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Development and validation of a lockdown preparedness scale: Understanding lockdown preparedness through a social vulnerability perspective

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ABSTRACT

Millions of people around the world were subjected into nationwide or community wide lockdowns in response to the COVID-19 pandemic. Scientists also predict that as we enter into a new normal, another pandemic is not impossible, and that lockdowns may be implemented again. Therefore, examining factors affecting lockdown preparedness (LDP) is important. Through a survey of 800 adult residents in Singapore during the pandemic, this study proposed and tested an LDP scale and found that quality of social interactions, news consumption, as well as education and income affect the extent of psychological and emotional preparedness for lockdowns.

The 2019 coronavirus disease (COVID-19) has triggered nationwide lockdowns around the world, affecting the lives and livelihoods of billions of people. The multiple resurgences and new variants (e.g., the Omicron variant) have resulted in many countries or cities going through repeated cycles of lockdown imposition and relaxation [1,2]. The cumulation of the various COVID-19-induced changes, coupled with the lockdown restrictions, has negatively affected the quality of life for many around the world [3].

Studies have examined the psychological or physiological repercussions during lockdowns and people’s adaptive responses toward them (e.g., Refs. [4,5]). However, it is rare that these studies acknowledge the volatile nature of the impending lockdowns and people’s preparedness to experience them (i.e., lockdown preparedness; LDP). Addressing this research gap is critical because adaptive coping during lockdowns (e.g. Refs. [6–8]), as well as the decreased chances of experiencing psychological illnesses after a disaster or a stressful event (e.g. Refs. [9,10]), has generally been positively associated with individuals’ high level of preparedness.

Due to its novelty, the research on individuals’ LDP during COVID-19 poses a couple of challenges. First, there is an absence of a validated measurement scale for LDP, thus making it difficult for scholars to quantify and assess LDP. Despite numerous measures relating to pandemic preparedness in the literature, there has not been one that is specifically related to lockdowns. Rather, existing studies have measured pandemic preparedness either at the macro-level, using cross-national or country-level indicators like the magnitude of epidemic workforce, healthcare expenditure in the country, or community stockpiles of material resources such as personal protective equipment [11–13]; or at the micro-level, such as citizens’ access to news media [14] and digital technology [15] as well as their level of health literacy [16].

Second, a theoretical framework to guide researchers’ understanding of LDP is also lacking in the literature. Therefore, it is difficult to conceptualize and validate how this new measure may relate with other variables in the socio-physical environment. Research studies on emergency, disaster and crisis management suggest how LDP can potentially be associated with a variety of factors influencing capabilities to cope with the event; for example, from possession of stockpiled medical and food supplies [17] to one’s cultural...
or racial background [18], and to one's accessibility of information, training, digital or coping resources [19]. However, a logical framework is still lacking in the literature to systematically link these factors with LDP.

Turning to the social vulnerability theory (SVT; [20,21]), this study seeks to address these research gaps by examining the relationship between LDP during COVID-19 and social vulnerability factors. The SVT defines social vulnerability as the “susceptibility of social groups or society at large to potential losses (structural or non-structural) from hazard events and disasters” [20] due to social inequalities. Social vulnerability is not only a factor that can affect societal or individual resilience toward adverse events [22], but may also be indicative of the level of preparedness toward these events [23].

Guided by previous studies on disaster and emergency preparedness, and the framework of SVT, this current study proposes and tests a quantitative measurement scale for LDP within the context of Singapore, and examines the social vulnerability factors that may potentially be associated with LDP.

1. Literature Review

1.1. Assessing Lockdown Preparedness

Examining the empirical link between individuals' social vulnerabilities and their preparedness toward lockdowns is crucial, and yet this is hampered by the lack of quantitative measures to assess lockdown preparedness at the individual level. Thus, this current study's objectives are two-fold: First, it develops and validates a proposed lockdown preparedness scale, guided by research that examined subjective measures of preparedness in the disaster, crisis, and emergencies literature. Second, it employs the framework of social vulnerability theory to examine factors that affect an individual's LDP.

Studies have adopted psychometric scales to allow survey participants to subjectively self-report their level of preparedness toward disasters or emergencies. For example, in Virginia, Ferguson et al. [24] measured household perceived preparedness toward large-scale disasters, as well as the self-reporting of specific preparedness behaviors within households (e.g., practicing emergency plans with household members), using a 5-point Likert scale (1 = “Unprepared” to 5 = “Completely prepared”). Likewise, Oligeran Steeves et al. [25] measured teachers' perceived preparedness toward six types of crises (e.g., bomb threat, suicide, intruder on campus) in elementary schools in Louisiana, using a 5-point Likert scale (1 = “Not at all prepared” to 5 = “Adequately prepared”). In the medical context, Al Khalailah et al. [26] measured nurses' preparedness toward large-scale disasters in Jordan by using a 45-item questionnaire. These items measure nurses' perception toward their own preparedness in terms of their knowledge and specific skillsets, such as “being familiar with local emergency response system for disasters,” on a 6-point Likert scale (1 = “Strongly disagree” to 6 = “Strongly agree”). In Australia, Zulch et al. [27] developed and validated a scale to measure individuals’ psychological preparedness toward disasters—the items loaded on four factors focusing on individuals’ anticipation, their perceived confidence and ability to cope with as well as their knowledge to manage the disaster.

