID-19”) OR noft(“SARS-CoV-2”) OR noft(virus*) OR noft(“forest fire*”) OR noft(calamit*)) **Replicated code** noft(("social vulnerability ind*")) AND noft((hazard* OR "natural hazard*" OR disaster* OR risk* OR threat* OR emergenc* OR (climat* NEAR/5 chang*) OR (climat* NEAR/5 vari*) OR hurricane* OR storm* OR (weath* NEAR/5 extreme*) OR (severe NEAR/5 weath*) OR earthquake* OR tsunami* OR volcan* OR epidemic* OR pandemic* OR flood* OR heat* OR landslide* OR fire* OR wildfire* OR "wild fire*" OR geohazard* OR "air qual*" OR pollut* OR "global warming" OR drought* OR evacuation* OR outbreak* OR disease* OR contaminat* OR cyclon* OR avalanche* OR "tidal wave*" OR tornado* OR typhoon* OR catastroph* OR rockslid* OR mudslid* OR famine* OR scarc* OR crisis* OR crise* OR degrad* OR casualt* OR "El Niño" OR "La Niña" OR hail* OR

	shock* OR seismic* OR coronavirus* OR "COVID-19" OR "SARS-CoV-2" OR virus* OR "forest fire*" OR calamit*))
Public Affairs Information Services (ProQuest) *NOFT:* Anywhere but the full text. N = 26 **Publication Date Range:** January 01, 2000 - December 31, 2021 **Language:** English **Reviewed:** Peer-Reviewed	**Original code** (noft("social vulnerability ind*")) AND (noft(hazard*) OR noft("natural hazard*") OR noft(disaster*) OR noft(risk*) OR noft(threat*) OR noft(emergenc*) OR noft(climat* NEAR/5 chang*) OR noft(climat* NEAR/5 vari*) OR noft(hurricane*) OR noft(storm*) OR noft(weath* NEAR/5 extreme*) OR noft(severe NEAR/5 weath*) OR noft(earthquake*) OR noft(tsunami*) OR noft(volcan*) OR noft(epidemic*) OR noft(pandemic*) OR noft(flood*) OR noft(heat*) OR noft(landslide*) OR noft(fire*) OR noft(wildfire*) OR noft("wild fire*") OR noft(geohazard*) OR noft("air qual*") OR noft(pollut*) OR noft("global warming") OR noft(drought*) OR noft(evacuation*) OR noft(outbreak*) OR noft(disease*) OR noft(contaminat*) OR noft(cyclon*) OR noft(avalanche*) OR noft("tidal wave*") OR noft(tornado*) OR noft(typhoon*) OR noft(catastroph*) OR noft(rockslid*) OR noft(mudslid*) OR noft(famine*) OR noft(scarc*) OR noft(crisis*) OR noft(crise*) OR noft(degrad*) OR noft(casualt*) OR noft("El Niño") OR noft("La Niña") OR noft(hail*) OR noft(shock*) OR noft(seismic*) OR noft(coronavirus*) OR noft("COVID-19") OR noft("SARS-CoV-2") OR noft(virus*) OR noft("forest fire*") OR noft(calamit*)) **Replicated code** noft(("social vulnerability ind*")) AND noft((hazard* OR "natural hazard*" OR disaster* OR risk* OR threat* OR emergenc* OR (climat* NEAR/5 chang*) OR (climat* NEAR/5 vari*) OR hurricane* OR storm* OR (weath* NEAR/5 extreme*) OR (severe NEAR/5 weath*) OR earthquake* OR tsunami* OR volcan* OR epidemic* OR pandemic* OR flood* OR heat* OR landslide* OR fire* OR wildfire* OR "wild fire*" OR geohazard* OR "air qual*" OR pollut* OR "global warming" OR drought* OR evacuation* OR outbreak* OR disease* OR contaminat* OR cyclon* OR avalanche* OR "tidal wave*" OR tornado* OR typhoon* OR catastroph* OR rockslid* OR mudslid* OR famine* OR scarc* OR crisis* OR crise* OR degrad* OR casualt* OR "El Niño" OR "La Niña" OR hail* OR

	shock* OR seismic* OR coronavirus* OR "COVID-19" OR "SARS-CoV-2" OR virus* OR "forest fire*" OR calamit*))

Appendix C: Standardized questionnaire.

Section 1: Article Metadata	**Guidance**
1. List the title of the publication	List the title verbatim, and in its entirety.
2. List the journal	List the title verbatim, and in its entirety.
3. List the online publication date	List the online publication date.
4. List all authors	List all authors, using last names and initializing first and middle names. Separate using semicolons.
5. List the affiliation(s) of the first author	List the full affiliation(s) of the first author. If multiple affiliations, separate using semicolons.
6. Provide the countr(ies) of the affiliation(s) for the first author. Please use the ISO-3166 Country Codes, found here	List all countries using ISO-3166 Country Code. If multiple countries, separate using semicolons.
Section 2: Evaluation of the SVI	**Guidance**
Conceptual Evaluation of the SVI	
7. What underlying research frameworks do the authors use in conceptualizing social vulnerability? **Please note: This goes beyond the SVI itself.**	Check one: ● "Hazards" (general) ● Social Vulnerability (individual decision-making; urban or rural planning; indicators over systems) ● Political-economy / political-ecology (e.g., colonial/capitalist systems of oppression) ● Other: _____
8. Do the authors use an **existing** social vulnerability index, in part or in full (i.e., authors do **not** create an SVI in its **entirety**)? *Guidance:*	Select one: ● Yes ● No

Be sure to understand where indicators came from as cited in the full text.	
9. If yes, which social vulnerability index is used?	Please list: ● CDC ● Cutter et al. (2003) ● Other: _____
10. What level of adaptation did the author(s) use for the social vulnerability index used?	Please rank as follows: 1. No modification 2. Minor modification (e.g., one section) 3. Significant modification through addition (e.g., significant sections or questions added) 4. Significant modification through omission (e.g., significant sections or questions taken out) 5. Significant modification through change (e.g., new categories and proxies) 6. Entirely self-created
11. What definition of social vulnerability do the authors use?	Provide the exact, verbatim definition in quotation marks, with citation(s). If no definition is present, write "N/A".
Empirical Evaluation of the SVI	
12. List each of the criteria used in the SVI. These are the criteria that are understood to affect vulnerability.	List all criteria, verbatim. Please note: If the SVI is one component of a larger SVI (e.g., with "environmental" vulnerability), please only list the SVI criteria. Separate indicators using semicolons. This includes the full set of understood criteria.
13. Are any of the SVI criteria quantitatively weighted?	Select one: ● Yes ● No

14. If **"Yes"** to 13, please list the weighted criteria.	Please list the weighted criteria, verbatim and separate using semicolons. Do not list the unweighted criteria.
15. What is the smallest spatial scale at which the SVI is applied?	Check all that apply: ● Intrahousehold ● Household ● Neighborhood ● Community (i.e., multiple neighborhoods) ● Census Tract ● Municipality ● District ● State, Territory ● Country ● Other: _____
16. Is this study longitudinal?	Select one: ● Yes ● No
17. Describe the methods used for constructing the index (GIS, participatory mapping, regression, etc.).	Check all that apply: ● GIS/spatial analysis ● Quantitative modeling (regression, ANOVA, etc.) ● Qualitative (e.g., inductive-based approach; participatory mapping)
18. Did the authors use primary data (e.g., surveys, interviews, participatory mapping, etc.)?	Select one: ● Yes ● No
Uncertainty, Validation, and Future Research	
19. Did the authors attempt to validate the SVI?	Select one: ● Yes ● No
20. Did the authors quantify uncertainty or discuss uncertainty in a qualitative way?	Select one: ● No Discussion ● Indirect assessment (e.g., limitation of variables discussed)

	● Formal uncertainty analysis completed
21. What areas did the authors identify as important for policy implications, *as applied to the SVI?*	This must be in specific relation to re-developing or elaborating a future SVI. Paraphrase these areas. If none is provided, write "N/A".
Application	
22. What hazard or disaster context(s) is the SVI applied in (e.g., hurricanes; epidemics)?	Check all that apply: ● Hurricane, cyclone, or typhoon ● Tropical storm ● Extreme storm (e.g., thunderstorm, hail) ● Flooding (e.g., inland, urban, or coastal) ● Drought ● Famine ● Earthquake (or seismic event) ● Tsunami ● Tornado ● Volcano ● COVID-19 ● Epidemic/Pandemic (other than COVID-19) ● Heat wave ● Landslide, mudslide, or rockslide ● Wildfire ● Avalanche ● Other: _____
23. Is the application of the SVI in the context of climate change?	Select one: ● Yes ● No
24. What geographic context is the SVI applied in?	Please check all that apply: ● Urban ● Rural ● Peri-urban/Suburban/Exurban ● Coastal (Ocean) ● Coastal (River; Lake) ● Mountainous ● Land-locked

	● Multiple (e.g.,over three choices) ● Other: _____
25. What country(ies) is the SVI applied in? Please use ISO-3166 Country Code, found here.	List all countries using ISO-3166 Country Code. If multiple countries, separate using semicolons.
Race/Ethnicity and Politics	
26. If "ethnicity or race" or some variation is used, how is it measured in the SVI?	If yes, list out each criterion. If no, put "N/A."
27. If "ethnicity or race" or some variation is used, how is it described?	If yes, describe in full. If no, put "N/A."
28. Does the SVI examine "politics" or "socio-political" factors? Politics has several meanings, including but not limited to, "political", "socio- political", "elections", "clientelism", "corruption", "agency", "contention", "political participation", "political behavior."	Select one: ● Yes ● No
29. If "politics" or some variation is used, how is it measured in the SVI?	If yes, list out each criterion. If no, put "N/A."
30. Please add any other notes from the publication worth citing.	List.

