Social Vulnerability to COVID-19: Preliminary Indicators and Research Agenda

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Disease outbreaks and epidemics, similar to natural hazards, affect different socioeconomic groups in different ways. Understanding the varying degrees of vulnerability across socioeconomic groups, commonly referred to as social vulnerability, can lead to enhanced decision making and better resource allocation in a pandemic situation like COVID-19. This chapter reports on a study which aims to contextualise social vulnerability to pandemic situations in the wake of the COVID-19 pandemic. By building upon the existing literature and novel observations made during the pandemic, the study attempts to identify the preliminary indicators of social vulnerability to pandemics. Consequently, three main components of social vulnerability to pandemics are identified: societal determinants, built environment determinants, and individual characteristics. The latter two are discussed in detail. The chapter ends with a discussion of the implications and limitations of the study and outlines a research agenda for further work.

7.1 Introduction

Though not as frequent as natural hazards, disease outbreaks and epidemics do occur and leave behind a trail of death, destruction, and devastation. In that sense, epidemics can be thought of as natural hazards, posing public health threats and causing emergencies in the same way as earthquakes or hurricanes [1]. However, biological hazards and pandemics seem to recognise no boundaries, no particular groups, and no exceptions. Pandemics, as evidenced by the recent COVID-19 outbreak, lead to significant and long-lasting disruptive and traumatic consequences of a different nature, dynamic, and severity, compared to those of non-biological hazards. For instance, while disasters such as earthquakes and floods can inflict substantial immediate loss of life and harm the economy, mainly due to physical and infrastructural damage, epidemics cause no direct physical damage to structures or property. Instead, they pose enormous threats to humanity in terms of public health, morbidity, and mortality, as well as multifaceted socioeconomic losses due to the resultant confinement, social isolation, and suspension of economic activities.

Like natural hazards and environmental shocks, epidemics are likely to affect various demographic groups disproportionately. Lessons learned from past disasters around the world demonstrate that one's personal, social, and contextual attributes play an essential role in how one prepares for, responds to, and recovers from hazards and disasters [2–4]. The notion that the same disaster is experienced in different ways by different socioeconomic and demographic groups is generally regarded in the disaster literature as “social vulnerability” [5–7]. The development of methods and indicators to identify groups that are more susceptible to complications from

health pandemics can result in better prioritisation of the response strategies, and effective resource allocation by the government and health authorities.

While the use of the term “social vulnerability” in the scientific literature can be traced back to the 1970s (e.g. [8]), it was after the mid-1990s that the concept came to be widely used in the disaster management domain [3, 5, 9]. This means that most of the systematic attempts to conceptualise, define, and measure social vulnerability in a disaster context are relatively new in many ways and are still in their conceptual or methodological adolescence. Moreover, the vast majority of the studies conducted in this area are primarily concerned with social vulnerability to natural and environmental hazards, and, to the best of the author’s knowledge, little systematic attention has been paid to the assessment of social vulnerability to disease outbreaks and epidemics.

This chapter, first and foremost, intends to contextualise social vulnerability to pandemic situations in the wake of the COVID-19 crisis. To achieve this, [Section 7.2](#) sets the scene and provides the context for social vulnerability relating to pandemics and disease outbreaks. [Section 7.3](#) identifies preliminary indicators of social vulnerability to pandemics. Finally, implications, limitations, and an agenda for further research are discussed in [Section 7.4](#).

7.2 Social Vulnerability and Pandemics

The scientific use of the term “vulnerability” draws its roots from geography and natural hazards literature, but it is also used in different fields, referring to diverse settings and situations [10]. “Vulnerability”, in general, refers to susceptibility to threat scenarios, which can manifest itself in various ways, such as harm, powerlessness, and marginality of both physical and social systems [11, 12]. The available literature suggests that vulnerability is a broad and multifaceted concept encompassing an array of causes and contexts, such as physical, social, economic, political, and environmental.

The multi-dimensional nature of the concept of vulnerability is widely recognised and endorsed by the United Nations Office for Disaster Risk Reduction (UNDRR), where social, economic, and infrastructural vulnerabilities are considered as the constituent dimensions of the vulnerability of a specific region to hazards [13, 14]. According to UNDRR [14], infrastructural vulnerability refers to the basic infrastructures required for the production of goods and sustainability of livelihoods; economic vulnerability is associated with the economic status of individuals and communities, and social vulnerability accounts for the inability of people and society to cope with, or recover from, the devastating impacts of disasters.