Most of these preparedness scales focus broadly on how individuals or households may physically (e.g., stockpiling) and mentally (e.g., knowledge, anticipation) prepare for impending disasters [28]. Specifically, the dimensions of these preparedness scales highlighted how individuals may perceive their own knowledge and their accessibility of material or social resources in preparation to deal with the impending disaster. A lockdown, however, is different. Going into lockdown seeks to prevent a health crisis from worsening, yet it also disrupts people’s normal lives and may thus affect them negatively. However, there remains no validated way to assess an individual’s lockdown preparedness, a gap that has been made more salient by the series of lockdowns implemented across the world during the COVID-19 pandemic. Therefore, guided by previous studies and scales developed for disaster and emergency preparedness, we raise the following research question, with the goal of developing and validating a set of psychometric scale items to assess lockdown preparedness:

RQ1. How do we quantitatively measure individuals’ lockdown preparedness during the COVID-19 pandemic?

1.2. The Impact of Social Vulnerabilities

The second objective of this study is to examine what factors affect an individual’s lockdown preparedness. For this, we turn to social vulnerability theory (SVT) for guidance. The SVT was first conceptualized to address the inconsistencies in the definitions of vulnerability in the risk, hazards, and disasters literature [20]. Grounded in the geographical hazards research [29], the SVT originally posits that the potentials of hazards are “filtered through” both the societal fabric and geographical context which determines social and technological/physical vulnerability, respectively [20]. More recent advancements of the SVT included the development of social vulnerability index (SoVI) [21], focusing on the social vulnerability aspect of the framework. Specifically, the original SoVI comprises of 11 survey items (see Ref. [21]; Table 3) subsumed under four dimensions: social (e.g., ethnicity, race), economic (personal wealth, occupation type), physical (e.g., age), and environmental (e.g., density of built environment and dwelling type). These dimensions, according to Cutter [21]; are the direct indicators of one's vulnerability toward environmental hazards/disasters by facilitating (or impeding) their efforts to get around them.

Since its development, the SVT has been applied across various contexts, from hazards and natural disasters studies to more recent ones, such as the COVID-19 pandemic. For example, Nyahunda et al. [30] adopted the SVT to investigate how climate change can have adverse impact on rural women in Zimbabwe during the pandemic. The study found that social vulnerability factors, such as gender inequalities and social exclusion, aggravated the catastrophic consequences (e.g., food insecurities and lack of access to healthcare) suffered by rural women and caused by climate change. In a study of individuals’ vulnerability toward contracting COVID in various geographical areas in Colorado, Lee and Ramírez [31] found that COVID-19 infection rates were associated with social vulnerability factors such as inequalities in education, income level, as well as racial and ethnic minorities. These inequalities resulted in
disproportionate exposure to COVID-19 infection within the communities across different geographical regions. Outside the context of COVID-19 pandemic, the SVI has also been applied to examine the effects of natural disasters on communities across the globe. For example, Hamideh et al. (2022) adopted the SVI to investigate how a wildfire in California can impact households and their recovery from the disaster. It was found that socially vulnerable households (i.e., those with low household income, with young or elderly members, or those poor in health) encountered substantial challenges in recovering from the disaster.

There have been several revisions to the four dimensions of SoVI alongside with its applications. These revisions often involve the inclusion of new items to, as well as the modification or replacement of several items from, the original SoVI. For instance, Zhou et al. [32] adapted the SoVI and used economic status, development, education, age, gender, population change, unemployment, rural character and food security as their indicators when constructing a SoVI to assess social vulnerability toward natural disasters in China. Likewise, to measure municipality-level community resilience in Japan, Fraser [33] used an improvised version of the SoVI with a total of 29 indicators that were categorized under six main groups: demographics, population structure, socioeconomic status, employment, housing and social dependence, combined with four social capital indices. Perhaps the most notable adaptation of the SoVI is the re-creation and application of a new social vulnerability index (SVI) by the Centers for Disease Control in U.S. since 2018 [34]. The new index, which includes 15 survey items, are broadly categorized into four factors, namely socio-economic status, household composition, minority statuses, and housing/transportation type [35].

