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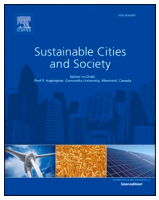

Urban resilience: A vague or an evolutionary concept?

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ABSTRACT

Considering the rapid urbanization trends in many parts of the world and the increasing consequences of climate change, more and more cities are at risk of natural disasters and other environmental, socio-economic, and political disruptions. To address these issues, resilience thinking has attracted the attention of a wide range of stakeholders. However, despite considerable attention to this concept and its frequent usage, resilience remains ambiguous with diverse interpretations in policy discussions and academic debates about cities. Since such vague interpretations would lead to difficulties in theory and practice, the present study aims to clarify some of these concepts by providing a comprehensive review focused on resilience features and comparing different perspectives regarding urban resilience. The study results showed that the main reason behind such ambiguities is that resilience has undergone fundamental changes since its inception, and recent approaches to resilience are generally based on the non-equilibrium model of resilience. There are three main dimensions, including systems, agents, and institutions, as well as three main approaches to urban resilience, including recovery, adaptation, and transformation. This study's conceptual framework of urban resilience provides scholars and policymakers with a more transparent and comprehensive picture of urban resilience and helps them make better-informed decisions.

1. Introduction

The threat scale facing cities and their social and built environment have remarkably increased recently due to demographic, economic, and socio-political changes, including global population growth, urbanization, climate change, other creeping environmental changes, and terrorist attacks (Bosher, 2011; Bosher et al., 2007). Therefore, following the 1980s and 1990s decades, which are known as the "sustainable development" decade, we can observe a paradigm shift and resource allocation change on the concept of "resilience" in the present century (Sudmeier-Rieux, 2014). As urbanization is a central driver of climate change and many creeping environmental changes, it is essential to integrate solutions and strategies to mitigate such problems in urban planings and align policies (Olazabal et al., 2012). It is not thus surprising that the concept of resilience is being used more often as a primary principle to orient scientific and political discussions regarding cities (Sharifi & Yamagata, 2018), and improving resilience has become a core component of disaster risk development programs regarding cities in recent decades (UNISDR, 2005; Cabinet Office, 2008; The Rockefeller Foundation, 2014; OECD, 2016).

Despite various applications in different disciplines, urban resilience does not have a universally accepted definition, and there are many theoretical interpretations of this concept (Büyüközkan et al., 2022). Therefore, resilience has remained a fuzzy concept (Alexander, 2013; Lewis & Kelman, 2010). Moreover, most studies use general, vague, and confusing terminology. Thus, the term "resilience" has been the subject of much debate (Jabareen, 2013; Leichenko, 2011; Rose, 2007; Davoudi et al., 2013, Hutter & Kuhlicke, 2013; Brand & Jax, 2007). Many consider resilience an asset, a process, a state, or a quality in various domains and on numerous global, national, and local scales. Sometimes, there is a focus on the resilience of individuals, and some other times the resilience of different urban, social, economic, political, and natural systems is considered (Davoudi, 2012; Weichselgartner & Kelman, 2015; Be'ne' et al., 2012; Wilson, 2012; Manyena, 2006; Sudmeier-Rieux, 2014).

The National Academy of Sciences (2012: 14) defined resilience as "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events". Meerow et al. (2016: 42-45), in a study on the typology of definitions, identified six conceptual differences concerning resilience definitions, including "(1) definition of

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'urban'; (2) understanding of system equilibrium; (3) positive vs. neutral (or negative) conceptualizations of resilience; (4) mechanisms for system change; (5) adaptation versus general adaptability; and (6) timescale of action". They defined urban resilience "the ability of an urban system and all its constituent socio-ecological and socio-technical networks across temporal and special scales to maintain or rapidly return to desired functions in the face of disturbance to adapt to change, and to transform systems that limit current or future adaptive capacity quickly".

In general, these differences and inconsistencies have led to the feeling that resilience knowledge is not yet pragmatic since it does not have a well-established descriptive, conceptual, and theoretical basis. Lack of unanimity is not necessarily harmful. However, since the conditions and contexts in which resilience is defined are broad (Parker, 2020), a lack of clear definitions would lead to partial or inaccurate conclusions and misinterpretation of the phenomenon (Jabareen, 2013), as well as confusion in policymaking regarding the cities in practice. Therefore, it is crucial to interpret resilience for its application in policies and protocols in the face of either sudden or incremental disruptions (O'Hare & White, 2013).

As a result, this study aims to review the literature to find the reasons behind such vague interpretations and clarify some ambiguities regarding resilience knowledge, such as (1) resilience planning objectives, (2) the scope of resilience, and (3) resilience dimensions, (4) phases, and (5) approaches. Therefore firstly, we examine the meaning, origins of creation, and conceptual models of resilience thinking as the main reasons behind such ambiguities. Then, we discuss the different objectives, general and specified resilience, dimensions, phases, and resilience approaches and clarify them, particularly in the urban planning domain. Eventually, the conceptual model of urban resilience, including the abovementioned elements, is presented.

2. Materials and methods

This research addresses the aims mentioned in the previous section through an exploratory qualitative archival method. In brief, we followed Moher et al. (2009) systematic-review framework for selecting the related studies. Then, to identify the relevant terminologies, core concepts, theories, and knowledge gaps to scope our study, we used PRISMA-ScR Checklist (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) (Tricco et al., 2018). In this step, the inductive content-analysis method was used to categorize each section of the PRISMA-ScR Checklist. The following paragraphs explain each process in more detail.

Initially, a broad-based search string that included related terms to resilience, including "urban resilience" and "resilient cities", was developed through WoS. The first literature search was conducted on December 15th, 2020. The investigation was restricted to publications in English, and the result was 747 articles. In addition to those articles, 52 more studies were added by searching the related papers to the research concept on Google Scholar and screening the cited references of all articles. Then, the abstracts of all papers were screened to select those related to the characteristics of resilience thinking. The screening criteria were: specific focus on urban resilience or resilient cities and concentration on at least one of its components or attributes. Articles related to disaster risks but not focused on at least one of the abovementioned terms were excluded.

