

Title: Scoping study of definitions of and instruments measuring vulnerability in older adults: Toward research, policy and practice fostering social participation and health equity

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Abstract: It is important to foster social participation and health equity, especially for older adults in situations of vulnerability. Despite growing interest in the concept of vulnerability, there is no consensus regarding how to define or measure it. This paper provides an inventory and synthesis of definitions and instruments measuring vulnerability in older adults. Using a scoping study framework, eight databases (Abstracts in Social Gerontology, Academic Search Complete, AgeLine, CINAHL, MEDLINE, SocINDEX, PsycInfo, Scopus) were searched with relevant keywords [Vulnerab* AND (Concept*, Defin*, Meaning, Terminology, Measurement, Assessment*, Indicator*, Instrument*, Scale*, Questionnaire* OR Test*) AND (Aging, Ageing, Elder*, Gerontolog*, Older OR Senior*)]. Thirty-one original definitions and five measurement instruments were identified, content-analyzed and compared. Vulnerability definitions mostly focused on people under conditions that increased their risk of being harmed because of individual physical factors or the social environment. Considering these definitions, experts in the field of aging, including two representing older adults, took part in a workshop, and a consensus was reached to define a situation of vulnerability as ‘*a set of circumstances in which one or more individuals experience, at a specific moment in time, one or multiple physiological, psychological, socioeconomic or social difficulties that may interact to increase their risk of being harmed or having coping problems that lead to negative consequences on their life*’. Although none of the measures fully targeted this definition, the Perceived Vulnerability Scale (PVS) was judged best at operationalizing the concept with 22 items considering feelings of vulnerability toward personal and environmental factors; it also has good psychometric properties. The proposed definition and the PVS help to provide a common language and measure in health and social sciences research, policy and practice identifying and reaching older adults in situations of vulnerability and intervening to foster social participation and health equity.

Introduction

The challenges of global aging and the growing burden of chronic diseases require innovative interventions on health determinants, such as social participation, and health equity (World Health Organization (WHO), 2015). Fostering social participation, i.e. *'person's involvement in activities providing interactions with others'* (Levasseur et al., 2010; p. 2144) *'in community life and in important shared spaces, evolving according to available time and resources, and based on the societal context and what individuals want and is meaningful to them'* (Levasseur et al., 2021), is in fact more difficult with health inequity. Health equity relies on the absence of unfair systems and policies that cause health inequalities, i.e., when some groups are at greater risk of experiencing poorer overall health than the general population (Public Health Agency of Canada, 2011). As proposed by the Active Ageing policy framework of the World Health Organization (WHO, 2002), enhancing social participation must consider the independence, dignity and self-development of older adults and their rights to equal treatment and opportunities in all areas of their life. Moreover, health equity requires increased access to opportunities and conditions conducive to health for all by, for example, improving living environments and enhancing health promotion and disease prevention policies. To strengthen policies and empowerment, social support and community development are also important (Diderichsen, 2004).

To foster social participation and health equity in older adults, it is important to have a better understanding of vulnerability, which is a critical step in focusing research, policy and practice (Kong & Yang, 2019) and implementing effective interventions (Saliba et al., 2001). Identifying and reaching older adults facing vulnerability and knowing the causes, consequences, sources and ways in which these situations occur is essential in developing appropriate actions (Rogers et al., 2012). For example, better measurement of the degree of vulnerability may lead to more effective interventions (Barbosa et al., 2017). This is a complex and challenging task for healthcare professionals (Barbagallo et al., 2018; Drewes et al., 2014) since vulnerable older adults are a heterogenous group requiring adapted interventions (Barbagallo et al., 2018; Grundy, 2006; Kraus et al., 2010) and, especially when they

combine risk factors such as having no regular source of care, a low income and no insurance, are more likely to have needed medical care delayed or even not get it (Shi & Stevens, 2005). In addition to being difficult to identify, this population often presents inconsistent communication and social skills and may claim to have abilities that sometimes contrast with their performance, which makes vulnerability hard to identify (Agu, 2013). Today's retirement plans are more diverse than ever (Lesemann, 2007) and aging is not a sufficient criterion for vulnerability (Bozzaro et al., 2018). Since they spend less time in employment activities, older adults might be further exposed to vulnerability, which in turn might impact their health more negatively than that of younger adults. Better recognition of vulnerability is thus crucial in providing support for older adults and preventing them and their families from experiencing adverse outcomes (Davidson & Rossall, 2014; De Witte et al., 2013).

Although vulnerable older adults have been the focus of some theoretical work and empirical studies, there is still insufficient knowledge (Barbosa et al., 2017) about this population. Previous studies mainly identified groups at higher risk, e.g., older adults who are poor, frail or isolated (Schröder-Butterfill & Marianti, 2006). Furthermore, similar concepts such as frailty (Abley, 2012; Abley et al., 2011; Barbagallo et al., 2018; Ennuyer, 2017), dependence (Ennuyer, 2017) and autonomy (Agu, 2013; Ennuyer, 2017) are sometimes used interchangeably with vulnerability, which adds to the confusion both conceptually and operationally. Indeed, there is no consensus around a common definition, which inevitably influences the emergence and use of conceptual foundations. Moreover, there is currently no instrument that is recognized as a gold standard to measure vulnerability. In fact, in the fields of gerontology, geriatrics, medicine and health sciences, vulnerability seems to be defined and measured differently. Definitions are often very restrictive or very broad (Bozzaro et al., 2018; Hurst, 2008; Luna, 2014; Rogers et al., 2012) and might contribute to stigmatizing people (Bozzaro et al., 2018; Ennuyer, 2017; Wiles, 2011). The concept is also more frequently defined by 'experts' rather than by older adults or people in situations of vulnerability (Abley, 2012; Abley et al., 2011; Henke, 2016; Spiers, 2000). Although a few instruments have been developed to measure vulnerability, using either informant-report

or self-administered questionnaires, no valid, standardized method is recognized as a gold standard (Drewes et al., 2014). Furthermore, the screening tools available might be ineffective in identifying older adults in situations of vulnerability (Burnett et al., 2011).