As a multi-dimensional construct, SoVI's components are often assessed independently as predictors of specific outcomes relating to one's encounter of hazardous/stressful events. For example, Kashem et al. [36] used a revised version of the SoVI to predict COVID-19 infection rates in both short- and long-term periods in Chicago. The revised version of the SoVI focuses on the built environment of a neighborhood (e.g., walkability, open space accessibility, dependency on public transport) and socio-economic items (e.g., occupation type, household income, family size, ethnicity, and race). Kashem et al. [36] found that large household sizes, poor internet accessibility, low education level, belonging to ethnic minority group, and having high dependency on public transport (i.e., not owning a vehicle) are positively related to high infection rates. Likewise, in a study on the relationship between social vulnerability and count of COVID-19 cases in the U.S. counties, Karaye and Horney [37] predicted that one's socio-economic statuses, housing composition, disability, minority status, housing type, and possession of a vehicle are related to the count of cases in the counties. The study found that one's minority status in the country is positively related to the count of cases in the counties. They argued that, due to social inequality, people who belonged to minority communities suffer from a lack of access to proper or quality healthcare resources, and hence tend to be more vulnerable during the COVID-19 pandemic. Fletcher et al. [38] used social vulnerability components like socioeconomic status, household composition and disability, minority status and language, and housing type and transportation to study stay-at-home behaviour during COVID-19 stay-at-home orders in the United States. They found a relationship between stay-at-home behaviour and household composition, whereby people living in single-parent households were less likely to stay-at-home, in turn, increasing their COVID-19 exposure risk.

Other studies have treated SoVI as an aggregated component (i.e., a single vulnerability score). For example, Huang et al. [39] predicted COVID-19 case and mortality rates in South Carolina using an eight-factor SoVI derived from a set of 29 items that were measured previously in a U.S. national survey. These factors include demographics such as race, ethnicity, gender, age, belonging to a minority group, household dynamics (e.g., female-headed households), and socio-economics ones like wealth (e.g., median household income), dependency on social security benefits, and employment type. Unlike the previous study, Huang et al. [39] aggregated the scores from these factors (to form a SoVI score) in the prediction analyses. The study found that SoVI is a positive predictor of case rate but not mortality rate. Focusing on children's vulnerability to COVID-19 in Indonesia, Adwilvito and Rakhmawan [40] developed four factors to measure the SoVI, derived from 11 survey items relating to socio-economic and health status (e.g., percentage of children with no access to internet and children who smoked), family structure (e.g., percentage of children under four years old), access to healthcare (e.g., percentage of children with no health insurance) and household characteristics (e.g., percentage of households with single mothers). The scores for these factors were aggregated to form the “SoVI in children” scores and were then analyzed spatially across various regions and districts across Indonesia.

1.3. Lockdown Preparedness and Social Vulnerabilities

These social vulnerability factors have been traditionally acknowledged by researchers to play an important role in the countries' or individuals' preparations toward impending catastrophic disasters [41]. For example, in a study of emergency preparedness, Nukpezah [42] expanded the original SoVI by taking into account respondents' household size as well as their political orientation (i.e., liberals vs conservatives) and used them to predict individuals' emergency preparedness. The respondents' emergency preparedness was measured by the extent to which emergency preparedness actions are perceived as important (e.g., stockpiling supplies and collecting information). While it was found that high education level and size of household have a positive effect on emergency preparedness, individuals' political orientation, however, has no effect. In a more specific context, Nikkanen et al. [43] adopted the SoVI to predict individual preparedness toward winter storms in Finland. Individuals' level of preparedness was measured by the self-reported number of preparedness measures that they have. The authors found that, among other social vulnerability determinants (e.g., living in urban/rural areas, gender, age, education level and employment status), dwelling types as well as one's past experience with storms can predict their level of preparedness toward these events.

Likewise, in earlier studies, Dzialek et al. [44] predicted how social vulnerability drivers (such as age, gender, education level, house/flat ownership, social capital) can affect people's preparedness for a flood in the future in Poland. Flood preparedness in the study was measured by the respondents' self-report on the range of preparedness measures they have undertaken (e.g., possessing flood insurance). It was found that those with household members having low education levels, not being homeowners, and having negative views of their relationships in the social environment are less prepared for flood. In a study to map the social vulnerability of
communities living in Galveston, Van Zandt et al. [45] highlighted the relationship between social vulnerabilities and preparedness. Social vulnerabilities can affect a person's ability to obtain useful information and act on them, to attain or retain resources (physical, financial, social) as well as to use them, which, in turn, affects their preparedness toward emergencies.

These studies imply that the relationship between social vulnerability factors (as independent variables) and individual-level preparedness (as dependent variable) is negative. That is, an increase (vs decrease) in one's level of social vulnerability is associated with worsened (vs improved) preparedness toward these stressful events. Therefore, in the context of this study, it can be expected that the social vulnerability aspects of individuals should adversely affect their preparedness toward lockdowns.