Next, the remaining 168 studies were carefully examined by using the PRISMA-ScR Checklist method to extract data regarding the characteristics of urban resilience, different items such as the scope of the article, the type of resilience attribute(s), the represented ideas about the studied attribute(s), and different classifications of the related terms. PRISMA-ScR Checklist included 22 items and covered all the information on each paper. In this step, different parts of the related articles were classified into 22 PRISMA-ScR Checklist items. Then, an Excel sheet was produced for each item of the PRISMA-ScR Checklist, and the data under each item was sub-categorized into different classes via qualitative inductive content-analysis. Different categories for each section were formed inductively as we proceeded to read the articles. New information was added to either the existing categories or to the new categories, which were added to the initial classifications, as we proceeded with the content analysis of the papers. This method helped the researchers to extract different perspectives and insights from the literature inductively without preconceived researchers' bias. This process continued until all data was covered. After reading the full texts, 52 more articles were dropped as they did not include details related to different aspects of urban resilience.

In the end, three main reasons for ambiguities regarding urban resilience were found. The reasons included "resilience meaning", "resilience origin", and "different conceptual models of resilience". In addition, five categories of resilience features, namely, "urban resilience objectives", "the scopes of urban resilience", "urban resilience dimensions", "urban resilience phases", and "urban resilience approaches", were identified.

However, it is essential to mention that other related papers have been published since our initial search in 2020. While they were not included in the systematic search, we integrated their insights into different study sections. Moreover, the study's methodology allowed us to include as much relevant research to the concept of the study as possible in the reviewing process. Even though there might be other related articles that have not been identified, we believe that the number of reviewed papers is large enough to help achieve the study's goals and adding more articles would probably not change the study results Fig. 1 shows the steps of selecting relevant studies and their analysis for the literature review.

In the following paragraphs, different insights and perspectives regarding meanings, origins, and conceptual models of resilience are mentioned. Then, different theories concerning some urban resilience ambiguities (objectives of resilience planning, the scope of resilience, urban resilience dimensions, urban resilience phases, and the urban resilience approaches) will be discussed in detail. Lastly, the conceptual framework of urban resilience will be introduced.

3. The meaning, origins, and conceptual models of resilience thinking

The urban resilience concept is repeatedly criticized for its variation in interpretation, malleable nature, and ambiguity in some areas (Büyüközkan et al., 2022; Wardekker, 2021; Meerow & Newell, 2019; Matyas & Pelling, 2014; Vale, 2014). Since different interpretations can lead to conceptual vagueness and miscommunication between city actors, it is important to first clarify the resilience meaning and origin (Wardekker, 2021). Therefore, after reviewing the resilience literature, several reasons for diversity and fuzziness of interpretations and concepts associated with resilience thinking were found: resilience meanings, origins, and framings.

3.1. Resilience meaning

One of the main reasons for the vague definitions and interpretations stems from the linguistic roots of the word "resilience", which does not convey the meaning properly. The Latin word "resilire" is the root of the word "resilience", which means springing back (Davoudi et al., 2013). It is, therefore, tangible that resilience has often been used to indicate the capacity for rebounding and has commonly been described as the ability to bounce back post-disaster (Manyena, 2006; Peek & Mileti, 2002; Paton et al., 2003). However, based on more recent literature, resilience is not merely about "bouncing back", but it is more of individuals and/or communities' "adaptive capacity" to respond to possible unexpected risks and changes (Büyüközkan et al., 2022; Norris et al., 2008; Klein et al., 2003). Many researchers believe urban adaptive capacities against unexpected shocks to protect social, economic, and infrastructure

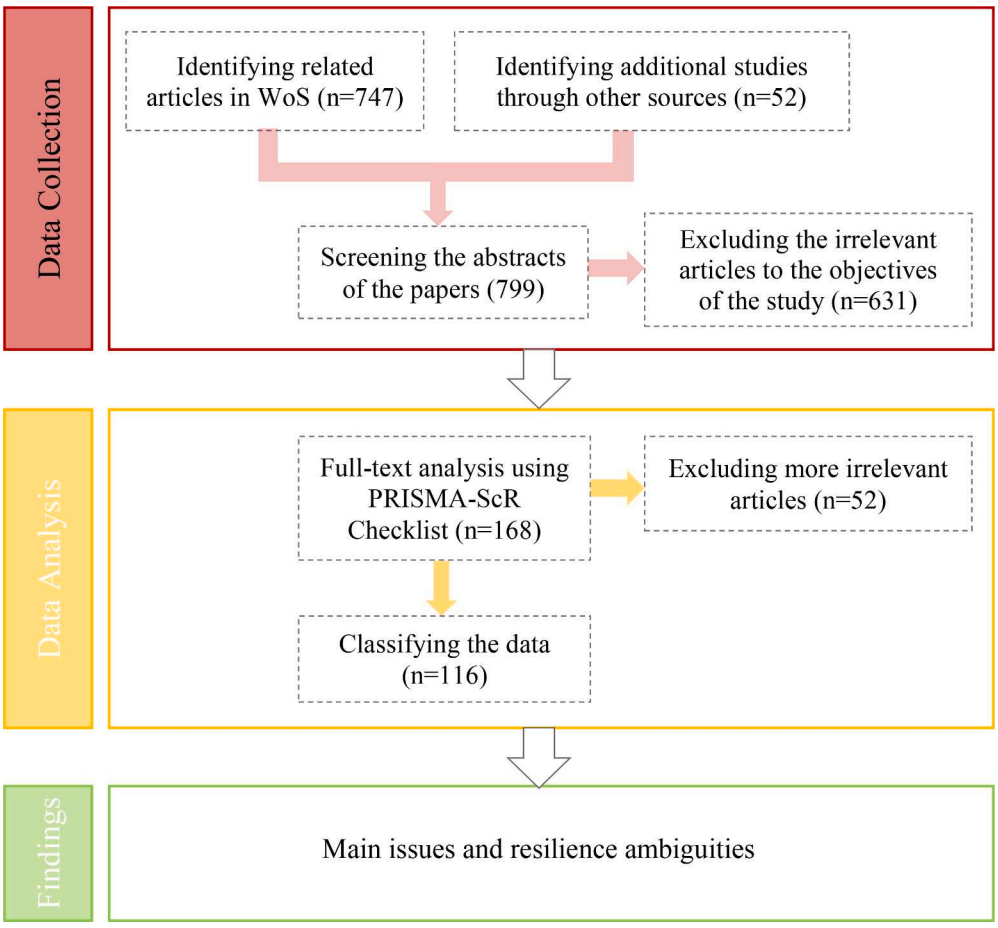

Fig. 1. The flowchart of procedures for literature search and selection through the different phases - adapted from Moher et al. (2009).

systems have become more essential in resilience meaning for planners, policymakers, and researchers recently (Büyüközkan et al., 2022), and over-reliance on previous perspectives can lead to unsustainable development patterns in cities (Chelleri, 2012; Saunders & Becker, 2015).