The lack of consensus around a definition of vulnerability has had negative consequences, such as communication difficulties between those using the concept (Abley, 2012), problems in developing and selecting instruments to assess vulnerability (Henke, 2016; Rogers et al., 2012), and undefined or incomplete health and social research, policy and practice efforts (Fawcett, 2009; Shi, 2001). More specifically, for healthcare professionals, this lack of consensus around a definition or measure could result in partial or inconsistent analysis of situations of vulnerability, followed by incomplete, unequal or inappropriate interventions (Nyamathi et al., 2007). For researchers, ambiguous definitions might also lead to major methodological problems in trying to accurately document the prevalence and health status of this population and comparing results from various studies (Aday, 1994). The present study thus aimed to provide an inventory and content analysis of definitions of and instruments measuring vulnerability in older adults.

Method

Following PRISMA guidelines, including collaboration between researchers and knowledge-users, the methodological framework for scoping studies (Anderson et al., 2008; Arksey & O'Malley, 2005; Colquhoun et al., 2010; Levack, 2009) was used to synthesize current knowledge concerning the definitions of and instruments measuring vulnerability in older adults. Validated by a documentalist (FL), the search strategy identified papers published between January 1980 and December 2019 in eight databases with relevant keywords (Table 1). Restricted, but not exclusively, to older adults, materials from the fields that usually address vulnerability (health sciences, gerontology and geriatrics) as well as literature on psychology, ethics and social work were examined. Papers were excluded if written in a language other than English or French and if they focused on narrower concepts (such as exclusively on

vulnerability in the context of older adults with specific health problems such as diabetes or cancer, or who are homeless, experiencing natural disasters or in specific abusive situations) that potentially did not fully represent the complexity of the concept of vulnerability. Inclusion criteria were that documents must: 1) report an empirical study, review or conceptual paper, and 2) provide a definition of vulnerability or description of an instrument that measures it. The definitions and measurement instruments retained were original (i.e., not refer to another source) statements of the meaning or description of the target concept. The title and, when available, abstract were reviewed for all the papers identified through electronic searches by MLT and MLB. Additional articles were identified by MLT and MLB after reviewing all the reference lists of selected papers, as well as searching personal reference files of the principal investigator (ML). All members of the team were also invited to share relevant references but none met the inclusion criteria.

Table 1. Synthesis of databases searched, selected keywords and search strategies*

Databases	Abstracts in Social Gerontology, Academic Search Complete, AgeLine, CINAHL Plus with Full Text, MEDLINE with Full Text, SocINDEX with Full Text, PsycInfo, Scopus
Keywords	1. Vulnerab*
[strategy:	2. Concept* OR Defin* OR Meaning OR Terminology OR Measurement OR
1 AND 2	Assessment OR Indicator* OR Instrument* OR Scale* OR Questionnaire* OR Test*
AND 3]	3. Aging OR Ageing OR Elder* OR Gerontolog* OR Older OR Senior*

*Complete search strategy is available upon request.

Conceptual definitions (not their operationalization) were extracted from each paper by MLT and MLB and content-analyzed using seven specific predetermined interrogative pronouns (who, how, what, about what, where, when, and why; i.e., *every definition was questioned using each pronoun*; Levasseur et al., 2010). These pronouns were used to both identify and analyze critical dimensions of the concept (Polatajko et al., 2007), i.e., content of vulnerability definitions. Themes emerging from this extraction were deductively organized and renamed according to the Human Development Model–Disability Creation Process (HDM–DCP), a model of human development and disability (Fougeyrollas et al., 2019).

The HDM–DCP was chosen as it is an explanatory model of the causes and consequences of disease, trauma, or other damage to the individual’s integrity or development that clearly defines personal and environmental factors as well as participation factors and illustrates their interactions. The content analysis was mainly performed by one member of the research team (MLB) and reviewed by four other members (MLT, ML, DN, KG & MG). All discrepancies were resolved through discussions between at least two members of the team, with final decision being approved by the principal investigator (ML). The characteristics of the measures identified from the literature review were compared, i.e., conceptual (underlying definition, instrument’s goal, type of vulnerability, discipline, consideration of theoretical models), construct (population studied, country, language, number of items, administration, scoring and scale, reported completion and scoring time), and psychometric properties (predictive, content, construct, and convergent validity, reliability, sensitivity to change). Additional information about the languages in which the instruments are available and their psychometric properties was obtained by searching in Google Scholar references citing the five papers that originally presented them.

As is often done in scoping studies (Anderson et al., 2008) and to enrich and validate the results of this first step, the dimensions of the definitions identified with the interrogative pronouns and the characteristics of the measurement instruments found in the review provided the starting point for a three-hour group workshop led by the principal investigator (ML). Thirteen experts [9 interdisciplinary researchers in aging (excluding the first author who facilitated the discussion), 2 professionals (a living lab coordinator and a field worker) familiar with the process and the team for the current study representing older adults’ voices, and 2 research assistants] were invited to corroborate the analysis by triangulating perspectives. The workshop was audiotaped and began with a short PowerPoint presentation summarizing the preliminary results, followed by a 60-minute discussion. The probe question was: *In your opinion, which key elements should be retained to define or measure vulnerability?* A synthesis of the workshop report based on note-taking and the audiotape was considered throughout the ensuing analysis. The coauthors of this paper were able to reach a consensus on both a comprehensive

definition and the most suitable available instrument to measure the chosen definition of situations of vulnerability.