Appendix D: List of all journals publishing the articles contained within the review.

Journal Name	Number of Articles
Natural Hazards	29
International Journal of Disaster Risk Reduction	18
Sustainability	14
Natural Hazards and Earth System Sciences	8
International Journal of Disaster Risk Science	7
Natural Hazards Review	5
Annals of the American Association of Geographers	4
Applied Geography	4
International Journal of Environmental Research and Public Health	4
Ocean and Coastal Management	4
Environmental Science and Policy	3
Geomatics, Natural Hazards and Risk	3
Morbidity and Mortality Weekly Report	3
PLoS ONE	3
Risk Analysis	3
Climatic Change	2
Disaster Medicine and Public Health Preparedness	2
Disasters	2
Environment, Development and Sustainability	2
Epidemiology and Infection	2
Healthcare	2
International Journal of Applied Geospatial Research	2
International Journal of Environmental Health Research	2
International Journal of Geo-Information	2
IOP Conference Series: Earth and Environmental Science	2
JAMA Network Open	2
Jàmbá: Journal of Disaster Risk Studies	2
Journal of Epidemiology and Community Health	2
Journal of Flood Risk Management	2
Journal of Homeland Security and Emergency Management	2
Journal of Risk Research	2
Journal of the American Medical Directors Association	2
Land	2
Mitigation and Adaptation Strategies for Global Change	2
Regional Environmental Change	2
Ain Shams Engineering Journal	1
American Journal of Climate Change	1

American Journal of Preventative Medicine	1
American Journal of Public Health	1
American Journal of Tropical Medicine and Hygiene	1
Annals of Epidemiology	1
Annals of Internal Medicine	1
Applied Clinical Informatics	1
Australasian Journal of Regional Studies	1
Biology	1
BMJ Open	1
Bulletin of the American Meteorological Society	1
Carpathian Journal of Earth and Environmental Sciences	1
Chinese Geographical Science	1
Chinese Science Bulletin	1
Cities	1
Coastal Management	1
Computación y Sistemas	1
Computers, Environment and Urban Systems	1
Data in Brief	1
Earth's Future	1
Ecosystems	1
Energy Policy	1
Environment and Planning B: Planning and Design	1
Environmental and Climate Technologies	1
Environmental and Sustainability Indicators	1
Environmental Earth Sciences	1
Environmental Hazards	1
Environmental Research Communications	1
European Journal of Operational Research	1
Fire	1
Frontiers in Marine Science	1
Frontiers in Psychiatry	1
Frontiers in Public Health	1
Frontiers in Sociology	1
Frontiers of Earth Science	1
Geoforum	1
GeoHealth	1
GeoJournal	1
Geoscience	1
Geospatial Health	1

Gynecologic Oncology	1
Health and Place	1
Infection Control and Hospital Epidemiology	1
International Journal Disaster Risk Science	1
International Journal of Architectural Heritage	1
International Journal of Climatology	1
International Journal of Disaster Resilience in the Built Environment	1
International Journal of Wildland Fire	1
International Mountain Society	1
ISPRS International Journal of Geo-Information	1
Journal of Coastal Conservation	1
Journal of Coastal Research	1
Journal of Community Health	1
Journal of Computing in Civil Engineering	1
Journal of Decision Systems	1
Journal of Environmental Health	1
Journal of Environmental Science and Management	1
Journal of Health Care for the Poor and Underserved	1
Journal of Immigrant and Minority Health	1
Journal of Infection and Public Health	1
Journal of Occupational and Environmental Medicine	1
Journal of Public Health Policy	1
Journal of Telemedicine and Telecare	1
Journal of the American Society of Nephrology (JASN)	1
Journal of the National Medical Association	1
Journal of Urban Health: Bulletin of the New York Academy of Medicine	1
Land Use Policy	1
Landscape and Urban Planning	1
Modeling Earth Systems and Environment	1
Online Journal of Public Health Informatics	1
Osong Public Health and Research Perspectives	1
Philippine Sociological Review	1
PRS Global Open	1
Public Administration Review	1
Public Health	1
Public Health Reports	1
Research on Aging	1

Revista da Sociedade Brasileira de Medicina Tropical	1
SN Applied Sciences	1
Social Science Quarterly	1
Southeastern Geographer	1
Spatial Information Research	1
Stochastic Environmental Research and Risk Assessment	1
Sustainable Cities and Society	1
The Journal of Rural Health	1
The Milbank Quarterly	1
The Professional Geographer	1
Theoretical and Applied Climatology	1
Urban Climate	1
Water	1
Water, Air, and Soil Pollution	1
Weather, Climate, and Society	1
Women's Health Issues	1

Appendix E: List of hazard contexts and their prevalence.

Hazard Context	Prevalence
General Hazards	30.08%
Flooding (e.g., inland, urban, or coastal)	21.54%
COVID-19	20.33%
Hurricane, Cyclone, or Typhoon	11.79%
Earthquake (or seismic event)	7.32%
Heat wave/Heat Hazard	4.07%
Tsunami	2.85%
Wildfire	2.03%
Coastal Hazards	1.63%
Drought	1.63%
Landslide, Mudslide, or Rockslide	1.63%
Epidemic/Pandemic (other than COVID-19)	1.22%
Extreme Storm (e.g., thunderstorm, hail)	1.22%
Sea Level Rise	1.22%
Volcano	0.81%
Geological Hazards	0.40%
Sea Surface Temperature Rise	0.40%
Storm Surge	0.40%
Toxic Hazards	0.40%
Tropical Storm	0.40%
Wind Speed	0.40%

Appendix F: The 246 journal articles included in the systematic scoping review.

Author List	Title	Year	Journal
Aboagye, D.; Attakora-Amaniampong, E.; Owusu-Sekyere, E.	Place-Based Assessment of Intersection of Biophysical and Social Vulnerability to Flooding in Accra, Ghana	2021	*International Journal of Applied Geospatial Research*
Adger, W.N.; Vincent, K.	Uncertainty in adaptive capacity	2005	*Geoscience*
Ahmed, N.; Howlader, N.; Al-Amin Hoque, M.; Pradhan, B.	Coastal erosion vulnerability assessment along the eastern coast of Bangladesh using geospatial techniques	2020	*Ocean and Coastal Management*
Aksha, S.K.; Juran, L.; Resler, L.M.; Zhang, Y.	An Analysis of Social Vulnerability to Natural Hazards in Nepal Using a Modified Social Vulnerability Index	2018	*International Journal of Disaster Risk Science*
Aksha, S.K.; Resler, L.M.; Juran, L.; Carstensen Jr., L.W.	A geospatial analysis of multi-hazard risk in Dharan, Nepal	2020	*Geomatics, Natural Hazards and Risk*
Alem, D.; Bonilla-Londono, H.F.; Barbosa-Povoa, A.P.; Relvas, S.; Ferreira, D.; Moreno, A.	Building disaster preparedness and response capacity in humanitarian supply chains using the Social Vulnerability Index	2020	*European Journal of Operational Research*
Amadio, M.; Mysiak, J.; Marzi, S.	Mapping Socioeconomic Exposure for Flood Risk Assessment in Italy	2018	*Risk Analysis*
Anderson, C.C.; Hagenlocher, M.; Renaud, F.G.; Sebesvari, Z.; Cutter, S.L.; Emrich, C.T.	Comparing index-based vulnerability assessments in the Mississippi Delta: Implications of contrasting theories, indicators, and aggregation methodologies	2019	*International Journal of Disaster Risk Reduction*
Andrade, L.A.; Silva da Paz, W.; Fontes Lima, A.G.C.; Araujo, D.C.; Duque, A.M.; Peixoto, M.S.; Goes, M.A.O.; Freire de Souza, C. D.; Ribeiro, C. N.; Lima, S. V. M.; Bezerra-Santos, M.; Dantas dos Santos, A.	Spatiotemporal Pattern of COVID-19–Related Mortality during the First Year of the Pandemic in Brazil: A Population-based Study in a Region of High Social Vulnerability	2021	*American Journal of Tropical Medicine and Hygiene*