3.2. Resilience origins

Another reason behind the ambiguities would relate to the various epistemological orientations of resilience thinking (Zhou et al., 2008). Resilience has emerged as a combination of ideas from different disciplines and paradigms (ODI, 2012). The origins of resilience go back to the engineering sciences and fluid mechanics (Tierney & Bruneau, 2007). First, physicists used it to describe the material resistance to external shocks. Then, following the growth of systemic thinking in the 1960s, ecologists began to use the word and expanded its meaning. Then an ecologist, Holling (1973), used the phrase resilience in the ecological literature to understand the non-linear dynamics in ecosystems. He defined resilience as the ecosystem capability of withstanding disturbances without changing self-organized structures. Since then, numerous studies have contributed to resilience thinking. For instance, the concept of resilience is mainly borrowed from ecologists by planning scholars (Sharifi & Yamagata, 2018).

Moreover, Alexander (2013) provided a more detailed etymology of the term "resilience". According to him, this term has existed for centuries and migrated from manufacturing, mechanics, and pharmacy to the social sciences in the 1950s. Alexander argued that the word "resilience" was used in the developmental psychopathology of children, Garmezy, who began studying schizophrenia in the 1940s. However, after the concept entered the ecology field in the 1960s, we are witnessing its widespread use in various areas, like social sciences (Adger, 2000; Leichenko, 2011; Pelling, 2003), psychology, and the behavioral sciences (Norris et al. 2008), economic recovery (Rose, 2004; Pendall et al., 2010; Pike et al., 2010), disaster risk management (Cutter et al., 2008b; Colten et al., 2008; Vale & Campanella, 2005), governance (Pearson et al., 2014), education (Gillham et al., 2013), and urban resilience to terrorism (Coaffee, 2008, 2009). Fig. 2 shows some of the different disciplines using the resilience concept.

Fig 2. The concept of "resilience" in various sciences.

3.3. Models of resilience thinking

Resilience thinking has evolved from its inception, and one of the fundamental developments in resilience thinking emerges from the models that form the theoretical basis of this thinking. Concerning system status and dealing with the effects of disruption, resilience includes two main conceptual models: the equilibrium model and the non-equilibrium model (evolutionary resilience) (Wardekker, 2021).

3.3.1. The equilibrium model of resilience

The "equilibrium model", also known as the "single equilibrium model" or "engineering resilience", can only be used for studying the behavior of linear systems (Arefi, 2011). This is the primary and old model of resilience that relates to the capacity of bouncing back and returning to equilibrium (Norris et al., 2008; Folke et al., 2010; Skerratt, 2013). Indeed, the equilibrium paradigm or deterministic conception of nature assisted many 20th-century scientific achievements (Ahern, 2010). The equilibrium model of resilience tends to apply strategies to prevent or exclude disturbances (Bengtsson et al., 2003). It often emphasizes returning to normal after the onset of a disorder and concentrates on manners close to a static equilibrium or the rate at which a system achieves a static state after a disruption. Therefore, this resilience model consists of systematic approaches that enable a system to return to its previous condition while experiencing a disruption (Dhar & Khirfan, 2016). Thus, low-resilience systems may take a long time to recover or not recover at all. This model focused on maintaining the status quo, the system's function and continuity efficiency, and a predictable, stable state (Wardekker, 2021). It has shaped natural resource management by controlling resource flows optimally (Folke, 2006). In this model, a prominent feature of a resilient system is its ability to return to the previous condition relatively quickly. The equilibrium model seeks to recover and reduce the urban vulnerability in time of disruption or shock by increasing the capacity of urban infrastructure, reducing carbon emissions, or organizing forces (Musacchio & Wu, 2002). Reliance on this model for increasing urban resilience might provide planners and policymakers with a fake sense of security (Sharifi & Yamagata, 2018).

3.3.2. The non-equilibrium model of resilience

In the late 20th century, based on chaos or non-equilibrium theory, many scholars argued about an alternative, non-equilibrium paradigm to understand the natural and built environment. Therefore, they reconsidered the way of thinking about urban stability (Steiner, 2002; Rohde, 2005; Botkin, 1990). Based on a non-equilibrium perspective, nature and the built environment are inherently variable, uncertain, and unpredictable. Changes and disruptions are accepted in this model and are expected system characteristics (Ahern, 2010).

The "non-equilibrium model" of resilience, which is also known as "evolutionary resilience", was formed based on the assumption that differences in the types of disturbances and stresses and spatial diversity led to unique and distinct return paths (Davoudi, 2012). Systems may look similar, but they are different and unpredictable due to their continuous growth and development. This model is based on Folke's (2006) perspective that considers the system an ever-changing socio--ecological process rather than a single status. Folke highlighted the ability for "renewal", "re-organization", and "development". The idea has derived from ecological resilience since it assumes the existence of various stable states, including "basins of attraction", "multiple equilibria", or "regimes" (Wu & Wu, 2013).

Furthermore, in the "non-equilibrium model", the application of terms such as "regime shift", which has a sense of dynamism, is recommended instead of "returning" to a state of stability or equilibrium for complex adaptive systems (Folke, 2006). Unlike the previous model, which emphasized a quick return to the previous status and function, in this model, the emphasis is on the capacity of the system for adaptive change. In the time of an accident or any system malfunction thus, the system may shift to a more sustainable state or condition. By accepting change as the inevitable component of systems, the non-equilibrium model seeks to increase the adaptability of systems rather than reduce vulnerability (Arefi, 2011). In addition to adaptability, taking advantage of opportunities for transformation is another feature of the non-equilibrium model of resilience.

While relying on equilibrium model and engineering resilience perspectives (such as return and resistance) might lead to unsustainable urban development patterns, in the non-equilibrium model of the resilience of complex systems, "urban resilience should be framed within the resilience (system persistence), transition (incremental system change), and transformation (system reconfiguration) views". (Chelleri, 2012: 287). Recent approaches to resilience are generally based on the non-equilibrium model. The main features of both models are represented in Table 1.

4. Clarifying some ambiguities related to urban resilience

The main aim of this study is to introduce, compare, and clarify different perspectives on the urban resilience concept. Thus, reviewing a wide range of literature regarding the resilience concept showed that there are various and, in some cases, contradictory views towards some areas of urban resilience. These different perspectives can be categorized into the objectives of resilience planning, the scope of resilience, urban resilience dimensions, urban resilience phases, and urban resilience approaches.