Results

Definitions of vulnerability

Of the 1691 papers retrieved through the electronic searches, 1557 (92.1%) did not meet the inclusion criteria based on title and abstract (Fig. 1). Of the remaining 134 papers, 116 (86.6%) were excluded since they did not provide an original definition or instrument measuring vulnerability. Ultimately, 29 documents were selected, with more than one third (n=11; 37.9%) stemming from manual searches in reference lists [nine from papers in journals, one working paper and one from a conference (Fig. 1)]. About one third of the papers (n=9) were published in journals from the field of gerontology or geriatrics, another third (n=10) from medicine and health sciences, and just over one quarter (n=8) from multidisciplinary journals. Thirty-one original definitions were extracted and their content analyzed (Table 2). Three original definitions came from the same reference, Kaushik (2013), and two from Abley and colleagues (2011). Twenty-seven of the definitions (87.1%) were published after 2000, with the most productive years being 2011 and 2013 (n=5; 16.1% each). Only a limited number (< 2; 6.5% each) of the definitions came from social work, psychology or ethics literature. The first authors of twelve (38.7%) and nine (29.0%) of the definitions were from Europe and North America, respectively; only one was from Canada. The majority of papers specifically concerned adults aged 65 and older (n=18; 58.1%) and did not specify the type of vulnerability (n=20; 64.5%; Table 2), other than physical (n=1; 3.2%) or social (n=3; 9.7%) vulnerability or for specific clienteles (n=7; 22.6%). Overall, a majority (n=18; 58.1%) of the papers with an original definition came from theoretical paper.

Figure 1. Flow chart

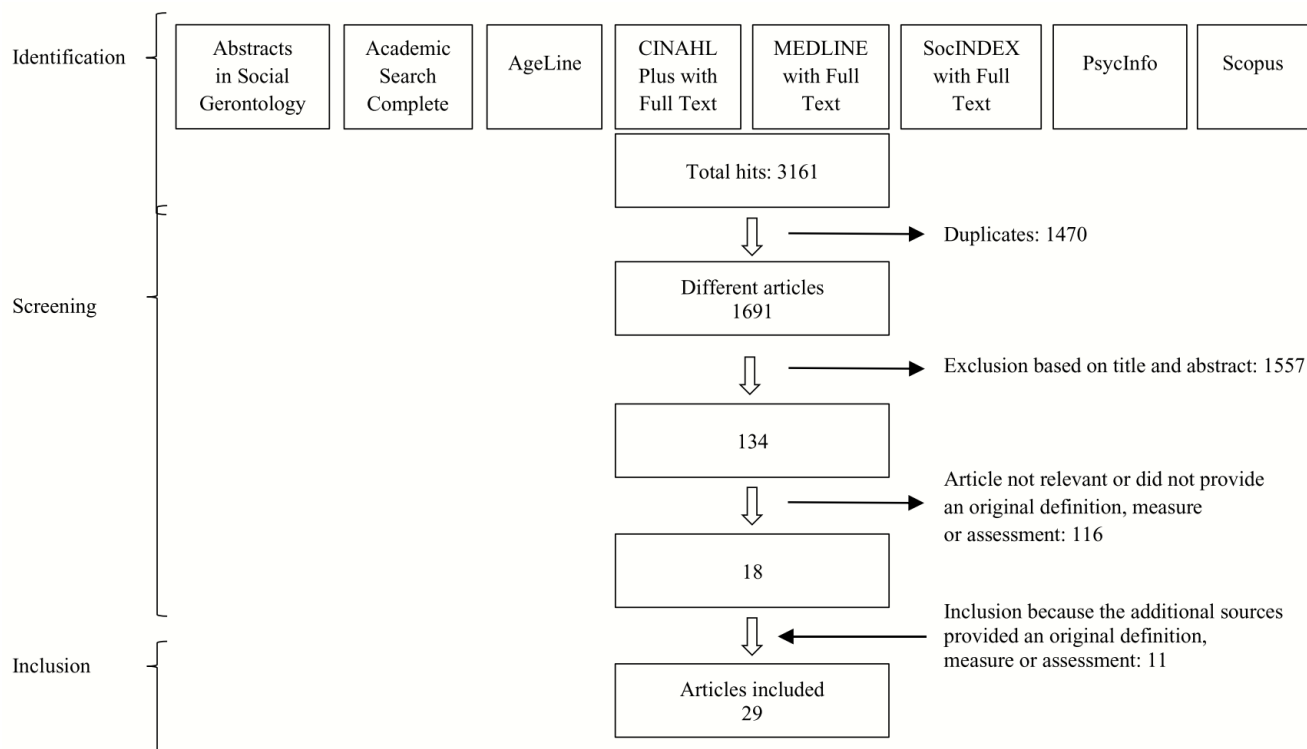


Table 2. Original definitions of vulnerability identified through an extensive search of the literature from January 1980 to December 2019 (N=31)