Angelidou, A.; Sullivan, K.; Melvin, P.; Shui, J.E.; Goldfarb, I.T.; Bartolome, R.; Chaudhary, N.; Vaidya, R.; Culic, I.; Singh, R.; Yanni, D.; Patrizi, S.; Hudak, M.L.; Parker, M.G.; Belfort, M.B.	Association of Maternal Perinatal SARS-CoV-2 Infection With Neonatal Outcomes During the COVID-19 Pandemic in Massachusetts	2021	*JAMA Network Open*
Arling, G.; Blaser, M.; Cailas, M.D.; Canar, J.R.; Cooper, B.; FlaxHatch, J.; Geraci., P.J.; Osiecki, K.M.; Sambanis, A.	A Data Driven Approach for Prioritizing COVID-19 Vaccinations in the Midwestern United States	2021	*Online Journal of Public Health Informatics*
Armas, I.; Gavris, A.	Social vulnerability assessment using spatial multi-criteria analysis (SEVI model) and the Social Vulnerability Index (SoVI model) – a case study for Bucharest, Romania	2013	*Natural Hazards and Earth System Sciences*
Aroca-Jimenez, E.; Bodoque, J.M.; Garcia, J.A.; Diez-Herrero, A.	Construction of an integrated social vulnerability index in urban areas prone to flash flooding	2017	*Natural Hazards and Earth System Sciences*
Babcicky, P.; Seebauer, S.	People, not just places: Expanding physical and social vulnerability indices by psychological indicators	2021	*Journal of Flood Risk Management*
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McAlarnen, L.A.; Tsaih, S.W.; Aliani, R.; Simske, N.M.; Hopp, E.E.	Virtual visits among gynecologic oncology patients during the COVID-19 pandemic are accessible across the social vulnerability spectrum	2021	*Gynecologic Oncology*
Mengal, A.; Goda, K.; Ashraf, M.; Murtaza, G.	Social vulnerability to seismic-tsunami hazards in district Gwadar, Balochistan, Pakistan	2021	*Natural Hazards*

Miah, J.; Hossain, K.T.; Hossain, M.A.; Najia, S.I.	Assessing coastal vulnerability of Chittagong District, Bangladesh using geospatial techniques	2020	*Journal of Coastal Conservation*

Michellier, C.; Kervyn, M.; Barette, F.; Syavulisemob, A.M.; Kimanuka, C.; Mataboro, S.K.; Hage, F.; Wolff, E.; Kervyn, F.	Evaluating population vulnerability to volcanic risk in a data scarcity context: The case of Goma city, Virunga volcanic province (DRCongo)	2019	*International Journal of Disaster Risk Reduction*
Morrison, D.; Beevers, L.; Wright, G.; Stewart, M.D.	The impact of data spatial resolution on flood vulnerability assessment	2021	*Environmental Hazards*
Muyambo, F.; Jordaan, A.J.; Bahta, Y.T.	Assessing social vulnerability to drought in South Africa: Policy implication for drought risk reduction	2017	*Jàmbá: Journal of Disaster Risk Studies*
Nafeh, A.M.B.; Beldjoudi, H. Yelles, A. K.; Monteiro, R.	Development of a seismic social vulnerability model for northern Algeria	2020	*International Journal of Disaster Risk Reduction*
Neelon, B.; Mutiso, F.; Mueller, N.T.; Pearce, J.L.; Benjamin-Neelson, S.E.	Spatial and temporal trends in social vulnerability and COVID-19 incidence and death rates in the United States	2021	*PLoS ONE*
Nelson, K.S.; Abkowitz, M.D.; Camp, J.A.	A method for creating high resolution maps of social vulnerability in the context of environmental hazards	2015	*Applied Geography*
Nguyen, C.V.; Horne, R.; Fien, J.; Cheong, F.	Assessment of social vulnerability to climate change at the local scale: development and application of a Social Vulnerability Index	2017	*Climatic Change*
Nicholsona, D.; Vanlia, O. A.; Jungb, S.; Ozguvenb, E. E.	A spatial regression and clustering method for developing place-specific social vulnerability indices using census and social media data	2019	*International Journal of Disaster Risk Reduction*
Oates, G.R.; Juarez, L.D.; Horswell, R.; Chu, S.; Miele, L.; Fouad, M.N.; Curry, W.A.; Fort, D.; Hillegass, W.B.; Danos, D.M.	The Association Between Neighborhood Social Vulnerability and COVID-19 Testing, Positivity, and Incidence in Alabama and Louisiana	2021	*Journal of Community Health*
Ogie, R.I.; Pradhan, B.	Natural Hazards and Social Vulnerability of Place: The Strength- Based Approach Applied to Wollongong, Australia	2019	*International Journal of Disaster Risk Science*

Ong, P.M.; Pech, C.; Gutierrez, N.R.; Mays, V.M.	COVID-19 Medical Vulnerability Indicators: A Predictive, Local Data Model for Equity in Public Health Decision Making	2021	*International Journal of Environmental*

			Research and Public Health
Oulahen, G.; Mortsch, L.; Tang, K.; Harford, D.	Unequal Vulnerability to Flood Hazards: "Ground Truthing" a Social Vulnerability Index of Five Municipalities in Metro Vancouver, Canada	2015	*Annals of the American Association of Geographers*
Page-Tan, C.; Buhler Corbin, T.	Protective policies for all? An analysis of Covid-19 deaths and protective policies among low-, medium-, and high-vulnerability groups	2021	*Disasters*
Palaiologou, P.; Ager, A.A.; Nielsen-Pincus, M.; Evers, C.R.; Day, M.A.	Social vulnerability to large wildfires in the western USA	2019	*Landscape and Urban Planning*
Park, G.; Xu, Z.	The constituent components and local indicator variables of social vulnerability index	2021	*Natural Hazards*
Park, G.; Xu, Z.	Spatial and Temporal Dynamics of Social Vulnerability in the United States from 1970 to 2010: A County Trajectory Analysis	2020	*International Journal of Applied Geospatial Research*
Pauline, E.L.; Knox, J.A.; Seymour, L.; Grundstein, A.J.	Revising NCEI's Climate Extremes Index and the CDC's Social Vulnerability Index to Analyze Climate Extremes Vulnerability across the United States	2021	*Bulletin of the American Meteorological Society*
Pérez-Maqueo, O.; Martínez, M. L.; Sánchez-Barradas, F. C.; Kolb, M.	Assessing Nature-Based Coastal Protection against Disasters Derived from Extreme Hydrometeorological Events in Mexico	2018	*Sustainability*
Pricope, N.G.; Halls, J.N.; Rosul, L.M.; Hidalgo, C.	Residential flood vulnerability along the developed North Carolina, USA coast: High resolution social and physical data for decision support	2019	*Data in Brief*
Rabby, Y.W.; Hossain, M.B.; Hasan, M.U.	Social vulnerability in the coastal region of Bangladesh: An investigation of social vulnerability index and scalar change effects	2019	*International Journal of Disaster Risk Reduction*
Rahman, M.T.; Aldosary, A.S.; Nahiduzzaman, K.M.; Reza, R.	Vulnerability of flash flooding in Riyadh, Saudi Arabia	2016	*Natural Hazards*

Reams, M.A.; Lam, N.S.N.; Baker, A.	Measuring Capacity for Resilience among Coastal Counties of the US Northern Gulf of Mexico Region	2012	*American Journal of Climate Change*

Reckien, D.	What is in an index? Construction method, data metric, and weighting scheme determine the outcome of composite social vulnerability indices in New York City	2018	*Regional Environmental Change*
Remo, J.W.F.; Pinter, N.; Mahgoub, M.	Assessing Illinois's flood vulnerability using Hazus-MH	2015	*Natural Hazards*
Rickless, D.S.; Wilt, G.E.; Sharpe, J.D.; Molinari, N.; Stephens, W.; LeBlanc, T.T.	Social Vulnerability and Access of Local Medical Care During Hurricane Harvey: A Spatial Analysis	2021	*Disaster Medicine and Public Health Preparedness*
Rickless, D.S.; Yao, X.A.; Orland, B.; Welch-Devine, M.	Assessing Social Vulnerability through a Local Lens: An Integrated Geovisual Approach	2019	*Annals of the American Association of Geographers*
Rifat, S.A.A.; Liu, W.	One year into the pandemic: the impacts of social vulnerability on COVID-19 outcomes and urban–rural differences in the conterminous United States	2021	*International Journal of Environmental Health Research*
Rifat, S.A.A.; Senkbeil, J.C.; Liu, W.	Assessing Influential Factors on Inland Property Damage from Gulf of Mexico Tropical Cyclones in the United States	2021	*International Journal of Geo-Information*
Roder, G.; Sofia, G.; Wu, Z.; Tarolli, P.	Assessment of Social Vulnerability to Floods in the Floodplain of Northern Italy	2017	*Weather, Climate, and Society*
Rodriquez, C.; Monteiro, R.; Ceresa, P.	Assessing Seismic Social Vulnerability in Urban Centers — the Case-Study of Nablus, Palestine	2018	*International Journal of Architectural Heritage*
Roncancio, D.J.; Cutter, S.L.; Nardocci, A.C.	Social vulnerability in Colombia	2020	*International Journal of Disaster Risk Reduction*
Roncancio, D.J.; Nardocci, A.C.	Social vulnerability to natural hazards in São Paulo, Brazil	2016	*Natural Hazards*
Rowan, S.; Kwiatkowski, K.	Assessing the Relationship between Social Vulnerability, Social Capital, and Housing Resilience	2020	*Sustainability*