4.1. Objectives of resilience planning

The term "resilience" is a comparatively novel concept in urban planning and design literature. For the reasons mentioned in the previous section and given extensive changes of this paradigm in recent years, various objectives have been considered for resilience in the literature. The general goal of resilience is to ensure the system's survival and continued performance. In addition, it focuses on the at-risk people life quality in times of both crisis and normal circumstances (Cimellaro, 2016). Other objectives are returning to the normal, reducing vulnerability, adaptation, improving capacities and strengths, and sustainable development.

4.1.1. Returning to the normal

As discussed earlier, the word resilience means "bouncing back". The primary approaches to resilience, such as "engineering resilience", are based on the concept of returning to "normal" or capacity for reversion to the condition that prevailed prior to disruption or disaster (Kelman et al., 2015), which is strongly connected to the concept of "resistance"

Table 1
Conceptual models of resilience.

Attributes	Equilibrium model	Non-equilibrium model
Structure	Linear, simple, and static	Non-linear, complicated, and dynamic
Domain/s of stability	One stability domain	Multiple stability domains
Purpose/ objectives	Maintains efficiency of function	Supports the ability to change
Focus	Efficiency Consistency Predictability	Persistence Adaptability Transformability Unpredictability
Responding to	External disturbances	Internal and external disturbances With or without any disturbance
Main approaches	Resistance Recovery	Renewal Re-organization Adaptation Transformation

and "robustness" in the literature of social vulnerability and socio-ecological systems (Lyon & Parkins, 2013). Thus, it is tangible why some researchers and policymakers, particularly in disaster risk management, have emphasized "returning to normal" and "resistance" as the main objectives of resilience despite several critical conceptual challenges.

However, returning to the normal or the pre-disaster state after a disaster, rather than seeking something new, sometimes means returning to the poor development and vulnerability to the same catastrophe instead of moving towards a better future. Moreover, due to the constant changes of societies, the assumption of having a "normal" social state could be questioned (Kelman et al., 2015). Returning to the normal, especially after a weather-related perturbation, can be an inadequate adaptation response or even maladaptation (Davoudi, 2012; Klein et al., 2003; McGray et al., 2007).

4.1.2. Reducing vulnerability

Some researchers put resilience and vulnerability at the opposite end of a spectrum, as the final limits of this spectrum are much easier to conceptualize (Wilson, 2012; O'Brien et al., 2006; Leichenko, 2011; Helderop & Grubesic 2019). Most risk assessment tools consider the "vulnerability" part of the risk assessment triplet. Likewise, resilience assessment and management is, in part, an effort to address the remaining unmitigated risk as well as to improve the overall ability of the system to respond to emerging threats (Linkov et al., 2018).

Like "resilience", the term "vulnerability" is complex and dynamic (Sobhaninia & Buckman, 2022) and is defined differently by various scientific traditions. Vulnerability is a system's capacity for loss and damage in time of disruptions (Cutter, 1996; Grubesic & Matisziw, 2013). It is the communities' or societies' level of susceptibility and their capacity to respond to the harmful effects of a disaster (Lankao & Qin, 2011; UNISDR, 2009). It is also defined as "the degree to which a system or unit is likely to experience harm due to exposure to perturbations and stresses" (Sherbinin et al., 2007: 41). According to Cutter et al., 2008b: 599), vulnerability is "the pre-event, inherent characteristics or qualities of social systems that create the potential for harm". It is also a dynamic state affected by biophysical and socio-economic circumstances (Dow, 1992; Liverman, 2001, Kasperson et al., 2001). In addition, Wamsler (2014) believed that severe disruptions occur, and hazardous events become unmanageable when natural hazards are combined with vulnerable conditions such as people and systems prone to the effect of these shocks.

On the other hand, some other researchers have no consensus on the placement of resilience and vulnerability at the opposite end of a spectrum (Kelman, 2018; Kelman et al., 2015; Lewis & Kelman, 2010). Vulnerability and resilience are relatively generic concepts, and the underlying factors to distinguish them often overlap. Moreover, when disaster exposure, shock sensitivity, and adaptive capacity are also considered, it becomes more confusing to understand their relationship and interaction with one another (O'Brien et al., 2006). Furthermore, some have criticized resilience for ignoring the causes of vulnerability that are sometimes outside a community. According to the presented definitions, resilience focuses more on consequences than eliminating the root causes of the crisis or vulnerability (Timmerman, 1981; Lewis & Kelman, 2010; Kelman, 2018). In some cases, people's resilience is denied because of their vulnerability since these studies considered people as passive recipients of experts' insight. On the contrary, some researchers consider the capacity of people to act adaptively during an adverse event, and they consider the community and collaboration between people and other agents as a resilience prerequisite (Ntontis et al., 2020; Torabi et al., 2018).

As a result, resilience and vulnerability are two related but different approaches of systems' response to both sudden shocks and slow creeping changes (Chacowry et al., 2021). Lewis (2013) asserted that resilience and vulnerability processes could exist parallel based on the existing realities. Both are affected by inequalities that affect local coping and adaptability capacities. Communities are never resilient to all disruptions. The highest degree of resilience can never be achieved in a society, and it should be seen as an ideal state. Moreover, resilience and vulnerability are inherent in all dynamic systems against constant changes as well as disruptions. In other words, all resilient systems may contain some aspects of vulnerability. Conversely, even the most vulnerable systems may have resilience characteristics to some extent (Sapountzaki, 2014; Wilson, 2012). Folke (2006) asserted that specific adaptive capacities that maintain the system's overall resilience could lead to more vulnerability to less likely risks. Resilience and vulnerability thus are coexistent, inevitably interdependent, constantly reproducing, contradicting, and causing each other to grow (Kelman, 2018). We should continuously try to increase the resilience of systems and reduce vulnerability in urban systems, but this goal alone is not enough to improve resilience.

4.1.3. Adaptation

In addition to addressing vulnerability in recent studies, resilience also overlaps with adaptation, especially on climate change. Despite the differences between the terms, many researchers have equated resilience with adaptation. Nelson et al. (2007) recognized the difference between adaptation and resilience. They believed that adaptation is based on agents, policies, and projects, while resilience focuses on systemic thinking. By making the systems more adaptable through the above three factors, the overall resilience of the systems can be improved. UNISDR (2009: 4) defined adaptation as "the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploit beneficial opportunities." It is accepting the inevitable future damages and attempts to minimize their negative consequences (Kundzewicz & Matczak, 2012; Felgenhauer & Webster, 2013; Carter, 2011).