Social vulnerability, among other types of vulnerability, is relatively more challenging to observe, define, and quantify [15–17]. This explains why socially created vulnerabilities are ignored or overlooked in both emergency decision-making and loss estimation reports in favour of more quantifiable factors such as human casualties and property loss [6]. The complexity surrounding the social dimension becomes even more significant during health crises like the COVID-19 pandemic. During pandemics, high levels of uncertainty and novel problems, coupled with environment-specific factors, lead to greater social, economic, and environmental complexity [18]. These all point to a need to adapt social vulnerabilities in the pandemic’s context and recognise their role in coping and resource management strategies.

Although social vulnerability to pandemics has not been fully characterised, the reports from previous pandemics in 1918 and 2009 imply a link between socioeconomic factors and pandemic outcomes [19–21]. During the 1918 influenza pandemic, mortality rates in high-income countries were relatively lower than those in low-income countries. For example, in country-level analyses, the mortality rate in India was 40 times higher than in Denmark [22], and the mortality rates in some Central and South American countries were up to 20 times higher than in European countries [23].

Similar results were also found at city and community levels. Studies on the 1918 pandemic detected a considerable link between disease transmissibility and population density, illiteracy, and unemployment in Chicago [24]. Likewise, Rutter et al. [25] found an association between deprivation

and the mortality rate for the 1918 pandemic in England. The results of these studies show that marginalised and disadvantaged social groups may be at greater risk from disease outbreaks. Thus, the explicit identification of populations vulnerable to disease outbreaks can be of great use in devoting attention to the groups most at risk during pandemics and their aftermath. Such a precise identification can be determined through the empirical analysis of precise indicators and variables.

The next section of this chapter is devoted to social vulnerability indicators in the context of the COVID-19 pandemic.

7.3 Social Vulnerability Indicators

Herein, social vulnerability refers to the combinations of social, cultural, economic, political, and institutional factors that account for the inability of society to cope with or withstand the impact of disasters and large-scale crises [14, 26]. There is broad agreement over the key defining factors of social vulnerability itself. Examples of such factors include [5–7, 11, 27–29]:

- poverty and economic marginalisation,
- lack of, or limited access to, resources and lifelines,
- ethnic and language minorities,
- community connectedness,
- household structure and housing conditions, and
- age and general health status.

However, as Cutter et al. [6] and Kuhlicke et al. [30] have also pointed out, there are discrepancies in specific indicators and variables representing the broader factors and the techniques used for the quantification of social vulnerability.

Despite disagreements over the indicators and variables, quantitative and statistical methods are widely used in the quantification of social vulnerabilities. Two examples are the Social Vulnerability Index (SoVI) developed in 2003 at the University of South Carolina, and the Social Vulnerability Index (SVI) developed in 2011 at the US Centres for Disease Control and Prevention (CDC). The SoVI is a place-specific and quantitative method which provides an empirically-based comparative tool to measure the capacity of social groups to cope with or recover from environmental hazards [6]. The SVI is also a well-recognised approach to facilitate the location-based quantification and comparison of social vulnerabilities to disasters [7]. Quantitative methods similar to SoVI and SVI focus on the identification of social vulnerability components associated with the specific context of the study. They then apply location-based and statistical models to the census data or other available information corresponding to the identified components.

Thus, the identification of the components of social vulnerability relating to COVID-19 could be considered as the first step towards formulating a reliable model. The rest of this chapter will be concerned with this step. Meaningful and relevant indicators are the building blocks of quantitative and empirical analysis. This study aims to identify the key social vulnerability indicators in the COVID-19 pandemic context. First of all, the preliminary indicators will be extracted from the literature or the author's observations and research during the development of the COVID-19 situation in Australia. After that, the proposed indicators will be assessed and validated by a group of emergency management and public safety experts.

It seems that COVID-19 related vulnerabilities generally arise from both the viral infection itself and the response measures, such as restrictions on the movement of people, business closures, and the subsequent economic downturn. The elderly population and people with underlying medical

conditions are at higher risk if they are infected with the COVID-19 virus¹ [31]. However, the entire community appears to be more impacted by the indirect effects of COVID-19, namely, the response measures and their negative well-being and socioeconomic outcomes. To simplify the concept, this chapter will explore social vulnerability to COVID-19 as a whole without differentiating between the direct and indirect impacts of COVID-19.

Building upon the previous literature (e.g., [2, 6, 7, 32–34]), this chapter identifies three main components of social vulnerability to pandemics, namely, individual characteristics, built environment determinants, and societal determinants (Figure 7.1). Identification of the indicators associated with each component should be a prerequisite to any attempt at quantification. However, due to the time limitations, and given the intrinsic complexity of societal determinants, this chapter will focus on individual characteristics and built environment determinants. Societal determinants will be left for future work.