While information access are casually included in social vulnerability measures, especially since many disasters are also often marked by the spread of rumors and inaccurate information, especially in the early stages, the importance of having timely and accurate information has become more salient during the COVID-19 pandemic. Therefore, in this study, access to information and communication channels is also considered to be a core aspect of measuring social vulnerability (e.g., Refs. [14,19]). Guided by studies that have employed SVT as well as incorporating information and communication access as a measure of social vulnerability, this current study poses the following research question, focusing on exploring the role of social vulnerabilities, including information and communication access, in an individual's LDP:

RQ2. How are social vulnerability factors related to individual lockdown preparedness during the COVID-19 pandemic?

2. Method

This study is based on two surveys involving adult residents in Singapore. The first survey (main survey) was conducted in July 2021 for the purpose of developing a proposed LDP scale and examining how LDP may be influenced by social vulnerabilities. The second survey (confirmatory survey) was conducted about a year later, in June 2022 for the purpose of validating the LDP scale as developed in the main survey.

2.1. Study Sample

In both surveys, participants were recruited by Dynata, an international private polling company that maintains a local office in Singapore. Dynata maintains a panel of respondents in Singapore that receive points from participating in online polls that can be redeemed into vouchers. Quotas were set during data collection to ensure that the sample is as representative of the general population in Singapore as possible. In accordance with the University's IRB guidelines, the minimum age to participate in this study was set as 21 years old and above. In addition, the eligibility to participate in the surveys was limited to only those currently residing in Singapore either as citizens or long-term residents. Thus, the findings only apply to adult residents currently in Singapore at the time of the data collection. Informed consent was sought from the participants prior to their attempt of each survey.

Main survey. A total of 800 eligible participants were recruited over a period of two weeks in July 2021. Since Singapore is a multi-racial society, the initial sample included Chinese, and other minority races. For consistency in the analysis, the 51 responses from participants who chose not to disclose their monthly household income, or their dwelling type were removed from the dataset. The final sample \( n = 749 \) mirrors closely the general population in Singapore in terms of median age (40.0 years old) and gender distribution (\( male = 50.7 \), \( female = 49.3 \)). Though ethnicity proportions are not as close to the general population, most of the responses in the final sample count come from the ethnic majority in Singapore: the Chinese (86.2%), and the rest of the response were from the minorities: Malays (7.21%) and the Indians/Other Races (6.54%).

Confirmatory survey. As a part of a multi-wave national survey in Singapore, a second (confirmatory) survey \( n = 992 \) was conducted about a year after the data collection for the current study was completed. Hence, this separate dataset includes the responses from participants in the current study as well as new participants. Recruitment procedures, the eligibility to participate, and the shortlisting criteria for this separate survey were similar to that of the current study. In line with the main study's sample, the demographic breakdown of the confirmatory study sample is close to that of the national population in Singapore in terms of median age (41.0 years old) and gender distributions (\( male = 51.9 \), \( female = 48.1 \)). The ethnic proportions in the confirmatory study sample, like the national population, have the Chinese (84.6%) as the ethnic majority. The rest of the ethnic groups belong to the minorities: Malays (7.87%) and Indians/Other Races (7.57%). Table 1 compares the demographic breakdown of the main study sample and confirmatory study sample with the national population in Singapore.

2.2. Procedures and Measures

Participants first answered demographic questions relating to their age, ethnicity, and citizenship. After that, they responded to questions that measure the quality of their social relationships with family, friends, and colleagues/classmates before responding to the LDP items. Participants also then answered questions relating to their internet use and news media consumption before ending the survey by responding to more questions relating to their demographic profile (e.g., gender, monthly household income, religion, marital status, employment status, and dwelling type). The survey method is constrained by its reliance on self-reporting by respondents, which is important to consider when assessing the findings of the current study.

Lockdown preparedness. This was measured using 14 items that were either adapted from previous studies on disaster preparedness (e.g. Ref. [27]), or developed within the specific context of COVID-19 lockdowns (see Table 2). Participants were first asked to imagine if Singapore is to go into another lockdown (or colloquially referred to as “Circuit Breaker”) at a time when rumors were rife that another lockdown was looming (this proved to be incorrect, as the government did not implement a second lockdown); they then rated their level of agreement or disagreement, using a 5-point Likert scale (1 = “Strongly disagree” to 5 = “Strongly agree”), with each of the 14 items that measure various aspects of perceived preparedness. The full list of the 14
Table 1
Study Samples Versus National Population.

| Demographics Breakdown | Main Study Sample (n = 749) (%) | Confirmatory Survey Sample (n = 992) (%) | National Population* (%) |
|------------------------|---------------------------------|----------------------------------------|--------------------------|
| Median age             | 40.0 years old                  | 41.0 years old                        | 42.2 years old           |
| Gender                 |                                 |                                        |                          |
| Male                   | 50.7                            | 51.9                                   | 52.3^                    |
| Female                 | 49.3                            | 48.1                                   | 47.7^                    |
| Ethnicity              |                                 |                                        |                          |
| Chinese                | 86.2                            | 84.6                                   | 75.9                     |
| Malay                  | 7.21                            | 7.87                                   | 15.0                     |
| Indian/ Others         | 6.54                            | 7.57                                   | 9.1                      |

* Retrieved from the Population in Brief 2020 report. https://www.strategysg.gov.sg/media-centre/publications/population-in-brief,
^ Retrieved from The World Bank. https://data.worldbank.org/indicator/SP.POP.TOTL.FE.ZS?locations=SG.