Adaptation as an integral part of resilience (Martin, 2012) includes building the adaptive capacity of individuals, communities, and organizations to change via implementing adaptation decisions and transforming adaptive capacities into actions (Adger et al., 2005). Walker et al. (2004) declared adaptation is an environmentally induced response to disruption and active utilization of new opportunities. Focusing on the "ability to adapt", the concept of resilience considers at-risk people as capable agents rather than passive victims (Olwig, 2012). Adaptation can be achieved spontaneously or due to targeted adaptation policies and schemes. Many disaster risk management measures can also directly lead to better adaptation (UNISDR, 2009).

Hamin & Gurran (2009) have argued that the phenomenon of climate change requires resilience strategies to ensure adaptation to the climate change effects, e.g., through more open spaces to allow rivers and floods to overflow, supporting the policies that mitigate climate change, such as increased density and reduced reliance on cars. Dhar & Khirfan (2016) have proposed a multi-dimensional framework for strengthening the resilience of the urban built environment to climate change. In this framework, adaptation strategies such as the link between green, blue and gray infrastructure, predefined room for future functions, flexible capacity for diverse functions that are needed, especially in a time of a disaster, the distinction between determined and not-determined components of urban form, hierarchies of urban structures according to their lifetime and spatial positions, clear/virtual clustering of urban form, and the interplay between streets and blocks are proposed.

4.1.4. Improving capacities, resources, capitals, strengths, etc

It should be noted that not all resilience researchers focus on disaster risk management or climate change issues. Currently, researchers in the fields of humanities, social sciences, economics, politics, psychology, and behavioral science are also studying resilience. Hence, based on the characteristics of the system under study and the type of disaster threatening the cities and communities, some have pointed out to enhancing some factors called "capacities" (Norris et al., 2008),

"resources" (Magis, 2010), "capitals" (Wilson, 2012), and "strengths" (Berkes & Ross, 2013) to building resilient communities or systems.

Gillespie-Marthaler et al. (2019) defined sustainable resilience as the ability to maintain desired system performance while considering the intrasystem and intergenerational distribution of vulnerabilities and sustainability capital. Galaitsi et al. (2021) asserted that desirable system performance in the face of threats can be characterized by many concepts, including adaptability, agility, reliability, resilience, resistance, robustness, safety, security, and sustainability.

4.1.5. Sustainable development

Moreover, many consider resilience a tool to achieve larger goals such as sustainable development (Pearson et al., 2014). In the natural hazard context, the terms "sustainable planning", and "resilience planning" are often being used interchangeably (Saunders & Becker, 2015). Folke (2006) highlighted that resilience provides a platform for producing integrated and interdisciplinary science on issues important to governance and management for more sustainable development between different disciplines. Resilient communities are structurally organized to limit the negative impacts of disruptions and simultaneously recover faster by maintaining the socio-economic vitality of societies (Tobin, 1999). Folke (2006) considered resilience as an approach and a way of thinking, which provides a valuable context for the analysis of socio-ecological systems and a field for exploratory research with a view to policymaking for sustainable development. Cutter et al. (2008b) believed that community resilience is inextricably linked to environmental conditions and the restoration of its benefits.

Therefore, the concept of sustainability plays an essential role in resilience studies. This means that an environment under unsustainable actions may face more severe hazards. Both sustainability and resilience seek to create strong communities and high-quality places that are safe to live in overtime. A resilient community should also be sustainable and ensure that future generations' needs are met economically, socially, culturally, and environmentally (Saunders & Becker, 2015). UN Commission on Sustainable Development (2002) proposed that sustainable development should enable societies to be more resilient to severe threats such as natural hazards. Marchese et al. (2018) asserted that considering resilience to achieve sustainable development means that sustainability increases as system resilience increases. However, increasing system sustainability does not necessarily increase resiliency. Newman et al. (2017: 10) also emphasized the importance of sustainability in resilient cities and declared that a resilient city would "invest in renewable and distributed energy, create sustainable mobility systems, foster inclusive and healthy cities, shape disaster recovery for the future, build biophilic urbanism in the city and its bioregion, and produce a more cyclical and regenerative metabolism".

The major objectives of resilience planning and their main focus are represented in Table 2.

Table 2
The main focus of resilience planning's objectives.

Objective(s)	Main focus
Returning to the normal	Returning to the normal or the pre-disaster state after a disaster or disruption.
Reducing vulnerability	Less vulnerable communities, structures, systems, etc.
Adaptation	Making the systems more adaptable, particularly to climate change consequences through agents, policies, and projects.
Improving capacities, resources, capitals, strengths, etc.	Building resilient communities.
Sustainable development	Providing a platform for producing integrated and interdisciplinary science between different disciplines to achieve sustainable development goals.

4.2. The scope of resilience

Urban resilience can also be viewed differently in terms of general resilience and specified resilience (or targeted resilience). Due to the type of risk, planning for resilience involves a broad scope, ranging from a specific type of stress to a wide range of disruptions. On the one hand, general resilience is about the overall resilience of a system to uncertain events, which is the system's resilience against all kinds of stresses, including completely novel ones (a broad system response to threat) (Wu & Wu, 2013; Galaitsi et al., 2021). On the other hand, specified resilience is referred to issues related to certain aspects of a system, which a known or specific disturbance may cause (a focused system response to threat) (Folke et al., 2010; Galaitsi et al., 2021).

4.2.1. General resilience

In general, urban resilience is the ability of a city to cope with a wide range of disruptions, shocks, and stresses (Leichenko, 2011). General resilience is more about withstanding uncertainty in all trajectory paths. Some researchers are skeptical about specified resilience. From their point of view, while different disciplines have contributed to resilience thinking, there is ample evidence that adopting partial perspectives on the resilience of systems would lead to unsustainable actions. Therefore, to create a more flexible basis for more sustainable decision-making, more integrated theories are needed to fill the interdisciplinary gaps while strengthening disciplinary perspectives (Holling et al., 2002). Moreover, excessive focus on particular parts of a system to get resilient to specific disturbances and shocks might lead to the fragility of a system in other ways (Folke et al., 2010). Some of the general features of urban resiliency are having diverse sources of local economic prosperity, high-quality economic infrastructure, social connectedness, innovation, and adaptability (Pearson et al., 2014).