#	Concepts as named by authors (Reference)	Definitions*
1	Physical vulnerability (Lee & Scanlon, 2007, p. 56) ^{42(p56),δ}	Person's impaired resistance to further harm caused by a weakened state of disease, ailments or trauma. This actual or potential physical susceptibility could lead to further morbidity or even mortality if unrecognized
2	Social vulnerability (Andrew, Fisk, & Rockwood) ^{43(p450)}	Spectrum of vulnerability to insults, from low to high
3	Social vulnerability (Paixao & Prufer de Queiroz Campos Araújo) ^{44(p168)}	Accumulation of social deficits that jeopardize health
4	Social vulnerability (Pinsker et al.) ^{45(p110),δ}	Impaired ability to detect or avoid potentially harmful interpersonal interactions
5	Vulnerability (Aday) ^{34(p487),δ}	Epidemiological concept of risk, in that there is a <i>probability</i> that an individual could become ill within a given period of time
6	Vulnerability (Barbagallo, Dominguez, & Cucinotta) ^{11(p237)}	Heterogeneous group of older people with multiple chronic conditions and/or loss of function in one or more domains (e.g., functional, somatic, psychological and social domains)

- 7 Vulnerability (Barbosa et al)^{10(p2)} Status of individuals or groups who for some reason have a reduced self-determination ability, and may experience difficulties in protecting their own interests due to deficits in power, intelligence, education, resources, strength, or other attributes
- 8 Vulnerability (Bozzaro, Boldt, & Schweda)^{18(p234)} Increased susceptibility to harm
- 9 Vulnerability (Chambers)^{46(p1),δ} Exposure to contingencies and stress, and difficulty in coping with them
Vulnerability has thus two sides: an external side of risks, shocks, and stress to which an individual or household is subject; and an internal side which is defencelessness, meaning a lack of means to cope without damaging loss
- 10 Vulnerability (de Groot et al.)^{47(p12)} Dynamic state that reflects converging effects of a set of interacting and amplifying personal and environmental factors, which together increase an individual's susceptibility to ill health and which hampers the recovery process to normal health once ill health has occurred
- 11 Vulnerability (Golaz & Rutaremwa)^{48(p611)} Groups of people likely to not cope as well as others in the event of a threat
- 12 Vulnerability (Hardin)^{49(p56)} Possibility of an adverse outcome or injury
- 13 Vulnerability (Hurst)^{25(p195),δ} Identifiably increased likelihood of incurring additional or greater wrong
- 14 **Vulnerability (Kaushik)^{41(p334)} Capacity to be harmed. It is the potential for negative outcomes or consequences**
- 15 **Vulnerability (Kaushik)^{41(p334)} Increased probability of occurrences of events leading to harmful consequences, or expected loss of lives, people injured, property, livelihoods, economic activity disrupted (or environment damaged) resulting from interactions between natural or human induced hazards and vulnerable conditions. Vulnerability refers to risk of being in problems/difficulties on occurrence of certain contingent conditions that require support system other than those available. These contingency situations could be poor health, stringent economic condition, lack of sufficient means to handle crisis and limited social support system**
- 16 **Vulnerability (Kaushik)^{41(p334)} Condition or state of some persons or groups who somehow carry a larger probability of being harmed by economic, environmental or health or social problems, than the rest of the population. For the purpose of the present study, vulnerability may be defined as those contingent conditions that hamper the well-being (social functioning) of elderly persons and requires the support system other than the existing ones to mitigate the factors that may result in helplessness and hopelessness, if not encountered promptly**
- 17 Vulnerability (Lepori)^{50(p2)} All of the living conditions that expose the elderly to the risks - generally advanced - of old age (social isolation, becoming withdrawn, loss of autonomy, accidents or even death, etc.)

- 18 Vulnerability (Shi)^{32(p520),δ} Likelihood of experiencing poor health and is determined by a convergence of predisposing, enabling, and need characteristics at both individual and ecological levels. Poor health can be manifested physically, psychologically, and/or socially
- 19 Vulnerability (Soulet)^{51(p25),δ} Relation between a group or an individual with specific characteristics (including a lack of protection to guard against the potential of being hurt) and a societal context which values the ability to be self-directed. [...] single people are vulnerable under certain conditions (that are variable and unequally distributed between them) and only under these conditions
- 20 Vulnerability (Spiers)^{29(p715),δ} Individuals and groups at risk of harm
- 21 Vulnerability (Spini et al.)^{52(p1),δ} Lack of resources, which in a defined context, places individuals or groups at major risks of experiencing negative consequences across their life course
- 22 Vulnerability (Wiles)^{27(p579)} Fragility and (or) weakness, but [...] could also be conceptualised as openness, susceptibility, and receptiveness
- 23 Vulnerability (from older people's perspective; Abley, Bond, & Robinson)^{23(p361)} Emotional response to being in a specific situation over which one has little or no control
- 24 Vulnerability (from older people's perspective; Sarvimäki & Stenbock-Hult)^{53(p375)} Being easily harmed and sensitive and growing old meant becoming even more vulnerable. The core meaning leavening through the themes and sub-themes was a deeper sense of vulnerability.
- 25 Vulnerable adults (Black & Brown)^{54(p1)} All those age 75 or older, or those age 60 to 74 who meet at least one of the following criteria: (1) say they are in fair or poor health; or (2) have one or more chronic illnesses (congestive heart failure, coronary artery disease, diabetes, stroke, or lung disease)
- 26 Vulnerable families (Demi & Warren)^{55(p188),δ} Families that are susceptible to harm because of their socioeconomic status, their minority status, or other stigmatizing status, such as having a family member with HIV infection or a family member who uses illicit drugs
- 27 Vulnerable groups and individuals (World Medical Association)^{56,δ} Some groups and individuals are particularly vulnerable and may have an increased likelihood of being wronged or of incurring additional harm
- 28 Vulnerable older people (Grundy)^{13(p107)} Those whose reserve capacity falls below the threshold needed to cope successfully with the challenges that they face
- 29 **Vulnerable older people** (Saliba et al.)^{8(p1691)} **Persons age 65 and older who are at increased risk of functional decline or death over 2 years**
- 30 Vulnerable older person (from professionals' perspective; Abley, Bond, & Robinson)^{23(p361)} [Someone] who has certain characteristics or risk factors or a combination thereof, such as being mentally and physically frail and living alone

31 **Vulnerable persons** (Morris, Sherwood, & Mor)^{57(p374)} **Persons [...] who have physical impairments or stamina problems that severely limit their ability to get around safely or perform activities in the home environment and persons who require help from others, or have difficulties, in personal and instrumental activities of daily living**

*Exact quotes except for definitions 17 and 19, which were translated from French to English by a professional translator; bolded definitions indicate those underlying the development of an instrument (see Table 5).