FIGURE 7.1

Main components of social vulnerability to COVID-19

7.3.1 Individual Characteristics

Individual characteristics refer to the personal attributes that may have a determinate role in an individual's susceptibility and capacity to tolerate the impacts of pandemics in general, and COVID-19 in particular. Examples of such characteristics include age, gender, ethnicity, education, disability, family conditions, and household circumstances.

7.3.1.1 Age

Those at both ends of the age spectrum are referred to as potentially more vulnerable when exposed to environmental hazards [2, 5–7, 29, 32, 35]. While people of all ages can be infected with the COVID-19 virus, older people appear to be more susceptible to it. Also, a compromised immune system or pre-existing medical condition, which can increase the severity of the infection is more common in the elderly population. Apart from the risk of exposure itself, older people are especially vulnerable to loneliness, which is the typical outcome of COVID-19 restrictions and social distancing measures. Moreover, given the prevalence of negative stereotyping of older people and age-based

¹According to the Australian Government Department of Health, people aged 70 years and over, people aged 65 years and over with chronic medical conditions, people with compromised immune systems, and Aboriginal and Torres Strait Islander people over the age of 50, are at greater risk of more serious illness if they are infected with coronavirus (<https://bit.ly/2Yulw47>).

discrimination, and their potential increase during public health emergencies, the older population can face various kinds of mistreatment and barriers in accessing health care and support services.

7.3.1.2 Gender

Gender-based vulnerabilities to environmental hazards are extensively discussed in the existing literature [29, 36, 37]. In the context of the COVID-19 pandemic, early studies indicate a tendency towards higher mortality in men than women in confirmed COVID-19 cases across the world [38, 39]. Women, on the other hand, seem to be more susceptible to the socioeconomic consequences of the pandemic. Also, there are several reports of increases in the frequency and intensity of violence against women, and a significant rise in reporting of first-time family violence by women in Australia and across the world [40, 41]. This newly emerging phenomenon is referred to as “shadow pandemic” by UN Women [42]. The United Nations Population Fund (UNFPA) projections predicted that for every three months of the lockdown, 15 million cases of gender-based violence could occur globally [43].

7.3.1.3 Minority Status and Language

Race, ethnicity, religion, and language proficiency are among the factors contributing to social vulnerability to natural hazards [6, 7, 29, 44–46]. These factors can signify unequal or uncertain access to livelihood resources and health services during a pandemic and can lead to various forms of discrimination in the allocation of welfare and relief packages. Also, the author’s observations and published records [47, 48] reveal a further amplification of ethnic inequality arising from a dramatic rise in racism and racially motivated attacks towards people of specific racial origins. As a result, some population groups can turn inwards and may experience a greater sense of isolation and exclusion at a time when staying connected matters most.

7.3.1.4 Family and Household Structure

Family structure refers to different forms of family or household settings, such as single-person household, shared living with non-family, a married or cohabiting couple (with or without children), single-parent families, and extended families. Previous studies suggest that overcrowded families, single-person households, and single-parent households are more vulnerable to natural hazards [6, 30, 44]. For example, according to Holand et al. [16], two-parent families can better manage the different responsibilities faced before, during, and after a hazard.

Within the context of COVID-19, family structure can also be associated with the allocation of in-house spaces and utilities, which, if required, is critical for effective self-isolation and minimising the risk of within-household transmission [49, 50]. This issue can be more severe in families with children or in extended families where special needs such as remote schooling of children or nursing care of older adults may increase the demand for space in a house.

7.3.1.5 Disabilities and Health Conditions

In general, people with physical or mental disabilities and those suffering from chronic health conditions are considered the most vulnerable groups in society, and disasters increase this vulnerability even further [3, 5]. Also, disabled groups are less likely to receive support or benefit from disaster relief programs [30]. In addition, as outlined previously, people with a suppressed immune system or a pre-existing health condition (e.g. heart-related issues, diabetes, chronic respiratory disease, or cancer) are more likely to progress to severe forms of COVID-19.

7.3.1.6 Education

An overview of previous studies suggests that people with higher education are more resilient to the impacts of disasters. Groups with higher education have better access to the necessary information and resources and can secure government financial assistance more than those with lower education [6, 29, 51, 52]. Given the complexity of the COVID-19 pandemic and its rapid development, higher education can increase awareness of resources, facilitate access to critical information, and maximise

compliance with response protocols. Moreover, people with higher education levels are expected to have higher computer competency and digital communication skills, which have proved to be crucial for staying connected, seeking practical help, online shopping, remote working, and online training.