Similarly, Sapountzaki (2014) contended that vulnerability and resilience assessment studies should not be applied to a specific risk. In the real world, vulnerabilities and resilience have complex relationships produced in facing multiple threats. Therefore, policies to promote resilience should not specifically address flood risk, earthquake, poverty risk, social segregation, epidemics, etc. Increasing systems resilience is an ongoing process that is not limited to specific shocks (Aguirre, 2006). Moreover, too much concentration on specified resilience might make the system as a whole less diverse, flexible, and effective in response to a disruption (Wu & Wu, 2013). In this regard, Holling et al. (2002) pointed out the rapid change in different areas at various global and regional scales and the need to create integrated perspectives and theories among related ecologic, economic, and social forces to increase resilience and sustainability. Thus, policies to promote resilience should be developed against a broad range of potential risks. It is not adequate to segregate risks and hazards and to adopt separate policies to strengthen resilience without communication with different disciplines since, in the real world, we face a series of risks simultaneously.

4.2.2. Specified resilience

On the other hand, some scholars believe that we should always seek and plan to achieve specified resilience in complex adaptive systems such as cities. Carpenter et al. (2001) were the first researchers who asked "resilience of what to what?" From their perspective, resilience is not a general concept that can be applied abstractly. Vale (2014) also argued that the importance of resilience is to achieve resilience of whom and against what. In order to assess resilience or plan for enhancing the resilience of a system, we should identify the local stressors or hazards that we want to be resilient to them (Desouza & Flanery, 2013).

The attributes of general resilience and specified resilience are represented in Table 3.

4.3. Urban resilience dimensions

Resilience is a multi-dimensional concept (Sharifi & Yamagata,

Table 3
Comparison of general resilience and specified resilience.

Attributes	General Resilience	Specified Resilience
Type of risk	All kinds of disturbances and shocks, including completely novel ones	Known or specific disturbance
System's response to a threat	Broad system response to a threat	Focused system response to a threat
Main focus	The overall resilience of a system	Issues related to certain aspects of a system
Perspective	Holistic	Partial
Advantage	More realistic in an uncertain world with many unknown risks	More pragmatic

2016b; Amirzadeh & Barakpour, 2019a), and researchers from different academic backgrounds have argued about the nature of urban resilience and have pointed out various dimensions for the conceptualization of the city systems' resilience at different scales, which often causes confusion.

Four correlated urban resilience dimensions that are frequently referenced in resilience theory and practice debates are (1) governance systems, (2) metabolic flows, (3) built environment, and (4) social systems (Chelleri, 2012). It seems that these four dimensions are taken from the literature of urban systems. Many reports and agendas also define dimensions of resilience as social, economic, environmental, and institutional (UNISDR, 2012). Fleischhaur (2008) argued that urban resilience includes three dimensions: environmental-physical, socio-economic, and institutional structures. Cutter et al. (2008b) believed that resilience includes ecological, social, economic, and infrastructural capabilities. In another study, Cutter et al. (2008a) considered four key sets of criteria to assess community resilience. These criteria involved: (1) community vulnerability, (2) built environment and its infrastructure, (3) natural systems, and (4) risk reduction and planning. The first three dimensions parallel the previous research, and the last criterion is based on the procedural dimension and policymaking.

In addition, Torjman (2007) considered urban resilience as the relationship between four groups of activity: sustenance, adaptation, engagement, and opportunity, that different combinations of them provide resilience. Solecki et al. (2015) proposed a conceptual framework for examining urban resilience, urbanization processes, and climate change. Moreover, Sharifi & Yamagata (2016a) identified different criteria for planning and designing urban energy resilience and classified them into five categories: infrastructure, resources, land use, urban form, political and social aspect, and demographic and human behavior.

One of the most critical conceptual frameworks of resilience is the urban resilience framework provided by Tyler & Moench (2012). This framework, which is called the "framework for urban climate resilience", included three main components: "systems", "agents", and "institutions". Today's natural and human-built world comprises complex and interconnected systems. Such systems can encounter various threats, challenges, or disruptions, including chronic and acute (Galaitsi et al., 2021). Urban systems include settlements, infrastructure, and ecosystems, which are flexible and diverse, redundant and modular, and capable of safe failure, enhancing their resilience (Tyler & Moench, 2012). Agents are key actors in targeted decisions, deliberated actions, and strategic choices and can achieve resilience through their ability to learn and respond. They involve individuals, households, communities, political actors, and organizations (Torabi et al., 2018). Institutions include policies, laws, social norms, and so on, which affect agents' systems usage. They can promote learning and help to build adaptive capacity (Tyler & Moench, 2012). It seems that although Tyler & Moench's (2012) model has been introduced as a framework for urban climate resilience, this framework can also be used for other urban hazards and disturbances.

In addition to the importance of these three components in the resilience of urban systems, Torabi et al. (2018) have highlighted the need for interactions between them for improving urban resilience. While most studies emphasize the urban systems, some scholars highlighted the role of agents, particularly communities, in strengthening urban resilience (Amirzadeh & Barakpour, 2019b, 2021; Platts-Fowler & Robinson 2016; Torabi et al. 2018; Peijun et al. 2011; Pfefferbaum et al. 2015; Magis 2010).

4.4. Urban resilience phases

Different resiliency phases are introduced by various researchers in different studies that some overlap with each other. Rodin (2014) considered three phases for building resilience: readiness, responsiveness, and revitalization. These phases are not distinct or sequential, but they are integrated. Readiness, in her opinion, begins with awareness and is followed by evaluation and measurements. Responsiveness is about responding effectively to a wide range of uncertainties, and revitalization includes learning from a shock and improving the system.

Folke (2006) noted the importance of the adaptive cycle, an innovative model produced by observing ecosystem dynamics in 4 stages of development, along with discontinuous events and processes. It has four phases: rapid growth, conservation, release, and reorganization. Wu & Wu (2013) declared that to have adaptation capacity, a resilient system should move through the adaptive cycle that includes four phases: exploitation, conservation, release, and renewal. Similarly, Buckman & Rakohimova (2020) also believed that cities and infrastructures often go through a sequence of four phases that the cycle starts anew after the final phase. These phases are the rapid growth phase, conservation phase, collapse phase, and reorganization.

Furthermore, Wamsler (2014) identified three main phases for disaster risk management: response, recovery, disaster risk reduction, and further development work. He noted that response, which can also be called emergency management, is implemented during and immediately after a disaster to provide basic needs, save lives, and provide shelter. Recovery, also called the window of opportunity, revolves around improving people's former living conditions through early recovery, rehabilitation, and reconstruction. Lastly, development work includes increasing people's quality of life and long-term support that looks for decreasing poverty, improving the economy, and creating capacities for better governance. In his opinion, risk reduction and adaption have five main activities: "hazard reduction and avoidance, vulnerability reduction, preparedness for response, preparedness for recovery, and risk assessment".