Table 2
Lockdown Preparedness (LDP) Measurement Items.

| Item No. | Measurement Items |
|----------|-------------------|
| LDP_1    | I feel that I am ready. |
| LDP_2    | I can quickly adjust my lifestyle. |
| LDP_3    | I have the necessary knowledge to deal with the change. |
| LDP_4    | I have the necessary technology and tools (e.g., laptop, internet connection) to carry out my work or study. |
| LDP_5    | I can keep myself entertained. |
| LDP_6    | I have a conducive physical space at home (or elsewhere) for work or study. |
| LDP_7    | I will be confident I will have sufficient food supplies. |
| LDP_8    | I will have easy access to technical support. |
| LDP_9    | I will have easy access to health & medical supplies. |
| LDP_10   | I will be able to continue communicating with others. |
| LDP_11   | I can stay cool and calm. |
| LDP_12   | I will be able to manage my feelings pretty well. |
| LDP_13   | I would know how to manage my own response. |
| LDP_14   | I will have some difficulty adjusting (reverse-coded). |

Now, we would like to know how prepared you are if Singapore goes into another Circuit Breaker. To what extent do you agree with the following statements?

Strongly disagree (1) ... Strongly agree (5)

If there is another lockdown in Singapore ...

LDP_1
LDP_2
LDP_3
LDP_4
LDP_5
LDP_6
LDP_7
LDP_8
LDP_9
LDP_10
LDP_11
LDP_12
LDP_13
LDP_14

The items is shown in Table 2. The items were then subjected to exploratory factor analysis (EFA) to determine the factor structure—two factors emerged and for each factor, the respective items were averaged to form a composite score (i.e., LDP score for each respondent). To validate the scale, the same items were asked in our confirmatory survey and subjected for confirmatory factor analysis (CFA).

Social vulnerability factors. Guided by previous studies, this current study identified demographic factors as social vulnerability factors: age, gender, ethnicity, education level, job statuses, monthly household income, and dwelling type. This study also included measures of individuals’ subjective perception of their quality of interaction (i.e., quality of relationship) toward family members and friends. These two factors were treated as accessible social resources during COVID-19 lockdowns. Specifically, participants were asked to rate the quality of social interaction with both their friends (M = 3.87, SD = .75) and the people at home (M = 4.05, SD = .83) on three 5-point scales (i.e., 1 = “Unpleasant”/“Unfriendly”/“Distant” to 5 = “Pleasant”/“Friendly”/“Close”).

Apart from the above-mentioned factors, internet and news media consumption has been integral to people’s lifestyle during the COVID-19 pandemic. Being able to access internet at home during lockdowns can facilitate people’s need to stay updated with the latest news (either through traditional media sources or social media platforms) as well as their communication with one another (e.g., through videoconferencing or instant messaging). Therefore, people’s social vulnerability can also be measured by their access to the internet as well as their news/social media consumption. Three variables were thus added to the list of social vulnerability factors. First, participants’ frequency of connecting to the internet using home Wi-Fi (M = 4.58, SD = .81) was measured as a single item on a 5-point Likert scale (1 = “Never” to 5 = “Very often”). Second, a set of 17 items was used measure participants’ news consumption frequency (M = 2.79, SD = .86). Each item reflects a different news media platform, ranging from traditional media sources (e.g., TV, radio, and print newspapers) to social media sources (e.g., Twitter, Instagram, Facebook, or YouTube) that participants could use to consume news. Participants were asked how frequently they consume news via a particular news media platform in a typical day (e.g., via local newspaper website, listening to local radio or reading news in Twitter). Finally, to measure the number of social media platforms that participants are currently accessing (M = 4.46, SD = 1.84), a multiple-response question involving 10 types of social media platforms (e.g., Facebook, TikTok, Instagram) was administered in the survey. Scores for this measure were summed and they range from a minimum score of zero to a maximum of nine. Table 3 summarizes all the social vulnerability factors used for this study.
Table 3
Social Vulnerability/Demographic Factors.