^δDocuments identified from manual search in reference lists.

Of the seven interrogative pronouns used to content-analyze the definitions, four dimensions (who, what, about what and why) were found in most definitions (Table 3). The other three dimensions (when, where and how) were mentioned less often. Overall, the definitions mostly focused on people (who) under certain conditions (when) increasing their risk (what) of being harmed (about what) because of individual physical factors or the social environment (why). Following is a detailed description of the dimensions found in the definitions for each interrogative pronoun.

Table 3. Synthesis of the content of the original definitions of vulnerability (N=31)

Interrogative pronouns	Dimensions*	Frequency (%)	
		By dimensions	By pronouns ^δ
Who	1. People ^{5, 6, 7, 11, 16, 17, 19 – 21, 25, 27 – 29, 31}	14 (45.2)	19 (58.1)
	1.1 Person ^{1, 9, 10, 19, 20, 30}	6 (19.4)	
	1.2 Family ^{9, 26}	2 (6.5)	
When	2. Under certain conditions ^{10, 15, 17, 19, 21, 23}	6 (19.4)	15 (48.4)
	2.1 In the context of a complication ^{9, 11, 15, 16, 28}	5 (16.1)	
	2.2 During a specific period of time ^{5, 15, 21}	3 (9.7)	
	2.2.1 At a particular age ^{6, 16, 17, 24, 25, 29}	6 (19.4)	
Where	3. In the home environment ³¹	1 (3.2)	1 (3.2)
What	4. A susceptibility to ^{1, 4, 8, 10, 13, 14, 17, 22, 26, 27}	10 (32.3)	23 (74.2)
	4.1 A risk of ^{4, 5, 9, 12, 14 – 22, 24, 29, 30}	16 (32.3)	
About what	5. A state of ^{1, 2, 10, 16}	4 (12.9)	
	6. Having (future) health problems ^{1, 3, 5, 6, 10, 17, 18, 29}	8 (25.8)	22 (71.0)
	6.1 Being harmed ^{1, 4, 8, 9, 12 – 17, 19, 20, 24, 26, 27}	15 (48.4)	
Why	7. Presenting other adverse outcomes ^{6, 9, 10, 12, 14 – 17, 21}	9 (29.0)	
	8. Personal factors ^{7, 10, 15, 18, 31}	5 (16.1)	19 (61.3)
	8.1 (Previous) health	4 (12.9)	
	8.2 Physical ^{1, 7, 15, 16, 18, 22, 25, 30, 31}	9 (29.0)	
		2 (6.5)	

	8.2.1 Physiological ^{6, 24, 30}	5 (16.1)	
		5 (16.1)	
	8.3 Psychological ^{6, 7, 18, 23, 30}	9 (29.0)	
	9. Environmental factors ^{10, 15 – 18,}	5 (16.1)	
	9.1 Social ^{2 - 4, 6, 15, 16, 18, 19, 26}	5 (16.1)	
	9.1.1 Socioeconomic ^{7, 15, 16, 26, 30}	3 (9.7)	
	10. Interaction factors ^{10, 15, 18, 30, 31}	6 (19.4)	
	10.1 Participation ^{4, 6, 31}		
	11. Other factors ^{6, 7, 15, 19, 21, 30}		
How	12. Coping difficulties ^{9- 11, 21, 28}	5 (16.1)	8 (25.8)
	13. Self-limitations ^{7, 21, 23, 31}	4 (12.9)	

* Numbers refer to the definitions given in Table 3.

δ The same definition can appear under more than one dimension but only once for the total of each interrogative pronoun.

Themes in **bold** were found in approximately one third or more of the definitions and were the most frequent for one pronoun.

Who – Depending on whether an individual or population perspective is taken, vulnerability involves either a person or people and sometimes families (Table 3). One definition (Barbagallo et al., 2018) noted the heterogeneity of older people who could be in situations of vulnerability.

When – Vulnerability can be experienced under certain conditions, often not further specified. These conditions include the context of a complication (threat, problems, difficulties, contingencies, stress, shocks, challenges) or a particular older age at which it occurred (60 to 74, or 65 or 75 and over).

Where – Contents related to the space or location were mentioned in only one definition and referred to the home environment (Table 3).

What – Most definitions of vulnerability involve some type of susceptibility, including being at risk or increasing the possibility of adverse outcomes. In the gerontology and geriatrics literature, vulnerability is viewed as a particular and dynamic state.

About what – Mainly cited in the medical and health sciences literature, the consequences of vulnerability highlighted in the definitions targeted actual or potential physical, psychological and social health problems (Table 3) including illness, functional decline, further morbidity or mortality. The risk of death over two years was mentioned in one definition. More specifically and frequently, vulnerability included being easily harmed and sensitive, defenseless, and more likely to suffer additional or greater

wrong, injury, or accidents. Finally, almost one third of the definitions identified mentioned other adverse outcomes such as the occurrence of events leading to losses, negative consequences, disruption to economic activities, damage to the environment, helplessness and hopelessness, problems or difficulties, social isolation and becoming withdrawn.