4.5. The approaches to urban resilience

There are diverse and sometimes contradictory definitions for urban resilience, from resistance against change to maintaining the status quo through transformation (Meerow et al., 2016). In general, there are three different resilience approaches based on the time scale (short, medium, and long-term) and the conceptual model of resilience (equilibrium, non-equilibrium model) as fundamental and sometimes contradictory components of urban systems: recovery, adaptation, and transformation (Ribeiro & Goncalves, 2019; Chelleri et al., 2015; Matyas & Pelling, 2014; Torabi et al., 2018).

The first and oldest approach is recovery and coping, which are often used in the short term. Recovery originates in the equilibrium model of resilience. It is about internal or external system shocks and is derived from the concept of resilience in engineering, which emphasizes a quick return to the normal state where full or critical levels of services, performance, or functions are regained (Connelly et al., 2017). UNISDR (2009: 23) defined recovery as "restoration and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities". It should be noted that, even though recovery is associated with shocks, disasters, and emergencies,

long-term structural changes can also be the result of the reconstruction process (Chelleri et al., 2015). Moreover, since recovery offers improving conditions for future risk reduction, it is also called the 'window of opportunity' (Wamsler, 2014). Linkov & Trump (2019: 21) defined recovery as "the ability to reduce harms while helping the targeted system rebound to full functionality as quickly and efficiently as possible".

Pearson et al. (2014) believed that coping with disturbances also describes an effective response to a disorder. UNISDR (2009: 8) defined coping capacity as "the ability of people, organizations, and systems, using available skills and resources to face and manage adverse conditions, emergencies, or disasters".

The second approach is adaptation, also known as incremental adaptation, which is applied in the medium-term (Torabi et al., 2018). This approach is, in essence, non-equilibrium. Adaptation refers to the capacity to adapt to external drivers and internal processes in order to develop along the present trajectory (Folke et al., 2010). Adaptation involves altering the system in light of knowledge gained from the event to be more resilient in the face of another (Linkov & Trump, 2019; Connelly et al., 2017).

Adaptation has been defined as "an adjustment in natural and human systems in response to actual or expected disturbances when frequencies tend to increase" (Pearson et al., 2014: 21) and also as "the capacity of actors in a system to influence resilience" (Walker et al., 2004: 5). IPCC (2007: 21) also defines it as "the ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences". This approach is the process of adjusting to current or expected changes and their consequences regardless of the system's limitations by moving the thresholds to maintain the system in an ordinary regime. However, adaptability can involve changes in different procedures and thus may have some overlaps with long-term transformation processes (Chelleri et al., 2015). Adaptive capacity is also related to vulnerability: "the more adaptive capacity a person or a system has, the less vulnerable they are" (Wamsler, 2014: 30).

The third approach, which is closely linked to the second approach, is transformation/ transformational adaptation. It involves long-term structural transitions, which may change the system's basic features to empower it to enter a new regime (Davidson, 2010; Chelleri et al., 2015). This approach is derived from evolutionary/socio-ecological resilience, which entails better acknowledging uncertainties. The system transformation approach was formed due to the shortcomings of the approaches mentioned above in response to the challenges of large-scale natural shocks (Matyas & Pelling, 2014). Davidson (2010) introduced "transformation" as one of the possible responses to disruptions. Transformation has been defined as "the capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable" (Walker et al., 2004: 5). It has also been defined as "a response to a disturbance that differs from both coping and adaptation strategies in that the decisions made and actions taken change the identity of the system itself" (Pearson et al., 2014: 21).

While some researchers consider the transformation of a system to be undesirable and only appropriate when the system has reached dangerous thresholds (Chelleri et al., 2015), many researchers consider the system transformation as a fundamental condition and one of the main approaches to resilience in systems risk management since it opens new possibilities to go beyond focusing on current status, to more development practices (Wamsler, 2014; Torabi et al., 2018). Transformational adaptation is the capacity to move towards new development trajectories.

In general, resilience thinking is associated with system changes and believes that change is not good or bad by itself. However, overshadowing or contradicting these changes would create more susceptibility to damage (Liquan & Junqing, 2016). Transformational change at more minor scales can develop a system's resilience at larger scales. Transformation involves novelty and innovation. The deliberate transformation consists of breaking down the old's resilience and building the resilience of the new (Folke et al., 2010). Transformation involves more remarkable changes in the systems, agents, and institutions.

As discussed earlier and shown in Fig. 3, the urban resilience dimensions, including systems, agents, and institutions, might become more resilient either in general or against a specific disruption, depending on different situations and contexts. The phases of resilience are other vital concepts in urban resilience. These phases start with exploitation, continue with conservation and collapse, and end with the reorganization. As shown in Fig.3, it starts from the beginning and continues after completing the cycle. Moreover, to make a city resilient, we can adopt different resilience approaches, recovery/ coping, adaptation, and transformation, which differ in the scope of actions and the time frame. The recovery/coping approach is more about slighter changes in the shorter term. As we move on to the transformational approach, changes are more fundamental and happen in the longer term. In the first approach, the main emphasis is on keeping the current condition and returning to the normal after a disruption. This approach would not warrant structural transitions, which are essential for the empowerment of urban systems to enter a new regime after a sudden shock or even during chronic changes. Over-reliance on short and mid-term approaches might be in contrast with the nature of resilience thinking, which seeks new opportunities for growth and moving towards new development trajectories. Thus, the more planners and policymakers move towards adopting transformational adaptation based on evolutionary resilience, the more it is likely to achieve the goals of resilience planning, particularly sustainable development.

5. Discussion and Conclusions

As discussed in previous sections, different city planners, policymakers, and researchers can interpret the resilience concept differently according to their specific scope of work or study. These various possible interpretations can be both advantageous and harmful in different ways. One of the main disadvantages of the diverse ideas around urban resilience is that different interpretations can lead to confusion of authorities or communities regarding resilience policies. Since these policies affect communities and determine how they shape their environment to better deal with future uncertainties, the concept should be less vague in terms of the scope and objectives. On the other hand, different interpretations throughout time have led to the evolution of the resilience concept based on different urban contexts' and research fields' needs.