|                                      | Percentage (%) | Mean (SD) |
|--------------------------------------|----------------|-----------|
| Age                                  |                | 41.1 (11.2) |
| **Gender**                           |                |           |
| Male                                 | 50.7           |           |
| Female                               | 49.3           |           |
| **Ethnicity**                        |                |           |
| Chinese                              | 86.2           |           |
| Non-Chinese*                         | 13.8           |           |
| **Highest Education Level Attained** |                |           |
| No Formal Education                  | .40            |           |
| Primary School                       | 1.47           |           |
| ‘O’ Level (Secondary School)         | 8.14           |           |
| ‘A’ Level (Junior College)           | 3.74           |           |
| Diploma/Advanced diploma             | 21.0           |           |
| Bachelor’s Degree                    | 52.7           |           |
| Master’s Degree                      | 10.8           |           |
| Doctorate                            | 1.74           |           |
| **Dwelling type**                    |                |           |
| Studio Apartment                     | .27            |           |
| Public housing**                     | 79.3           |           |
| Private condominium                  | 15.2           |           |
| Landed property**                    | 2.80           |           |
| Others                               | 2.40           |           |
| **Monthly household income**         |                |           |
| Less than S$1000                      | 2.67           |           |
| S$1000 to S$9999                     | 60.7           |           |
| $10,000 to S$19,999                  | 30.4           |           |
| S$20,000 and above                   | 6.14           |           |
| **Quality of social interaction**    |                |           |
| With people at home                  |                | 4.05 (.83) |
| With friends                         |                | 3.87 (.75) |
| Frequency of connecting to home Wi-Fi|                | 4.58 (.81) |
| Frequency of news consumption         |                | 2.79 (.86) |
| Number of social media platforms used|                | 4.46 (1.84) |

Note. * Include three other ethnic minority groups in Singapore officially classified as ‘Malay’, ‘Indian’, and ‘Others’. ** Includes 1-Room apartments to executive condominiums. *Excluded those who prefer not to disclose. ** Include terrace houses, semi-detached, and bungalows/detached houses.

3. Analysis and Results

The first part of the study is to develop and validate a measurement scale for LDP using a set of self-created survey items. To ensure that these items substantially load into one or more factors, we subjected these items to exploratory factor analysis. Furthermore, we employed confirmatory factor analysis to ensure that this factor structure is validated and preserved or replicated in a different dataset. The second part of this study is to explore the relationship between LDP dimensions and social vulnerability factors. Hence, structural equation modelling is employed to simultaneously regress LDP dimensions (using the validated LDP scale) on the identified social vulnerability factors. The preceding sections provide a detailed explanation of these statistical analyses.

3.1. Exploratory Factor Analysis

The factorability for the LDP measurement items from the main survey (n = 749) was assessed using the Kaiser-Mayer-Olkin (KMO) criterion. The LDP items were found to be suitable for factor analysis, with an overall KMO value of .90, greater than the recommended cut-off value of .50 [46]. Moreover, the factorability of these items was supported by the Bartlett’s test of sphericity, which was significant at alpha level of .05; χ² (21) = 3077.39, p < .001.

Having met the criteria for factor analysis, an exploratory factor analysis was then conducted using R (EFAtools package), version 4.0.5. The EFA technique involves using principal axis factoring (PAF) with oblimin rotation and enforcing a two-factor solution. The results of the EFA concluded with most of the items having strong loadings (greater than 0.50) on two factors. Items which did not load well on either of the factors were dropped from analysis. Table 4 shows the final rotated loadings for the two factors. Factor 1 and 2 has an eigenvalue of 4.14 and .41, respectively. Both factors explain a total of 64.9% of the variance in the data.

Parallel analysis Scree plots were constructed to establish an objective factor-retention criterion using eigenvalues [47]. This is also to confirm that the identified factor, derived from the EFA above can account for a substantial level of variance even in the presence of random noise (i.e., not due to chance). A total of 50 datasets were randomly simulated in the parallel analysis (each with the same items and sample size as actual data) using PAF. The eigenvalues for the real data were compared with the mean of the eigenvalues in the 95th percentile for each simulated datasets. The results of this analysis (see Fig. 1) show that the eigenvalues for the real data were larger than the mean eigenvalues in their 95th percentiles, across the simulated datasets, for two factors. The parallel analysis Scree plot recommended two factors for retention.
Table 4
Rotated Factor Loadings for LDP Measurement Items.

| Items   | Factor 1 | Factor 2 |
|---------|----------|----------|
| LDP_1   | .741     | .046     |
| LDP_2   | .916     | .056     |
| LDP_3   | .932     | .024     |
| LDP_4   | .575     | .115     |
| LDP_11  | .132     | .700     |
| LDP_12  | -.085    | .919     |
| LDP_13  | .074     | .768     |

Note. EFA performed using principal axis factoring with oblimin rotation.

Fig. 1. Parallel Analysis Scree Plot.