Rufat, S.; Tate, E.; Emrich, C.T.; Antolini, F.	How Valid Are Social Vulnerability Models?	2019	*Annals of the American Association of Geographers*

Rygel, L.; O'Sullivan, D.; Yarnal, B.	A Method for Constructing a Social Vulnerability Index: An Application to Hurricane Storm Surges in a Developed Country	2006	*Mitigation and Adaptation Strategies for Global Change*
Sabrin, S.; Karimi, M.; Fahad, G.R.; Nazari, R.	Quantifying environmental and social vulnerability: Role of urban Heat Island and air quality, a case study of Camden, NJ	2020	*Urban Climate*
Sabrin, S.; Karimi, M.; Nazari, R.	Developing Vulnerability Index to Quantify Urban Heat Islands Effects Coupled with Air Pollution: A Case Study of Camden, NJ	2020	*International Journal of Geo-Information*
Saia, S. M.; Suttles, K. M.; Cutts, B. B.; Emanuel, R. E.; Martin, K. L.; Wear, D. N.; Coulston, J. W.; Vose, J. M.	Applying Climate Change Risk Management Tools to Integrate Streamflow Projections and Social Vulnerability	2019	*Ecosystems*
Saldajeno, P. B.; Florece, L. M.; Lasco, R. D.; Velasco, M. T. H.	Vulnerability Assessment of Upland Communities in Sibalom Natural Park, Antique, using Capital-based Approach	2012	*Journal of Environmental Science and Management*
Santos, M.; del Rio, L.; Benavente, J.	GIS-based approach to the assessment of coastal vulnerability to storms. Case study in the Bay of Cádiz (Andalusia, Spain)	2013	*Journal of Coastal Research*
Schmidtlein, M.C.; Deutsch, R.C.; Piegorsch, W.W.; Cutter, S.L.	A Sensitivity Analysis of the Social Vulnerability Index	2008	*Risk Analysis*
Schmidtlein, M.C.; Shafer, J.M.; Berry, M.; Cutter, S.L.	Modeled earthquake losses and social vulnerability in Charleston, South Carolina	2010	*Applied Geography*
See, J.; Porio, E.	Assessing Social Vulnerability to Flooding in Metro Manila Using Principal Component Analysis	2015	*Philippine Sociological Review*
Shaji, J.	Evaluating social vulnerability of people inhabiting a tropical coast in Kerala, south west coast of India	2021	*International Journal of Disaster Risk Reduction*

Shao, W.; Jackson, N.P.; Ha, H.; Winemiller, T.	Assessing community vulnerability to floods and hurricanes along the Gulf Coast of the United States	2020	*Disasters*

Shupe-Diggs, C.; Kofi Diko, S.; Santo, C.A.	An integrated social vulnerability assessment of riverine flood hazards in Shelby County, Tennessee	2020	*International Journal of Disaster Resilience in the Built Environment*
Siagian, T.H.; Purhadi, R.; Suhartono, S.; Ritonga, H.	Social vulnerability to natural hazards in Indonesia: driving factors and policy implications	2013	*Natural Hazards*
Snyder, B.F.; Parks, V.	Spatial variation in socio-ecological vulnerability to Covid-19 in the contiguous United States	2020	*Health and Place*
Solangaarachchi, D.; Griffin, A.L.; Doherty, M.D.	Social vulnerability in the context of bushfire risk at the urban-bush interface in Sydney: a case study of the Blue Mountains and Ku-ring-gai local council areas	2012	*Natural Hazards*
Spangler, K.R.; Wellenius, G.A.	Spatial patterns of recent US summertime heat trends: Implications for heat sensitivity and health adaptations	2020	*Environmental Research Communications*
Spielman, S.E.; Tuccillo, J.; Folch, D.C.; Schweikert, A.; Davies, R.; Wood, N.; Tate, E.	Evaluating social vulnerability indicators: criteria and their application to the Social Vulnerability Index	2020	*Natural Hazards*
Stanturf, J.A.; Goodrick, S.L.; Warren, M.L.; Charnley, S.; Stegali, C.M.	Social Vulnerability and Ebola Virus Disease in Rural Liberia	2015	*PLoS ONE*
Su, S.; Pi, J.; Wan, C.; Li, H.; Xiao, R.; Li, B.	Categorizing social vulnerability patterns in Chinese coastal cities	2015	*Ocean and Coastal Management*
Sun, Y.; Chau, P.H.; Wong, M.; Woo, J.	Place- and Age-Responsive Disaster Risk Reduction for Hong Kong: Collaborative Place Audit and Social Vulnerability Index for Elders	2017	*International Journal Disaster Risk Science*
Sung, B.	A spatial analysis of the association between social vulnerability and the cumulative number of confirmed deaths from COVID-19 in United States counties through November 14, 2020	2021	*Osong Public Health and Research Perspectives*

Szczyrba, L.; Zhang, Y.; Pamukcu, D.; Eroglu, D.I.; Weiss, R.	Quantifying the Role of Vulnerability in Hurricane Damage via a Machine Learning Case Study	2021	*Natural Hazards Review*

Tanir, T.; de Souza de Lima, A.; de A. Coelho, G.; Uzun, S.; Cassalho, F.; Ferreira, C.M.	Assessing the spatiotemporal socioeconomic flood vulnerability of agricultural communities in the Potomac River Watershed	2021	*Natural Hazards*
Tascón-González, L.; Ferrer-Julià, m.; Ruiz, M.; García-Meléndez, E.	Social Vulnerability Assessment for Flood Risk Analysis	2020	*Water*
Tasnuva, A.; Hossain, Md. R.; Salam, R.; Towfiqul Islam, A.R.Md.; Patwary, M.M.; Ibrahim, S.M.	Employing social vulnerability index to assess household social vulnerability of natural hazards: An evidence from southwest coastal Bangladesh	2020	*Environment, Development and Sustainability*
Tate, E.	Uncertainty Analysis for a Social Vulnerability Index	2012	*Annals of the American Association of Geographers*
Tate, E.	Social vulnerability indices: a comparative assessment using uncertainty and sensitivity analysis	2012	*Natural Hazards*
Tate, E.; Cutter, S.; Berry, M.	Integrated multihazard mapping	2010	*Environment and Planning B: Planning and Design*
Tate, E.; Strong, A.; Kraus, T.; Xiong, H.	Flood recovery and property acquisition in Cedar Rapids, Iowa	2015	*Natural Hazards*
Tellman, B.; Schank, C.; Schwarz, B.; Howe, P.D.; de Sherbinin, A.	Using Disaster Outcomes to Validate Components of Social Vulnerability to Floods: Flood Deaths and Property Damage across the USA	2020	*Sustainability*
Thakore, N.; Khazanchi, R.; Orav, J.E.; Ganguli, I.	Association of Social Vulnerability, COVID-19 vaccine site density, and vaccination rates in the United States	2021	*Healthcare*
Toké, N.A.; Boone, C.G.; Ramón Arrowsmith, J.	Fault zone regulation, seismic hazard, and social vulnerability in Los Angeles, California: Hazard or urban amenity?	2014	*Earth's Future*

Toppy, S.; Wilt, G.E.; Whiteman, A.; Hallisey, E.; Crockett, M.; Sharpe, J.D.; Haney, G.; Cranston, K.; Klevens, R.M.	Geographic Associations Between Social Factors and SARS-CoV- 2 Testing Early in the COVID-19 Pandemic, February–June 2020, Massachusetts	2021	*Public Health Reports*

Tormos-Aponte, F.; García-López, G.; Painter, M.A.	Energy inequality and clientelism in the wake of disasters: From colorblind to affirmative power restoration	2021	*Energy Policy*
Török, I.	Assessment of social vulnerability to natural hazards in Romania	2017	*Carpathian Journal of Earth and Environmental Sciences*
Török, I.	Qualitative Assessment of Social Vulnerability to Flood Hazards in Romania	2018	*Sustainability*
Török, I.; Croitoru, A.-E.; Man, T.-C.	Assessing the Impact of Extreme Temperature Conditions on Social Vulnerability	2021	*Sustainability*
Tragaki, A.; Gallousi, C.; Karymbalis, E.	Coastal Hazard Vulnerability Assessment Based on Geomorphic, Oceanographic and Demographic Parameters: The Case of the Peloponnese (Southern Greece)	2018	*Land*
Tummalapalli, S.L.; Silberzweig, J.; Cukor, D.; Lin, J.T.; Barbar, T.; Liu, Y.; Kim, K.; Parker, T.S.; Levine, D.M.; Ibrahim, S.A.	Racial and Neighborhood-Level Disparities in COVID-19 Incidence among Patients on Hemodialysis in New York City	2021	*Journal of the American Society of Nephrology (JASN)*
Turek-Hankin, L. L.; Hino, M.; Mach, K. J.	Risk screening methods for extreme heat: Implications for equity-oriented adaptation	2020	*PLoS ONE*
Upchurch, D.M.; Wong, M.S.; Yuan, A.H.; Haderlein, T.P.; McClendon, J.; Christy, A.; Washington, D.L.	COVID-19 Infection in the Veterans Health Administration: Gender-specific Racial and Ethnic Differences	2021	*Women's Health Issues*
Vo, A.; Bhaskar R.; Chi, T.; Faddoul, G.	Identifying socially vulnerable regions with persistent low accessibility to emergency care through a spatial decision framework	2020	*Journal of Decision Systems*
Waly, N.M.; Ayad, H.M.; Saadallah, D.M.	Assessment of spatiotemporal patterns of social vulnerability: A tool to resilient urban development Alexandria, Egypt	2020	*Ain Shams Engineering Journal*