Why – Contents of the definitions specifying the causes or characteristics which can lead to vulnerability could be classified under four categories: personal, environmental, interaction or unspecified factors (Table 3). Personal factors encompass past or present health and psychological causes but mostly physical factors, including physiological aspects. Definitions with environmental contents mainly focused on social components, e.g., minority or other stigmatized status, limited social support system, accumulation of social deficits, social problems or a challenging societal context. According to two of Kaushik's definitions (2013), to mitigate the factors that could exacerbate its impact, vulnerability requires support systems other than the existing ones. About one in five definitions mentions interactions between characteristics and their possible amplifying effects and impact on activities done by the person. Less than one in five definitions includes other factors such as contingent or multiple chronic conditions, specific characteristics or deficits, such as in resources, or lack of sufficient means to handle crises.

How – Finally, vulnerability might involve coping problems or personal limitations. These limitations include reduced self-determination and impaired ability to do activities, recover from a stressful situation, and detect or avoid potentially harmful interpersonal interactions. Other examples of personal limitations include having little or no control, and difficulty protecting one's own interests. For coping problems, one definition involves a comparison with peers, i.e., "*likely to not cope as well as others*" (Golaz & Rutaremwa, 2011, p. 611).

Although not associated with the interrogative pronouns, other important content emerged from the analysis. Vulnerability can be viewed as holistic, variable and unequally distributed. Only two definition (Abley et al., 2011; Sarvimäki & Stenbock-Hult, 2016) were based on its meaning to older adults. Past, present or future health were mentioned, including difficulty recovering once illness has

occurred, or stamina problems, i.e., inability to sustain prolonged physical or mental effort. Very few definitions reported consequences on participation in activities. Finally, according to a conceptual framework for understanding vulnerability (Schröder-Butterfill & Marianti, 2006), vulnerability results from complex interactions of an accumulation of interrelated risks of suffering prejudice or damage, including the risk of: 1) being exposed to a threat, 2) a threat materializing, and 3) not being able to cope with a threat. In this framework, coping capacities refer to the assets and relationships that protect people from adverse outcomes or help them recover from a crisis. These assets and relationships encompass individual capacities (education, skills and health), social networks (family, friends, neighbors and community institutions), and formal social protection. This framework thus fosters a dynamic analysis of older adults in their environment and is based on their capacities to mobilize individual and collective resources (Michel et al., 2016).

According to this iterative content analysis including the workshop, we proposed to define a ‘*situation of vulnerability*’ (as opposed to only ‘vulnerability’) to stress the importance of contextual and environmental factors, and their fit with individual capacities. In this context, a situation of vulnerability is *a set of circumstances in which one or more individuals experience, at a specific moment in time, one or multiple physiological, psychological, socioeconomic or social difficulties that may interact to increase their risk of being harmed or having coping problems that lead to negative consequences on their life*. Situations of vulnerability are potentially upstream of frailty and easier to reverse because they involve additional residual capacities. To reduce its complexity, protective and risk factors should not be included in the definition but the notion of the risk of adverse outcome must be emphasised. The definition should also highlight the importance of interactions between factors, accumulation of circumstances, and the dynamic and temporal aspects of situations of vulnerability.

Instruments measuring vulnerability

Five measurement instruments were identified from the literature, analyzed and compared (Table 4). The associated papers were published between 1984 and 2013, the majority (n=3; 60%) after 2007. Most (n=3; 50%) were published in journals from the fields of gerontology and geriatrics by authors in North America, and involved quantitative studies. The instruments all target different types of vulnerability but the two most recent are general (Table 4). Both the *Hebrew Rehabilitation Center for Aged (HRCA) Vulnerability Index* (Morris et al., 1984) and the *Vulnerable Elders Survey 13 (VES-13)* (Saliba et al., 2001) aim to identify vulnerable older adults. By operationalizing vulnerability as an accumulation of deficits in social factors such as communication, living situation and socioeconomic status, social support, social engagement, leisure, empowerment and life control, the *Social Vulnerability Index (SVI)* (Andrew et al., 2008) was developed to compare social vulnerability with frailty and estimate the risk of death (Table 4). Similarly, the *Vulnerability Scale for the Elderly (VSE)* (Kaushik, 2013) measures level of vulnerability by considering health, social and economic risk factors. The *Perceived Vulnerability Scale (PVS)* (Myall et al., 2009) assesses how individuals perceive their vulnerability to possible physiological, psychological, socioeconomic, social and environmental complications or uncontrollable events (Table 4).

Table 4. Comparison of the original instruments measuring vulnerability (N=5).