3.2. Confirmatory Factor Analysis

Using a separate (confirmatory) survey dataset (n = 992), a confirmatory factor analysis (CFA) was performed on the two-factor structure (F1: LDP_1 to LDP_4 and F2: LDP_11 to LDP_13). The items for F1 and F2 correspond to items relating to psychological and emotional LDP, respectively, and henceforth the two factors are labelled as such. Factor loadings for the first item of each factor were fixed as one to ensure over-identification in the measurement model and for the computation of fit indices. Overall, the fit indices for this two-factor structure demonstrated an excellent fit (CFI = .992, TLI = .985, RMSEA = .054). The results from the CFA (see Fig. 2a) indicated all items indeed loaded well in the two latent factors, with standardized coefficients above the value of .60. The error terms for all latent and observed variables are statistically significant. In addition, both psychological and emotional LDP demonstrated good internal consistency with Cronbach alphas of .86 and .87, respectively. Furthermore, high correlation (r = .85, p < .001) was found between the two factors, and hence indicating a possibility of them explaining a higher-order variable.

A second-order CFA was thus conducted to establish a higher-order factor for psychological and emotional LDP. The loadings from the first-order factor and the second-order factor (LDP) were fixed for this measurement model to be identified. Overall, both first-order factors loaded strongly on the LDP (βpsychological = .96 and βemotional = .88), with the model’s fit indices remaining the same as the first-order factor structure (see Fig. 2b). The error terms for all latent and observed variables remained statistically significant. Therefore, this analysis confirmed that individuals’ LDP can be explained by two inter-related dimensions: psychological and emotional. This helps to validate the factor structure of our LDP scale as developed and tested in the main survey.

3.3. Structural Model

To examine how social vulnerability factors can affect the two components (i.e., F1 and F2) of individuals’ LDP during the COVID-19 pandemic, a structural model was constructed, using structural equation modelling technique (in R; lavaan package). Table 5 presents the path coefficients in this model. Specifically, in this analysis, both first-order factors of LDP as measured in the main survey were simultaneously regressed on a set of social vulnerability factors as identified earlier (see Fig. 3). Overall, the structural model demonstrated a good fit; CFI = .98, TLI = .97, RMSEA = .032).

The results of this SEM model show that the quality of interaction with people (both at home or as friends) has a significant and positive effect on both individuals’ psychological (βhome = .30, SE = .038, p < .001; βfriends = .16, SE = .042, p < .001) and emotional (βhome = .25, SE = .038, p < .001; βfriends = .23, SE = .042, p < .001) LDP. This suggests that social relationships (capital) may play an important role in building the two dimensions of LDP. Individuals’ frequency of news consumption has a positive association with their emotional LDP; β = .084, SE = .031, p = .034. Therefore, increasing one’s consumption of news media (which includes information about COVID-19) may enhance one’s emotional preparedness toward impending lockdowns.
Fig. 2. a. First-Order Two-factor Structure of Lockdown Preparedness (LDP). b. Second-Order Two-factor Structure of Lockdown Preparedness (LDP).

Table 5
Regression of Psychological and Emotional LDP on Social Vulnerability Factors using Structural Equation Modelling.

|                          | Psychological LDP (Factor 1) | Emotional LDP (Factor 2) |
|--------------------------|------------------------------|--------------------------|
|                          | β     | Std. Err. | p-value | β     | Std. Err. | p-value |
| Male                     | .021  | .050      | .576    | -.010 | .051      | .789    |
| Age                      | -.039 | .002      | .327    | -.039 | .002      | .324    |
| Ethnic majority (Chinese)| -.026 | .073      | .493    | -.007 | .074      | .860    |
| Primary School Education and below | **.461** | **.184** | **.012** | .027  | .185      | .491    |
| Residing in public housing | .035  | .063      | .360    | -.075 | .063      | .050    |
| Holding full-time work position | .026  | .071      | .511    | -.015 | .072      | .710    |
| Monthly Household Income of S$1K or less | .077  | .178      | .046    | .040  | .180      | .302    |
| Quality of interaction with people at home | .297  | .038      | <.001   | .254  | .038      | <.001   |
| Quality of interaction with friends | .160  | .042      | <.001   | .230  | .042      | <.001   |
| Frequency of connection to home Wi-Fi | .071  | .032      | .062    | .052  | .032      | .173    |
| Frequency of news consumption | .063  | .030      | .107    | .084  | .031      | .034    |
| Number of social media platform used | .035  | .014      | .372    | -.010 | .014      | .799    |

Model fit indices: CFI: .982, TLI: .974, RMSEA = .032

Note: Standardized beta (β) coefficients presented. Significant coefficients are in bold.

While none of the demographic profiling variables were significant to the emotional dimension of LDP, it was found that low education level (i.e., those with primary education level and below) has a negative association with psychological LDP; β = -.46, SE = .18, p = .012. In other words, having insufficient education may have an adverse impact on one's psychological LDP during COVID-19. Likewise, although monthly household income level has a significant effect on psychological LDP, the relationship is positive; β = .077, SE = .18, p = .046. That is, those who belong to households with lower financial means tend to have higher levels of psychological preparedness for a lockdown.
4. Discussion

A measurement tool has been developed in this study for researchers to quantitatively assess individuals' LDP in two dimensions: psychological and emotional. Drawing upon the existing definitions of psychological and emotional preparedness, psychological LDP may be referred to as one's cognitive capacity to consider their ability to handle the challenges that an impending lockdown may impose on them [48], while emotional LDP may be defined as the regulation and management of one's emotions to better respond to impending lockowns [49].