Wang, C.; Li, Z.; Mathews, M.C.; Praharaj, S.; Karna, B.; Solís, P.	The spatial association of social vulnerability with COVID-19 prevalence in the contiguous United States	2020	*International Journal of Environmental Health Research*

Wang, C.; Yarnal, B.	The vulnerability of the elderly to hurricane hazards in Sarasota, Florida	2012	*Natural Hazards*
Wang, H.; Xu, R.; Qu, S.; Schwartz, M.; Adams, A.; Chen, X.	Health inequities in COVID-19 vaccination among the elderly: Case of Connecticut	2021	*Journal of Infection and Public Health*
Ware, L.J.; Kim, A.W.; Prioreschi, A.; Nyati, L.H.; Taljaard, W.; Draper, C.E.; Lye, S.J.; Norris, S.A.	Social vulnerability, parity and food insecurity in urban South African young women: the healthy life trajectories initiative (HeLTI) study	2021	*Journal of Public Health Policy*
Watkins, L. E.; Wright, M. K.; Kurtz, L. C.; Chakalian, P. M.; Mallen, E. S.; Harlan, S. L.; Hondula, D. M.	Extreme heat vulnerability in Phoenix, Arizona: A comparison of all-hazard and hazard-specific indices with household experiences	2021	*Applied Geography*
Wigtil, G.; Hammer, R.B.; Kline, J.D.; Mockrin, M.H.; Stewart, S.I.; Roper, D.; Radeloff, V.C.	Places where wildfire potential and social vulnerability coincide in the coterminous United States	2016	*International Journal of Wildland Fire*
Wilson, B.S.	Overrun by averages: An empirical analysis into the consistency of social vulnerability components across multiple scales	2019	*International Journal of Disaster Risk Reduction*
Wilson, G.M.; Ball, M.J.; Szczesny, P.; Haymann, S.; Polyak, M.; Holmes, T.; Silva, J.S.	Health Intelligence Atlas: A Core Tool for Public Health Intelligence	2021	*Applied Clinical Informatics*
Wood, N.J.; Burton, C.G.; Cutter, S.L.	Community variations in social vulnerability to Cascadia-related tsunamis in the U.S. Pacific Northwest	2009	*Natural Hazards*
Wu, C.; Jhan, H.; Ting, K.; Tsai, H.; Lee, M.; Hsu, T.; Liu, W.	Application of Social Vulnerability Indicators to Climate Change for the Southwest Coastal Areas of Taiwan	2016	*Sustainability*
Yang, S.; He, S.; Du, J.; Sun, X.	Screening of social vulnerability to natural hazards in China	2014	*Natural Hazards*

Yang, X.; Lin, L.; Zhang, Y.; Ye, T.; Chen, Q.; Jin, C.; Ye, G.	Spatially Explicit Assessment of Social Vulnerability in Coastal China	2019	*Sustainability*

Yellow Horse, A.J.; Deschine Parkhurst, N.A.; Huyser, K.R.	COVID-19 in New Mexico Tribal Lands: Understanding the Role of Social Vulnerabilities and Historical Racisms	2020	*Frontiers in Sociology*
Yoon, D.K.	Assessment of social vulnerability to natural disasters: a comparative study	2012	*Natural Hazards*
Yorke, C.; Zhan, F.B.; Lu, Y.; Hagelman, R.	Incorporating evacuation potential into place vulnerability analysis	2013	*Geomatics, Natural Hazards and Risk*
Yu, H.; Shen, Y.; Kelly, R.M.; Qi, X.; Wu, K.; Li, S.; Yu, H.; Bao, X.	Trends in social vulnerability to storm surges in Shenzhen, China	2020	*Natural Hazards and Earth System Sciences*
Zachrison, K.S.; Yan, Z.; Sequist, T.; Licurse, A.; Tan-McGrory, A.; Erskine, A.; Schwamm, L.H.	Patient characteristics associated with the successful transition to virtual care: Lessons learned from the first million patients	2021	*Journal of Telemedicine and Telecare*
Zamboni Berra, T.; Rêgo de Queiroz, A.A.; Yamamura, M.; Arroyo, L.H.; Concebida da Cunha Garcia, M.; Paschoal Poplin, M.; Talita dos Santos, D.; Vieira Ramos, C.V.; Seles Alves, L. Fronteira, I.E.; Neto, F.C.; Palha, R.F.; Arcêncio. R.A.	Spatial risk of tuberculosis mortality and social vulnerability in Northeast Brazil	2017	*Revista da Sociedade Brasileira de Medicina Tropical*
Zarghami, S.A.; Dumrak, J.	A system dynamics model for social vulnerability to natural disasters: Disaster risk assessment of an Australian city	2021	*International Journal of Disaster Risk Reduction*
Zebardast, E.	Constructing a social vulnerability index to earthquake hazards using a hybrid factor analysis and analytic network process (F'ANP) model	2012	*Natural Hazards*
Zemtsov, S.P.; Goryachoko, M.D.; Baburin, V.L.; Krylenko, I.N.; Yumina, N.M.	Integrated assessment of socio-economic risks of hazardous hydrological phenomena in Slavyansk municipal district	2016	*Natural Hazards*
Zhang, N.; Huang, H.	Social vulnerability for public safety: A case study of Beijing, China	2013	*Chinese Science Bulletin*

Zhang, W.; Xu, X.; Chen, X.	Social vulnerability assessment of earthquake disaster based on the catastrophe progression method: A Sichuan Province case study	2017	*International Journal of Disaster Risk Reduction*
Zhang, Y.L.; You, W.J.	Social vulnerability to floods: a case study of Huaihe River Basin	2013	*Natural Hazards*
Zhou, Y.; Li, N.; Wu, W.; Wu, J.; Shi, P.	Local Spatial and Temporal Factors Influencing Population and Societal Vulnerability to Natural Disasters	2014	*Risk Analysis*
Zhu, J.; Lu, Y.; Ren, F.; McBride, J.; Ye, L.	Typhoon disaster risk zoning for China's coastal area	2021	*Frontiers of Earth Science*
Zottarelli, L.K.; Sharif, H.M.; Xu, X.; Sunil, T.S.	Effects of social vulnerability and heat index on emergency medical service incidents in San Antonio, Texas, in 2018	2020	*Journal of Epidemiology and Community Health*

Appendix G: The 172 journal articles excluded in the systematic scoping review.
Note: Year published may reflect either the online publication date or the in-print publication date.

Appendix G.1: Articles excluded in Phase 1 (N = 129).

Authors	Title	Year	Journal
De Ruiter, MC *et al.*	A comparison of flood and earthquake vulnerability assessment indicators	2017	*Natural Hazards and Earth System Sciences*
Merz, M *et al.*	A composite indicator model to assess natural disaster risks in industry on a spatial level	2013	*Journal of Risk Research*
Mavhura, E and Manyangadze, T	A comprehensive spatial analysis of social vulnerability to natural hazards in Zimbabwe: Driving factors and policy implications	2021	*International Journal of Disaster Risk Reduction*
Zhang, Z *et al.*	A cyberGIS-enabled multi-criteria spatial decision support system: A case study on flood emergency management	2019	*International Journal of Digital Earth*
Sharareh, N *et al.*	A vulnerability assessment for the HCV infections associated with injection drug use.	2020	*Preventive Medicine*
Santos LR *et al.*	Adherence of the dysphonic teachers in speech therapy.	2013	*CoDas*
Jorge KO *et al.*	Alcohol intake among adolescent students and association with social capital and socioeconomic status.	2018	*Ciência and Saúde Coletiva*
Asadzadeh, A *et al.*	An augmented approach for measurement of disaster resilience using connective factor analysis and analytic network process (F'ANP) model.	2015	*International Journal of Disaster Risk Reduction*
Lauve-Moon, K and Ferreira, RJ	An Exploratory Investigation: Post-disaster Predictors of Intimate Partner Violence	2017	*Clinical Social Work Journal*
Yee, CW *et al.*	Application of the Social Vulnerability Index for Identifying Teen Pregnancy Intervention Need in the United States.	2019	*Maternal and Child Health Journal*
Ardalan A *et al.*	Assessing human vulnerability in industrial chemical accidents: a qualitative and quantitative methodological approach.	2019	*Environmental Monitoring and Assessment*

Sanchez-Guevara, C *et al.*	Assessing population vulnerability towards summer energy poverty: Case studies of Madrid and London	2019	*Energy and Buildings*