Name (abbr.); Authors (year)	Definition # (as reported in Table 3)	Instrument's goal	Population studied (country)	Language	# of items	Type of vulnerability	Discipline	Administration	Max score	Scoring scale	Reported completion & scoring time
Hebrew Rehabilitation Center for Aged (HRCVA) Vulnerability Index; Morris et al. ⁵⁷	31	Identify functionally vulnerable older adults	Individuals aged ≥ 60 years (United States)	English	10	Functional	Gerontology	Self-reported or proxy	N/A	Categorical (dichotomous)	Quick and easy
Vulnerable Elders Survey 13 (VES-13); Saliba et al. ⁸	29	Identify vulnerable older adults in the community at greatest risk of death and/or functional decline	Individuals aged ≥ 65 years (United States)	English, French ⁶¹ , Portuguese ⁶² & German ⁶⁹	13	Physical	Geriatrics	Self-reported or proxy ⁶³	10	Continuous (summed score)	Average < 5 min on the phone
Social Vulnerability Index (SVI); Andrew et al. ⁵⁹	N/R	Operationalize social vulnerability	Individuals aged ≥ 65 years (Canada)	English, Dutch ⁶⁷ & Turkish ⁶⁸	23 based on National Population Health Survey (NPHS); OR 40 based on Canadian	Social	Medical sciences	Self-reported	1	Continuous (mean score)	N/R

Study of Health and Aging (CSHA)

Perceived Vulnerability Scale (PVS);
Myall et al.⁶⁰

N/R

Assess individual differences in aging-related perceptions of vulnerability

Individuals aged 50-90 years (Australia)

English

22

General (health, social, functional, attitude, environmental and economic)

Gerontology

Self-reported

6

Continuous (mean score)

N/R

Vulnerability Scale for the Elderly (VSE);
Kaushik⁴¹

14-16

Assess level of vulnerability through risk factors for older adults and, when updated and standardized, measure levels of vulnerability of older adults

Older adults (India)

English

68 (32 for health, 30 for social, and 6 for economic vulnerability)

General (health, social and economic)

Gerontology

Self-reported

9

Continuous (weighted and summed score; low, medium and high vulnerability based on 33rd and 67th percentiles:)

N/R

The VES-13 is the only instrument available in a language other than English and that is consistent with a theoretical model (the disablement process; Verbrugge & Jette, 1994). While the HRCA and VES-13 consider about a dozen items and reported a short completion time, the other instruments contain between 22 and 68 items (Table 4). All the instruments rely on self-reported information, and the HRCA is the only one that can be answered by a proxy. Most of the instruments present a comprehensive set of good psychometric properties (Table 4), although not in various contexts or with different sociocultural backgrounds, which is important for use in a variety of populations and regions. Two instruments were studied for their sensitivity or predictive value (VES-13 and VSE), test-retest reliability (PVS and VSE) and internal consistency (VES-13 and PVS), while only one reported criterion (HRCA), convergent (SVI), or concurrent (PVS) validity. Although its internal consistency (Cronbach's $\alpha = 0.95$) showed item redundancy, the PVS presents good six-week test-retest reliability ($r = 0.73, p < 0.001$ with a sample of 32 older adults; no confidence interval provided in the paper; Myall et al., 2009). Additionally, by showing the moderating effect of perceived vulnerability on the association between 1) dysfunctional beliefs (low sense of coherence or life attitude balance), and 2) psychological disorders (increased depressive symptoms and decreased physical and psychological well-being) in older adults, the PVS helps to understand dysfunctional beliefs and psychological well-being. All told, the PVS (Myall et al., 2009) appears to be shorter and assess situations of vulnerability in older adults better.

Discussion

This paper provides an inventory and content analysis of 31 definitions and five measurement instruments of vulnerability from a variety of fields. These definitions mostly focused on people under certain conditions that increase their risk of being harmed because of individual physical factors or the social environment. Since such conditions are related not only to personal but also to societal factors (Nyamathi et al., 2007; Shi, 2001; Shi & Stevens, 2005), we suggest that the emphasis should be on

situations of vulnerability. These situations can be defined as *a set of circumstances in which one or more individuals experience, at a specific moment in time, one or multiple physiological, psychological, socioeconomic or social difficulties that may interact to increase their risk of being harmed or having coping problems that lead to negative consequences on their life.* Also highlighted by others (Ennuyer, 2017; Luna, 2009), this emphasis reduces the focus on the person and especially the person's health and physical factors (Lepori, 2018). It also increases the importance of environmental factors, which should be reflected in health and social sciences research, policy and practice concerning older adults in situations of vulnerability. For example, additional environmental intervention strategies or protective factors are needed to support older adults in these situations. Since vulnerability is a dynamic state (Bozzaro et al., 2018; Ennuyer, 2017; Luna, 2014), the term should not be used as a shortcut for describing individuals, groups, or populations (Rogers et al., 2012), i.e., a category reinforcing stereotypes (Bozzaro et al., 2018; Ennuyer, 2017; Luna, 2014).

As more than three out of four papers retrieved did not provide a definition or measure, it is vital to propose a common language and way to define and measure situations of vulnerability. These papers were mainly empirical quantitative or qualitative studies, which is even more concerning. Moreover, the definitions found were mainly developed by the authors of the papers rather than based on a literature review supported by experts' input or empirical results; only one, from Abley, Bond & Robinson (2011), considers how older adults themselves view vulnerability. The opinions of experts have been found to differ from those of the person experiencing it (Henke, 2016). Since older adults are a heterogeneous group and many older adults do not view themselves as vulnerable, it is important for future work on the definition and operationalization of the concept to involve a substantial number of older adults in situations of vulnerability. Although this may be difficult (Flaskerud & Winslow, 1998; Hurst, 2008; Rogers, 1997), their involvement is necessary to reduce the risk of being paternalistic and overprotective (Bozzaro et al., 2018; Rogers, 1997; Wiles, 2011). Finally, as definitions might be influenced by their authors' field [e.g., gerontology or geriatrics mainly specified vulnerability as resulting from

physiological, psychological and social factors (*why*), while medicine and health sciences focused on people (*who*) susceptible to or at risk of (*what*) having future health problems or being harmed (*about what*)], future work should be multidisciplinary.