7.3.1.7 Employment and Occupation

Employment plays a crucial role in financial security, access to resources and the overall well-being of individuals, families, and communities. It is recognised that disasters cause high levels of unemployment, especially in the short term [53, 54]. Employment instability during a disaster could decrease coping capacity and increase dependency on external financial support. For example, early studies in Australia show that casual workers and the self-employed, especially young people working in the food, hospitality and retail sectors, are likely to be disproportionately impacted by the pandemic-created economic downturn [55, 56]. Occupations with less dependency on physical movement and remote-friendly jobs appear to be more resilient during situations similar to COVID-19.

7.3.1.8 Financial Status

Financial status is a notion encompassing various financial factors such as income, expenses, assets, savings, and debts. Financial status is believed to have a significant impact on the overall health of a person or household, their social status and connectedness, and their ability to deal with and recover from crises [57, 58]. Previous studies have reported a strong tie between financial status and social vulnerability to disasters [5, 6, 29, 32, 44]. For instance, while financial commitments such as mortgages can make people more vulnerable in times of crisis, people with reasonably large savings can show better resilience to shocks from crises. Moreover, observations made during the COVID-19 pandemic indicate that better financial status can be considered as a positive factor in people's adherence to the public health guidelines and government pandemic protocols.

7.3.1.9 Insurance Coverage

Adequate insurance coverage (whether it be health insurance, income protection, life insurance, or trauma cover) can decrease susceptibility to the adverse consequences of disasters [33, 59, 60]. For example, private health cover enhances the choice of providers and improves access to timely and effective health care services and management [61, 62]. Income protection insurance or trauma cover can help families ease or avoid financial stresses caused by the COVID-19 economic downturn.

7.3.1.10 Ownership Status

Ownership status refers to the ownership of property and motor vehicles. Various studies emphasise the role of house and car ownership in reducing the negative consequences of environmental hazards [6, 7, 32]. Regarding the COVID-19 pandemic situation, it is believed that car and house ownership, especially with no significant mortgage or car loans in place, can significantly reduce the financial stress and mental pressure caused by the pandemic's economic effects. Car ownership can provide families with better and safer commuting options and reduce their reliance on public transport – where the risk of infection is greater.

7.3.2 Built Environment Determinants

The built environment refers to the physical form of communities [63]. Some studies have demonstrated that built environment factors are significantly associated with health outcomes [33, 64]. Previous studies in the field of natural hazards attempted to measure built environment vulnerability by factors such as population density, quality of urban infrastructure, and road network density [16, 32]. Given the unique nature of the COVID-19 pandemic, this section identifies the following preliminary indicators as the pandemic's built environment determinants.

7.3.2.1 Spatial Accessibility

Spatial accessibility refers to the proximity and ease of access to essential urban services, civic amenities, and public infrastructure. Proximity to essential services and amenities such as hospitals, pharmacies, supermarkets, and parks can be a valuable resource, especially when there are limitations imposed on the movement of people and goods to prevent the spread of a virus. Studies show that people residing in inner metropolitan areas have better access to civic amenities than the residents of the outer metropolitan areas [65]. A proximity analysis conducted by the author within the state of Victoria, Australia shows that the number of essential amenities drops significantly as one moves away from the CBD (Figure 7.2). For example, the average number of essential services in a 5 km radius in the inner metropolitan suburbs of Melbourne is three times more than those in the middle metropolitan suburbs. The analysis suggests that the classification of residential areas based on their distance from the CBD can be a reliable indicator of spatial accessibility.

FIGURE 7.2
Average number of essential amenities within 5 km radius of residential addresses

In order to perform the analysis, Victoria’s suburbs have been classified into four zones: inner metropolitan suburbs (located within 10 km from the Melbourne CBD), middle metropolitan suburbs (located between 10 to 20 km from the Melbourne CBD), outer metropolitan suburbs (located more than 20 km from the Melbourne CBD), and regional and rural areas (suburbs located outside of the Melbourne metropolitan area). Then, the average number of accessible services is

calculated, based on the mean of the number of selected essential services falling within 5 km radius of 10 random residential addresses in each zone. The analysis was produced using ArcGIS Pro 2.5.0 and data downloaded from OpenStreetMap,² Victoria's Department of Health and Human Services,³ and the Australian Bureau of Statistics.⁴

7.3.2.2 Urban Infrastructure

Networks of robust urban infrastructure and essential utility systems (e.g., sewage and water networks, telecommunications, electricity, gas, road network, and public transport) play a vital role in protecting public health and the environment. The role of urban infrastructure becomes more crucial during disasters and public health emergencies, and the COVID-19 pandemic is no different. The continuity and quality of urban infrastructure and essential utility services during large-scale pandemics can provide a more convenient means for accessing essential services, complying with the stay-at-home orders, and staying connected with families, friends, and professional peers.