Quader, MA *et al.*	Assessing Risks from Cyclones for Human Lives and Livelihoods in the Coastal Region of Bangladesh	2017	*International Journal of Environmental Research and Public Health*
Aboagye, D *et al.*	Assessing Social Vulnerability to Fire Hazards at the Kumasi Central Market, Ghana	2018	*International Journal of Applied Geospatial Research*
Kim, J and Gim, THT	Assessment of social vulnerability to floods on Java, Indonesia	2020	*Natural Hazards*
Puvvula, J *et al.*	Association between Aqueous Atrazine and Pediatric Cancer in Nebraska	2021	*Water*
Zarzar, PM *et al.*	Association between binge drinking, type of friends and gender: A cross-sectional study among Brazilian adolescents	2012	*BMC Public Health*
Youmans, QR *et al.*	Association of County-Level Social Vulnerability Index and Cardiovascular Disease in the United States, 1999-2018	2020	*Circulation*
Diaz, A *et al.*	Association of County-Level Social Vulnerability with Elective Versus Non-elective Colorectal Surgery	2021	*Journal of Gastrointestinal Surgery*
Diaz, A *et al.*	Association of Neighborhood Characteristics with Utilization of High-Volume Hospitals Among Patients Undergoing High-Risk Cancer Surgery.	2021	*Annals of Surgical Oncology*
Diaz, A *et al.*.	Association of social vulnerability with the use of high-volume and Magnet recognition hospitals for hepatopancreatic cancer surgery.	2021	*Surgery*
Sunderraj A *et al.*	Associations of Social Vulnerability Index with Pathologic Myocardial Findings at Autopsy.	2021	*Frontiers in Cardiovascular Medicine*
Benra, F *et al*.	Balancing ecological and social goals in PES design—Single objective strategies are not sufficient	2022	*Ecosystem Services*
Mock, J *et al.*	Barriers to Access to Hematopoietic Cell Transplantation among Patients with Acute Myeloid Leukemia in Virginia.	2021	*Transplantation and Cellular Therapy*

Baquero, OS *et al.*	Bayesian spatial models of the association between interpersonal violence, animal abuse and social vulnerability in Sao Paulo, Brazil	2018	*Preventive Veterinary Medicine*
Phelos HM *et al.*	Can social vulnerability indices predict county trauma fatality rates?	2021	*The Journal of Trauma and Acute Care Surgery*

Gay JL *et al.*	Can the Social Vulnerability Index Be Used for More Than Emergency Preparedness? An Examination Using Youth Physical Fitness Data.	2016	*Journal of Physical Activity and Health*
Souza CDF *et al.*	Cerebrovascular Disease Mortality Trend in Brazil (1996 to 2015) and Association with Human Development Index and Social Vulnerability.	2021	*Arquivos Brasileiros De Cardiologia*
Lee King, PA *et al.*	Clinical Needs of In-treatment Pregnant Women with Co-occurring Disorders: Implications for Primary Care.	2015	*Maternal and Child Health Journal*
Wallace, LN	Community context and perceived risk: perceptions of active shooter risk in Pennsylvania	2021	*Crime Prevention and Community Safety*
Marzi, S *et al.*	Comparing adaptive capacity index across scales: the case of Italy	2018	*Journal of Environmental Management*
Ji, Z *et al.*	Comprehensive assessment of flood risk using the classification and regression tree method	2013	*Stochastic Environmental Research and Risk Assessment*
Marzi, S *et al.*	Constructing a comprehensive disaster resilience index: the case of Italy	2019	*PloS One*
Fatemi F *et al.*	Constructing the Indicators of Assessing Human Vulnerability to Industrial Chemical Accidents: A Consensus-based Fuzzy Delphi and Fuzzy AHP Approach.	2017	*PloS Currents*
Strully KW and Yang TC	County Social Vulnerability and Influenza Vaccine Rates: National and Local Estimates for Medicare Recipients.	2022	*American Journal of Preventive Medicine*
Diaz, A *et al.*	County-level Social Vulnerability is Associated with Worse Surgical Outcomes Especially Among Minority Patients.	2021	*Annals of Surgery*
Bunt, S *et al.*	Cross-Cultural Adaptation of the Social Vulnerability Index for Use in the Dutch Context	2017	*International Journal of Environmental Research and Public Health*
Varughese, RA *et al.*	Cumulative Deficits Frailty Index Predicts Outcomes for	2021	*Transplantation Direct*

	Solid Organ Transplant Candidates.		
Santos-Junior, N *et al.*	Cumulative Environmental Vulnerability Assessment in the Area of Influence of the Pecém Port Industrial Complex (Ceará, Brazil): A Spatial Analysis	2021	*International Journal of Environmental Research and Public Health*

Armstrong, JJ *et al.*	Cumulative impact of health deficits, social vulnerabilities, and protective factors on cognitive dynamics in late life: a multistate modeling approach	2015	*Alzheimer's Research and Therapy*
Peixoto, AMCL *et al.*	Demand for health services or professionals among adolescents: a multilevel study	2021	*Ciência and Saúde Coletiva*
Brito ACM *et al.*	Dental caries experience and associated factors in 12-year-old-children: a population based-study.	2020	*Brazilian Oral Research*
Hong, YR and Mainous, AG	Development and Validation of a County-Level Social Determinants of Health Risk Assessment Tool for Cardiovascular Disease.	2020	*Annals of Family Medicine*
Liu, HY *et al.*	Differential moderation effects of ApoE and 5-HTTLPR genotypes on social vulnerability in predicting mortality among community-dwelling middle-aged and older adults: a nationwide population-based study	2021	*Aging*
Finch, C *et al.*	Disaster disparities and differential recovery in New Orleans	2010	*Population and Environment*
Carmichael, H *et al.*	Disparities in Emergency Versus Elective Surgery: Comparing Measures of Neighborhood Social Vulnerability	2020	*Journal of Surgical Research*
Killian, AC *et al.*	Evaluation of Community-Level Vulnerability and Racial Disparities in Living Donor Kidney Transplant	2021	*JAMA Surgery*
Fu, XY and Zhai, W	Examining the spatial and temporal relationship between social vulnerability and stay-at-home behaviors in New York City during the COVID-19 pandemic	2021	*Sustainable Cities and Society*
Bozorgi, P *et al.*	Facility Attractiveness and Social Vulnerability Impacts on Spatial Accessibility to Opioid Treatment Programs in South Carolina	2021	*International Journal of Environmental Research and Public Health*
Green-McKenzie J *et al.*	Factors Associated With COVID-19 Vaccine Receipt by Health Care Personnel at a Major Academic Hospital During the First Months of Vaccine Availability.	2021	*JAMA Network Open*
Martins, MT *et al.*	Factors associated with dental caries in Brazilian children: a multilevel approach	2014	*Community Dentistry and Oral Epidemiology*

Harrison, NE *et al.*	Factors Associated with Voluntary Refusal of Emergency Medical System Transport for Emergency Care in Detroit During the Early Phase of the COVID-19 Pandemic.	2021	*JAMA Network Open*

Godfrey EM *et al.*	Family medicine provision of online medication abortion in three US states during COVID-19.	2021	*Contraception*
Mavhura, E *et al.*	Flood vulnerability and relocation readiness in Zimbabwe	2017	*Disaster Prevention and Management*
Melix BL *et al.*	Florida neighborhood analysis of social determinants and their relationship to life expectancy.	2020	*BMC Public Health*
Levy, P *et al.*	From pandemic response to portable population health: A formative evaluation of the Detroit mobile health unit program.	2021	*PLoS One*
Grunwell JR *et al.*	Geospatial Analysis of Social Determinants of Health Identifies Neighborhood Hot Spots Associated with Pediatric Intensive Care Use for Life-threatening Asthma.	2021	*The Journal of Allergy and Clinical Immunology: in Practice*
Pence, J *et al.*	GIS-Based Integration of Social Vulnerability and Level 3 Probabilistic Risk Assessment to Advance Emergency Preparedness, Planning, and Response for Severe Nuclear Power Plant Accidents.	2019	*Risk Analysis*
Hyer, JM *et al.*	High Social Vulnerability and "Textbook Outcomes" after Cancer Operation	2021	*Journal of the American College of Surgeons*
Fitzpatrick, KM *et al.*	How bad is it? Suicidality in the middle of the COVID-19 pandemic	2020	*Suicide and Life-Threatening Behavior*
Clar, C	How demographic developments determine the management of hydrometeorological hazard risks in rural communities: the linkages between demographic and natural hazards research	2019	*Wiley Interdisciplinary Reviews: Water*
Kreibich, H *et al.*	How to improve attribution of changes in drought and flood impacts	2019	*Hydrological Sciences Journal*
Pascom, ARP *et al.*	Impact of antiretroviral regimen on viral suppression among pregnant women living with HIV in Brazil	2020	*International Journal of STD and AIDS*

Diaz A *et al.*	Impact of hospital quality on surgical outcomes in patients with high social vulnerability: Association of textbook outcomes and social vulnerability by hospital quality.	2021	*Surgery*
Carter, AJ *et al.*	Impact of Social Vulnerability on Access to Educational Programming Designed to Enhance Living Donation	2021	*Progress in Transplantation*