As some authors did not distinguish vulnerability from related concepts, especially frailty but also loss of autonomy, future work should help to highlight their conceptual differences. In fact, several articles could not be included in the current synthesis because their definitions of vulnerability were not distinct enough from the concept of frailty. Moreover, the dimensions found under '*what*' in this paper are very similar to the definition of frailty, which could refer to an increased state of vulnerability (Chen et al., 2014; Clegg et al., 2013; Paixao & Prufer De Queiroz Campos Araújo, 2010). According to some authors, frailty is more associated with physical constraints, functional decline, or worse health leading to situations of vulnerability (Junius-Walker et al., 2018; Paixao & Prufer De Queiroz Campos Araújo, 2010); therefore, future studies should explore how frailty differs from vulnerability. Because autonomy might be disrupted by vulnerability (Agu, 2013), people losing their autonomy are more likely to experience situations of vulnerability (Ennuyer, 2017; Hardin, 2015). Nevertheless, Bozzaro and colleagues (2018) criticized a definition of vulnerability based solely on the capacity to regain full autonomy, i.e., capacity for self-determination. In their contribution to the debate, however, these authors did not seem to distinguish between the concepts of autonomy and dependence. Finally, as proposed by Rockwood (2005) for frailty, a situation of vulnerability is a multidimensional and dynamic construct involving interactions between its underlying factors and should identify individuals at risk of negative consequences in order to guide actions targeting optimization of personal and environmental resources. Although these two concepts share many similarities, e.g., accumulation of risks or health deficits, functional or social challenges, vulnerability might be seen as an earlier stage of frailty; in other words, individuals in a situation of vulnerability might be '*prefrail*'.

Among the measures, as the PVS assesses how older adults cope with complications from physiological, psychological, socioeconomic and social domains (Myall et al., 2009), it is the most

relevant to the definition proposed in this paper. While the PVS and VSE reported good psychometric properties and operationalized vulnerability as a holistic concept, the PVS is shorter, also predicts anxiety and stress, and considers more dimensions, so that it encompasses more diverse potential situations of vulnerability. Measurement instruments should specify the underlying conceptual definition and theoretical model of vulnerability. To get a more complete picture of situations of vulnerability experienced by older adults, a future measurement instrument or adaptation of an existing one might also consider some psychological, social or economic individual risk factors such as gender, level of education, mental health problems or history of victimization. Moreover, self-administered questionnaires have limitations; for example, the level of suffering that is socially acceptable varies with the individual (Henke, 2016). Subjective assessments might also present an improved picture of the situation. To properly consider both manifestations of situations of vulnerability and the coping of individuals, objective measures should be triangulated with self-reported awareness and concerns about vulnerability (Henke, 2016). Finally, the psychometric properties of instruments measuring vulnerability need further study, including with older adults from different cultures. Drewes and colleagues (2014) reported a trend in developing screening tools to identify older adults in possible situations of vulnerability but without proper formal evaluations for this population. As situations of vulnerability and their context might change over time, future studies should document the measurement instruments' sensitivity to change.

Strengths and limitations

Using a rigorous, innovative procedure and involving at least three people in each step of the analysis, this study reviewed a substantial number of original definitions of vulnerability and five measurement instruments. Time and budget constraints prevented the inclusion of papers written in languages other than English or French, limited databases to the fields of gerontology, psychology, social work, sociology, health and ethics, and restricted the inclusion of other potentially interesting terms such

as frailty, disadvantage, and impairment. Finally, although they might reflect an evolution in the definitions or different perspectives in the group, opinions from two active groups of investigators (Abley and colleagues, Kaushik) may be overrepresented in the analysis.

Conclusion

In an effort to come closer to achieving a consensus, this paper contributes to the debate over the conceptualization and operationalization of vulnerability. It provides insights into how vulnerability and related concepts are defined and measured in the literature. According to the current findings, we propose to rename the concept *situations of vulnerability*, which can be defined as *a set of circumstances in which one or more individuals experience, at a specific moment in time, one or multiple physiological, psychological, socioeconomic or social difficulties that may interact to increase their risk of being harmed or having coping problems that lead to negative consequences on their life*. This definition covers all the essential dimensions, highlights the importance of environmental factors and the dynamic nature of the concept, and limits potential stigmatization from its use. Although it does not cover this definition completely, the Perceived Vulnerability Scale (PVS) is the measure that best operationalizes the concept. The present synthesis might contribute to the mission of fostering social participation and health equity by improving the collective understanding of vulnerability, and how it is conceptualized and measured. With this contribution, research, policy and practice may be more effective in identifying and reaching older adults in situations of vulnerability and in knowing the causes, consequences and sources of these situations and how they occur.

This is a good starting point but future work should continue to deepen the conceptualization and measurement of situations of vulnerability. For example, future studies could specify how older adults might be harmed or have coping problems. More specifically, there is a need for a better understanding of how individuals mobilize (or not) different resources and protect themselves (Schröder-Butterfill & Marianti, 2006). A conceptual analysis of vulnerability might also help to identify possible uses of the

concept, its attributes, antecedents, consequences and empirical referents. Also, more empirical studies are needed to validate the proposed definition, including with older adults in situations of vulnerability, their families and health professionals. When designing and conducting their research, investigators should identify a specific definition of vulnerability. It may be helpful to question older adults about their perception of situations of vulnerability in order to further understanding of research findings. Also, it might be necessary to develop instruments to identify and measure characteristics of older adults in situations of vulnerability, especially to triangulate sources of information, including from older adults, their families and health professionals, and to consider individual and collective contexts (Andrew, 2010), such as various aspects of health (Shepard & Mahon, 2002). Finally, future studies are needed to examine the possibility of having an objective criterion for assessing vulnerability (Daniels et al., 2008).

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