The distinction of both psychological and emotional aspects of LDP in this study contributes to the pandemic and emergency preparedness literature, where emotional preparedness has received relatively less attention from scholars [50,51] until recently [52]. One of the reasons for this is the conceptual overlap between the two dimensions, where individuals' psychological preparedness may encompass their emotional regulation processes [48], thus making it difficult for researchers and participants to establish a clear distinction whenever such terms are used or measured [51]. Our proposed measurement tool for LDP not only provides a clear contrast between the two dimensions, but also a basis for researchers to assess individuals' emotional preparedness independently and directly, within the context of lockowns. Outside the context of LDP, researchers may also adapt these quantitative scales to conduct investigations focusing on emotional preparedness toward national emergencies (e.g., natural disasters) which, to date, has largely been qualitative in nature (e.g., Refs. [49,52]).

Furthermore, our SEM results demonstrated that individuals' emotional LDP can also be influenced by the frequency of their news media consumption. In other words, individuals' emotional preparedness can be influenced by their amount of exposure to external information cues, including journalistic reports, public opinions, and public messages from the government on the pandemic. In support of our finding, several communication studies have shown that news media have the potential to influence or manipulate news consumers' emotions, affecting their preparedness toward the pandemic (e.g., Refs. [53,54]). The relationship between emotional LDP and news media consumption also contributes to building the scope of the news media during this pandemic. Specifically, while existing research have been focusing on how the news media may influence the emotional responses of individuals during lockowns (e.g. Refs. [55,56]), this study demonstrated that the news media are also important in preparing individuals (emotionally) for future lockowns. For example, in Singapore, the citizens were informed of the details of the lockowns (i.e., implementation dates, rules, available support) by a government agency through various news media platforms to make sure the people are well-aware and emotionally prepared for it [57].

The results also demonstrated that the quality of interactions within one's social network (i.e., with friends and with people at home) is crucial in helping individuals build their psychological and emotional preparedness toward lockowns. This finding aligns with studies stressing the importance of good quality social relationships (or interactions) which can benefit individuals psychologically during the pandemic (e.g., Refs. [58,59]). Furthermore, the quality of social relationships can be viewed as a form of 'relational' social capital [42,60]. Thus, our findings suggest that social capital may play a 'dual' role in pandemic lockowns. Contributing to the abovementioned studies, which emphasize the importance of maintaining social capital during periods of lockowns for individuals' well-being, our SEM results showed that social capital (in the form of good quality social interactions) is also crucial in developing LDP even before the lockowns. We found that those with higher education levels tend to be more psychologically prepared, consistent with findings by studies that examined the impact of demographics on subjective emergency preparedness. Interestingly, those with low incomes tend to be more psychologically prepared for a lockdown—this may be due to high-income owners considering the negative effects of lockowns on their work or business. Future studies can help further tease these out.

The findings in this study demonstrated that lockdown preparedness can be considered along the lines of emergency preparedness, where both can be affected by general social vulnerability factors. While existing studies have proposed that social vulnerability factors can impact individuals' preparedness toward emergencies [37,39], the current study extends this proposition by demonstrating how the same factors can also affect individuals' psychological and emotional preparedness toward future lockowns. While lockowns are implemented to keep people safe by reducing mobility and therefore the spread of viruses, confining people at home may have varying negative effects on individuals—it can affect their work performance as well as psychological well-being, among others. How prepared people are for a lockdown may help determine how well they emerge out of it.

Of course, the findings presented here must be examined in the context of several limitations. First, the study focused on the experiences of participants living in Singapore, a relatively affluent and technologically advanced city state. The experiences of individuals living in another context may not be the same. For example, publics in other countries may have different levels of social vulnerabilities which may affect the extent to which they can be psychologically and emotionally prepared for a lockdown. Therefore, future
studies can build on what this current study has started and explore LDP in other countries. Second, the LDP scale developed and tested in this study measured perceived preparedness, which may not always be equivalent to actual preparedness. Thus, future studies should continue to examine ways to measure preparedness for future lockdowns, which can inform policy and community efforts. Finally, this study focuses on lockdown preparedness within the context of a pandemic. However, lockdowns may also be implemented in response to other types of crises or emergencies and the findings in this particular context may not be applicable to other contexts. Still, we hope that the findings presented in this exploratory study can inform future studies examining public response to lockdowns and improve community preparedness as we emerge from this pandemic and enter a post-COVID-19 world.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijidrr.2022.103367.

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