Ivčević, A *et al.*	Indicators in risk management: Are they a user-friendly interface between natural hazards and societal responses? Challenges and opportunities after UN Sendai conference in 2015	2019	*International Journal of Disaster Risk Reduction*
Colburn, LL *et al.*	Indicators of climate change and social vulnerability in fishing dependent communities along the Eastern and Gulf Coasts of the United States	2016	*Marine Policy*
Cárdenas, JRG *et al.*	Integral Seismic Risk Assessment through Fuzzy Models	2020	*Applied Sciences*
Diaz, A *et al.*	Intersection of social vulnerability and residential diversity: Postoperative outcomes following resection of lung and colon cancer	2021	*Journal of Surgical Oncology*
Ross, AM *et al.*	Introduction to the Special Issue: Social Work Practice in the Era of the COVID-19 Pandemic - Challenges and Innovations.	2021	*Social Work in Health Care*
Mitchell, BC and Chakraborty, J	Landscapes of thermal inequity: disproportionate exposure to urban heat in the three largest US cities	2015	*Environmental Research Letters*
Ferreira, AF *et al.*	Leprosy in the North and Northeast regions of Brazil: an integrated spatiotemporal approach	2020	*Tropical Medicine and International Health*
Ojerio, R *et al.*	Limited Involvement of Socially Vulnerable Populations in Federal Programs to Mitigate Wildfire Risk in Arizona	2011	*Natural Hazards Review*
Fitzpatrick, KM *et al.*	Living in the midst of fear: Depressive symptomatology among US adults during the COVID-19 pandemic	2020	*Depression and Anxiety*
Godin, J *et al.*	Long-Term Care Admissions Following Hospitalization: The Role of Social Vulnerability	2019	*Healthcare*
Estrella, JB *et al.*	Making it Complicated: Does Disparity in Access to Care Lead to More Perforated Appendicitis?	2021	*Journal of Surgical Research*
Menk, L *et al.*	Mapping the Structure of Social Vulnerability Systems for Malaria in East Africa	2020	*Sustainability*

Pizeta, FA *et al.*	Maternal Depression, Social Vulnerability and Gender: Prediction of Emotional Problems Among Schoolchildren	2018	*Journal of Child and Family Studies*
Lawal, O and Arokoyu, SB	Modelling social vulnerability in sub-Saharan West Africa using a geographical information system	2015	*Jàmbá: Journal of Disaster Risk Studies*

Notley C *et al.*	Negotiating cancer preventative health behaviours and adapting to motherhood: the role of technology in supporting positive health behaviours.	2020	*International Journal of Qualitative Studies on Health and Well-Being*
Jones KK *et al.*	Neighborhood Environment and Asthma Exacerbation in Washington, DC.	2019	*Annual Review of Nursing Research*
Grangeiro, A *et al.*	Nonoccupational post-exposure prophylaxis for HIV after sexual intercourse among women in Brazil: Risk profiles and predictors of loss to follow-up	2019	*Medicine*
Flanagan, B *et al.*	On the Validity of Validation: A Commentary on Rufat, Tate, Emrich, and Antolini's "How Valid Are Social Vulnerability Models?"	2020	*Annals of The American Association of Geographers*
Hyer, JM *et al*.	Patient Social Vulnerability and Hospital Community Racial/Ethnic Integration: Do All Patients Undergoing Pancreatectomy Receive the Same Care Across Hospitals?	2021	*Annals of Surgery*
Georgantopoulos, P *et al.*	Patient- and area-level predictors of prostate cancer among South Carolina veterans: a spatial analysis	2020	*Cancer Causes and Control*
Clar, C *et al.*	Population dynamics and natural hazard risk management: conceptual and practical linkages for the case of Austrian policy making	2021	*Natural Hazards*
Viegas CM *et al.*	Predisposing factors for traumatic dental injuries in Brazilian preschool children.	2010	*European Journal of Paediatric Dentistry*
Givens M *et al.*	Preterm birth among pregnant women living in areas with high social vulnerability.	2021	*American Journal of Obstetrics and Gynecology MFM*
Jorge, KO *et al.*	Prevalence and association of dental injuries with socioeconomic conditions and alcohol/drug use in adolescents between 15 and 19 years of age	2012	*Dental Traumatology*

Jorge, KO *et al.*	Prevalence and factors associated to dental trauma in infants 1-3 years of age	2009	*Dental Traumatology*
Paro A *et al.*	Profiles in social vulnerability: the association of social determinants of health with postoperative surgical outcomes.	2021	*Surgery*

Abbas, A *et al.*	Race/Ethnicity and County-Level Social Vulnerability Impact Hospice Utilization Among Patients Undergoing Cancer Surgery	2021	*Annals of Surgical Oncology*
Christie, EK *et al.*	Regional coastal flood risk assessment for a tidally dominant, natural coastal setting: North Norfolk, southern North Sea	2018	*Coastal Engineering*
Sánchez, ÉY *et al.*	Risk analysis of technological hazards: Simulation of scenarios and application of a local vulnerability index.	2018	*Journal of Hazardous Materials*
Alves, YM *et al.*	Risk areas for tuberculosis among children and their inequalities in a city from Southeast Brazil	2020	*BMC Pediatrics*
Martins-Oliveira JG *et al.*	Risk of alcohol dependence: prevalence, related problems and socioeconomic factors.	2016	*Ciência and Saúde Coletiva*
Serra-Negra JM *et al.*	Signs, symptoms, parafunctions and associated factors of parent-reported sleep bruxism in children: a case-control study.	2012	*Brazilian Dental Journal*
Delanois RE *et al.*	Social determinants of health in total knee arthroplasty: are social factors associated with increased 30-day post-discharge cost of care and length of stay?	2021	*The Bone and Joint Journal*
Abeliansky, AL *et al.*	Social vulnerability and aging of elderly people in the United States	2021	*SSM-Population Health*
Cestari, VRF *et al.*	Social vulnerability and COVID-19 incidence in a Brazilian metropolis	2021	*Ciência and Saúde Coletiva*
da Cunha, IP *et al.*	Social vulnerability and factors associated with oral impact on daily performance among adolescents	2017	*Health and Quality of Life Outcomes*
Curi, RLC and Gasalla, MA *et al.*	Social Vulnerability and Human Development of Brazilian Coastal Populations	2021	*Frontiers in Ecology and Evolution*
An, RP and Xiang, XL	Social Vulnerability and Leisure-time Physical Inactivity among US Adults	2015	*American Journal of Health Behavior*

Khan SU *et al.*	Social Vulnerability and Premature Cardiovascular Mortality Among US Counties, 2014 to 2018.	2021	*Circulation*
Armstrong, JJ *et al.*	Social vulnerability and survival across levels of frailty in the Honolulu-Asia Aging Study	2015	*Age and Ageing*

Bendo, CB *et al.*	Social Vulnerability and Traumatic Dental Injury among Brazilian Schoolchildren: A Population-Based Study	2012	*International Journal of Environmental Research and Public Health*
Dyer, JL and Milot, L	Social vulnerability assessment of dog intake location data as a planning tool for community health program development: A case study in Athens-Clarke County, GA, 2014-2016	2019	*PloS One*
Andrew, MK and Keefe, JM	Social vulnerability from a social ecology perspective: a cohort study of older adults from the National Population Health Survey of Canada	2014	*BMC Geriatrics*
Nguyen, TN *et al.*	Social Vulnerability in Patients with Multimorbidity: A Cross-Sectional Analysis	2019	*International Journal of Environmental Research and Public Health*
Yu, CY *et al.*	Social Vulnerability Index and obesity: An empirical study in the US	2020	*Cities*
Shah, S *et al.*	Social Vulnerability Index: a composite measure of social risk in older adults	2021	*Journal of the American Geriatrics Society*
Regmi MR *et al.*	Social Vulnerability Indices as a Risk Factor for Heart Failure Readmissions.	2021	*Clinical Medicine and Research*
Andrew MK and Rockwood K	Social vulnerability predicts cognitive decline in a prospective cohort of older Canadians.	2010	*Alzheimer's and Dementia*
Javalkar, K *et al.*	Socioeconomic and Racial and/or Ethnic Disparities in Multisystem Inflammatory Syndrome	2021	*Pediatrics*
Mitsova, D *et al.*	Socioeconomic vulnerability and electric power restoration timelines in Florida: the case of Hurricane Irma	2018	*Natural Hazards*
Ciobanu, SM and Benedek, J	Spatial Characteristics and Public Health Consequences of Road Traffic Injuries in Romania	2015	*Environmental Engineering and Management Journal*
Mavhura, E and Manyena, B	Spatial quantification of community resilience in contexts where quantitative data are scarce: The case of Muzarabani district in Zimbabwe	2018	*Geo: Geography and Environment*

de Souza CDF *et al.*	Spatiotemporal clustering, social vulnerability and risk of congenital syphilis in northeast Brazil: an ecological study.	2020	*Transactions of the Royal Society of Tropical Medicine and Hygiene*