Evidence from previous health emergencies like the cholera epidemics during the 1800s suggests that, in some cases, contaminated water and sewage networks can contribute to the spread of disease [66]. Although this is not the case for the COVID-19 virus at the moment, some studies imply that the potential spread of COVID-19 via sewage networks must not be neglected [67]. Also, many countries have started monitoring wastewater for traces of the COVID-19 virus, and some found evidence of the virus days or even weeks before the first official case was declared [68]. It is possible, therefore, that ongoing surveillance of sewage and water systems can provide early warning of impending outbreaks and help contain the spread of contagious diseases in the early stages.

7.3.2.3 Population Density

Population density is a measurement of the population per unit area and is recognised as a key determinant of vulnerability to natural and environmental hazards [28, 29, 69]. Studies have investigated the role of population density in both the 1918 influenza pandemic [24] and the present COVID-19 pandemic [70, 71], and suggest that in cities with greater population density, the virus spreads faster than in less crowded cities, due to more frequent contacts among people.

7.3.2.4 Walkability

Walkability refers to the extent to which the built environment can provide safe and friendly conditions for walking and cycling [72, 73]. A considerable volume of published studies describes the role of walking and cycling in promoting good physical and mental health and achieving greater social equality [74–76]. With the multi-directional effects of COVID-19 on most outdoor facilities and activities, a walkable neighbourhood can greatly encourage walking, cycling, and physical activity. Recent studies like Mattioli et al. [77] and McDougall et al. [78] suggest that physical activities can play a significant role in mitigating the physical and mental health challenges presented by COVID-19.

7.4 Discussion and Conclusion Remarks

COVID-19 has created unprecedented challenges across the globe and is expected to have lasting impacts in the years to come. Understanding how pandemics influence the lives of various socioeconomic groups can help decision-makers develop a clearer perception of the situation and direct resources to where they will have the most significant effect. As outlined earlier in this

²<https://www.openstreetmap.org/>

³<https://www.dhhs.vic.gov.au/>

⁴<https://www.abs.gov.au/>

chapter, a large body of literature under the umbrella concept of social vulnerability is devoted to understanding how different socioeconomic groups experience crises differently. However, due to the rarity of pandemics in recent history, little work has been done on social vulnerability in the context of disease outbreaks and pandemics.

This study is an early attempt to understand social vulnerability to disease outbreaks, learning from the COVID-19 pandemic and its socioeconomic ramifications on society. Borrowing from the literature, this chapter has elaborated on the concept of social vulnerability to the COVID-19 pandemic, which was later followed by the identification of social vulnerability components in pandemic settings. Three main components have been recognised: individual characteristics, built environment determinants, and societal determinants, the first two of which have been further divided into indicators to provide a more detailed description of their role in social vulnerability to pandemics.

It should be noted that this chapter is neither an attempt to define social vulnerability to pandemics on a global scale nor to provide an exhaustive list of its indicators. The study presents several inherent limitations that should be noted before future research directions are discussed. The first limitation comes from the highly-complex nature and rapidly changing and still unfolding implications of the COVID-19 pandemic. No doubt establishing a thorough understanding of the multi-dimensional impact of the ongoing pandemic will take years. The second limitation concerns the time constraints, which restricted the study to investigate selected components of social vulnerability to pandemics and leave the detailed investigation of the societal components for future work. The third limitation originates from the jurisdiction in which this study takes place. Some of the justifications in this chapter are made through careful observations of the COVID-19 situation in Australia and may not be generalisable to other countries because of different socioeconomic or cultural circumstances.

Future directions of this study include further expansion of the concept by a detailed investigation of the societal determinants of social vulnerability to COVID-19, as well as the external validation of the outcomes through focus groups or interviews. This will be followed by studying the relationship between the indicators and the morbidity and mortality caused by the pandemic using the actual COVID-19 data, which can lead to a more thorough validation of the work. Future extensions of this study will also explore potential biases or preconceived assumptions associated with the various indicators as well as the interplay between them. For example, while high population density can contribute to pandemic-related vulnerabilities, densely populated areas are likely to have better urban infrastructure networks. Similarly, people with higher education or better financial status are expected to be less vulnerable to pandemics, but the prevalence of international and long-distance mobility in such groups may also place them on the list of highly exposed and primary long-distance carriers of disease, especially in the early stages of a pandemic. It is expected the ultimate outcomes of this ongoing research will enhance the overall awareness of pandemics and will be of considerable value in drafting future pandemic preparedness plans.

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