Chamorro, A *et al.*	Sustainable Risk Management of Rural Road Networks Exposed to Natural Hazards: Application to Volcanic Lahars in Chile	2020	*Sustainability*
Ibrahim B *et al.*	The Association Between Neighborhood Social Vulnerability and Cardiovascular Health Risk Among Black/African American Women in the InterGEN Study.	2021	*Nursing Research*
Azap RA *et al.*	The association of neighborhood social vulnerability with surgical textbook outcomes among patients undergoing hepatopancreatic surgery.	2020	*Surgery*
Barboza GE	The Geography of Child Maltreatment: A Spatiotemporal Analysis Using Bayesian Hierarchical Analysis with Integrated Nested Laplace Approximation.	2019	*Journal of Interpersonal Violence*
Steinkamp L *et al.*	The Interplay of Diversity, Equity, and Inclusion in Addressing Health Inequities.	2021	*WMJ: Official Publication of The State Medical Society of Wisconsin*
Ouvrard C *et al.*	The Social Vulnerability Index: Assessing Replicability in Predicting Mortality Over 27 Years.	2019	*Journal of The American Geriatrics Society*
Jorge, KO *et al.*	Tobacco use and friendship networks: a cross-sectional study among Brazilian adolescents.	2015	*Ciência and Saúde Coletiva*
Frigerio, I *et al.*	Understanding the interacting factors that influence social vulnerability: a case study of the 2016 central Italy earthquake	2019	*Disasters*
Carmichael, H *et al.*	Using the Social Vulnerability Index to Examine Local Disparities in Emergent and Elective Cholecystectomy	2019	*Journal of Surgical Research*
Schmitz, M and Rudas, S	Vienna vulnerability index: An index for establishing the degree of risk to the mentally ill	2001	*European Journal of Psychiatry*
Gomez, MLA *et al.*	Vulnerability to coastal erosion in The Gambia: Empirical experience from Gunjur	2020	*International Journal of Disaster Risk Reduction*

Appendix G.2: Articles excluded in Phase 2 (N = 43).

Authors	Title	Year	Journal
Wraight S *et al.*	[Unknown Title]	2018	*N/A*
Holand IS *et al.*	A Social Vulnerability Index for Norway: A Viable Approach in Analyses of Social Consequences of Climate Change?	2009	*IOP Conference Series: Earth and Environmental Science*
Kyne, Dean and Aldrich, Daniel P	Capturing Bonding, Bridging, and Linking Social Capital Through Publicly Available Data	2020	*Risk, Hazards & Crisis in Public Policy*
McKinney, JR *et al.*	COVID Disease Severity: Comparing Demographics and Social Vulnerability Indices for Pregnant Patients	2021	*American Journal of Obstetrics and Gynecology*
Knocke K. *et al.*	COVID-19 Disproportionately Impacts More Vulnerable Rural Hospitals and Communities	2021	*Health Services Research*
Islam SJ *et al.*	Ecological Analysis of the Temporal Trends in the Association of Social Vulnerability and Race/Ethnicity with County-Level COVID-19 Incidence and Outcomes in the United States.	2021	*MedRxiv*
Grabich, SC	Evaluation of Social Vulnerability Indices in Us Rural County Level Environmental Hazards.	2012	*American Journal of Epidemiology*
Tortolero GA *et al.*	Examining Social Vulnerability and the Association With COVID-19 Incidence in Harris County, Texas.	2021	*Frontiers in Public Health*
Prosdocimi, D and Klima, K	Health Effects of Heat Vulnerability in Rio De Janeiro: A Validation Model for Policy Applications	2020	*SN Applied Sciences*
Nayak A *et al.*	Impact of Social Vulnerability on COVID-19 Incidence and Outcomes in the United States.	2020	*MedRxiv*
Kamiohkawa, S *et al.*	Index Assessment of Household Social Vulnerability to Climate Change: A Case Study of Laguna Province, Philippines	2021	*Journal of Environmental Science and Management*
Lue E and Wilson JP	Mapping Fires and American Red Cross Aid Using Demographic Indicators of Vulnerability.	2017	*Disasters*

Ge, Y *et al.*	Mapping Social Vulnerability to Air Pollution: A Case Study of the Yangtze River Delta Region, China	2017	*Sustainability*

Gupta, AK *et al.*	Mapping Socio-Environmental Vulnerability to Climate Change in Different Altitude Zones in the Indian Himalayas	2019	*Ecological Indicators*
Karanja, J and Kiage, L	Perspectives on Spatial Representation of Urban Heat Vulnerability	2021	*Science of The Total Environment*
Salmanian, B *et al.*	Pregnancy Affected By COVID-19, Patient Characteristics and Outcomes Based on Social Vulnerability Index (SVI)	2021	*American Journal of Obstetrics and Gynecology*
Lee, YJ *et al.*	Relationships Between Floods and Social Fragmentation: A Case Study of Chiayi, Taiwan	2017	*Tecnología y Ciencias Del Agua*
Contreras, D *et al.*	Review Article: the Spatial Dimension in the Assessment of Urban Socio-Economic Vulnerability Related to Geohazards	2020	*Natural Hazards and Earth System Sciences*
Sharma, A *et al.*	Role of Green Roofs in Reducing Heat Stress in Vulnerable Urban Communities - A Multidisciplinary Approach	2018	*Environmental Research Letters*
Fekete, Alexander	Social Vulnerability (Re-)Assessment in Context to Natural Hazards: Review of the Usefulness of the Spatial Indicator Approach and Investigations of Validation Demands	2019	*International Journal of Disaster Risk Science*
Thiri, MA	Social Vulnerability and Environmental Migration: The Case of Miyagi Prefecture After the Great East Japan Earthquake	2017	*International Journal of Disaster Risk Reduction*
Zottarelli, LK *et al.*	Social Vulnerability and Heat on Emergency Medical Services in San Antonio, Texas, 2015-2018	2020	*European Journal of Public Health*
Ratnapradipa, D *et al.*	Social Vulnerability and Lyme Disease Incidence: A Regional Analysis of the United States, 2000-2014	2017	*Epidemiology Biostatistics and Public Health*
Corbin, TB	Social Vulnerability and Political Advocacy After Hurricane Katrina	2015	*WIT Transactions on The Built Environment*
Lee, YJ	Social Vulnerability Indicators as a Sustainable Planning Tool	2014	*Environmental Impact Assessment Review*
Mason, K *et al.*	Social Vulnerability Indicators for Flooding in Aotearoa New Zealand	2021	*International Journal of Environmental Research and Public Health*

Fatemi, F *et al.*	Social Vulnerability Indicators in Disasters: Findings from a Systematic Review	2017	*International Journal of Disaster Risk Reduction*
Rufat, S *et al.*	Social Vulnerability to Floods: Review of Case Studies and Implications for Measurement	2015	*International Journal of Disaster Risk Reduction*

Ogie, R and Pradhan, B	Social Vulnerability to Natural Hazards in Wollongong: Comparing Strength Based and Traditional Methods	2020	*Australian Journal of Emergency Management*
Griego, AL *et al.*	Social Vulnerability, Disaster Assistance, and Recovery: A Population-Based Study of Hurricane Harvey in Greater Houston, Texas	2020	*International Journal of Disaster Risk Reduction*
Fekete, A	Societal Resilience Indicator Assessment Using Demographic and Infrastructure Data at the Case of Germany in Context to Multiple Disaster Risks	2018	*International Journal of Disaster Risk Reduction*
Torres, RR *et al.*	Socio-Climatic Hotspots in Brazil	2012	*Climatic Change*
Ribeiro CJN *et al.*	Space-Time Risk Cluster of Visceral Leishmaniasis in Brazilian Endemic Region with High Social Vulnerability: An Ecological Time Series Study.	2021	*PloS Neglected Tropical Diseases*
de Souza, CDF *et al.*	Spatial Clustering, Social Vulnerability and Risk of Leprosy in an Endemic Area in Northeast Brazil: An Ecological Study	2019	*Journal of The European Academy of Dermatology and Venereology*
Fekete, A	Spatial Disaster Vulnerability and Risk Assessments: Challenges in Their Quality and Acceptance	2012	*Natural Hazards*
Mollalo, A and Tatar, M	Spatial Modeling of COVID-19 Vaccine Hesitancy in the United States	2021	*International Journal of Environmental Research and Public Health*
Andrade AWF *et al.*	Temporal and Spatial Trends in Human Visceral Leishmaniasis in An Endemic Area in Northeast Brazil and Their Association with Social Vulnerability.	2021	*Transactions of The Royal Society of Tropical Medicine and Hygiene*
Marvel, SW *et al.*	The COVID-19 Pandemic Vulnerability Index (PVI) Dashboard: Monitoring County-Level Vulnerability Using Visualization, Statistical Modeling, and Machine Learning	2021	*Environmental Health Perspectives*
Cutler, MJ *et al.*	The Influence of Political Ideology and Socioeconomic Vulnerability on Perceived Health Risks of Heat Waves in the Context of Climate Change	2018	*Weather Climate, and Society*

Wood, E *et al.*	The Practical Use of Social Vulnerability Indicators in Disaster Management	2021	*International Journal of Disaster Risk Reduction*
Zhu Q *et al.*	The Spatial Distribution of Health Vulnerability to Heat Waves in Guangdong Province, China.	2014	*Global Health Action*

Carlier, B *et al.*	Upgrading of an Index-Oriented Methodology for Consequence Analysis of Natural Hazards: Application to the Upper Guil Catchment (Southern French Alps)	2018	*Natural Hazards and Earth System Sciences*
Ward, P and Shively, G.	Vulnerability, Income Growth and Climate Change	2012	*World Development*