This study considers three major reasons for the multiplicity and ambiguity of concepts related to resilience. One of the main reasons is that the term "resilience" does not convey the idea properly. Another reason relates to the various epistemological orientations of resilience thinking and the contexts in which resilience is conceptualized. Different disciplines have used this concept differently, and each discipline has specific definitions for different areas related to this concept. The third and most important reason behind the ambiguities and multiple interpretations is that resilience thinking has undergone fundamental changes since its inception. The first approaches to resilience are rooted in engineering sciences, which emphasize the time a system returns to a state of stability or equilibrium after a disturbance. While the basis of this thinking in the early years of creation was based on the equilibrium model, in recent years, this thinking is based on the non-equilibrium, multi-equilibrium, or evolutionary model, as according to some scholars, relying solely on a state of stability and returning to the equilibrium often results in maladaptation and would not lead to sustainability.

Following a holistic review of the literature related to resilience knowledge from various researchers' perspectives, the findings showed:

First, various goals have been listed concerning the resilience of urban systems and communities, including resistance, reducing vulnerability, climate change adaptation, and sustainability. What is

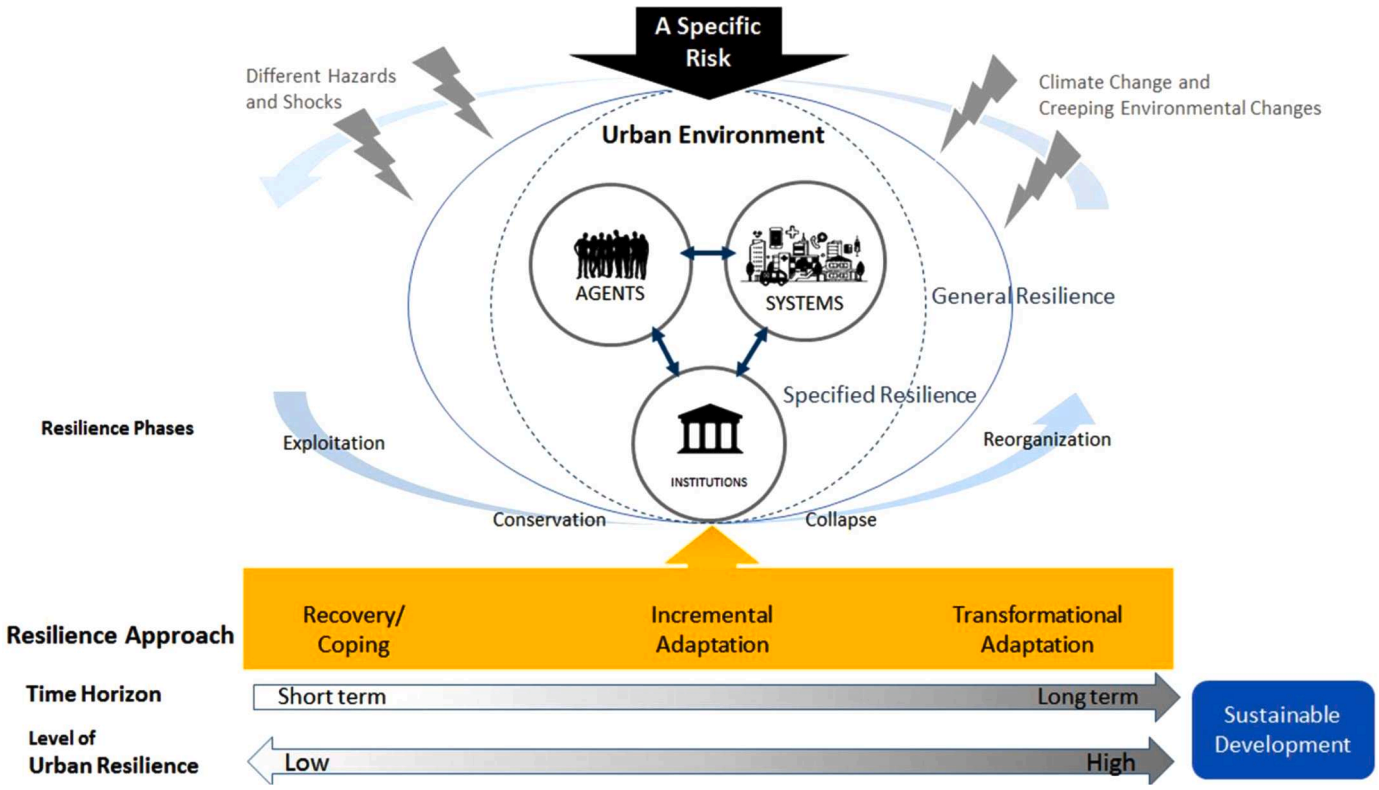

Fig. 3. The conceptual framework of urban resilience- adapted from Torabi et al. (2018).

essential about the resilience-related goals is that resilience is more than simple reversibility. Unlike ecosystems, individuals and communities can critically understand and learn. Due to the learning capability of human agents, it is never possible for a system to return to its previous status after a shock. Even if the structures are similar, people and organizations will probably change. According to evolutionary resilience, the system of human societies has potentially multiple levels of equilibrium (Matyas & Pelling, 2014). Thus, returning to a stable state after a disruption would not be possible.

Moreover, resilience is not placed just on the opposite side of vulnerability. Although overlaps and contradictions exist between these concepts, they are better understood separately. Considering these two concepts as the two sides of a spectrum leads to the sterilization of the concept. Resilience has the potential to provide a systematic and unifying approach to disaster risk management, climate change adaptation, and even humanitarian activities. The ultimate goal of resilience is to achieve sustainability. An urban environment under unsustainable actions may face more adverse hazards. Sustainability and resilience both aim to create urban environments that are high quality and safe to live in overtime. A resilient community should be sustainable to ensure that future generations' needs are met economically, socially, culturally, and environmentally (Saunders & Becker, 2015). However, some believe that it should be seen as a feature of sustainable development, not an alternative (Sudmeier-Rieux, 2014).

Second, due to the type of risk, planning for resilience involves a broad scope, ranging from a specific type of stress to a wide range of disruptions. On the one hand, general resilience is about the overall resilience of a system against all kinds of stresses. On the other hand, specified resilience is referred to issues related to certain aspects of a system against a specific disturbance.

Third, three main components of urban resilience are: "systems", "agents", and "institutions" (Tyler & Moench, 2012). In addition to the importance of these three components, there should be interactions between them for improving urban resilience. Moreover, the role of agents, particularly communities, in strengthening urban resilience should not be neglected.

Forth, urban resilience consists of different phases. It starts with exploitation, follows with conservation, collapse, and eventually reorganization. This process, which is called the adaptive cycle, starts anew after the final phase.

Ultimately, approaches such as recovery or coping avoid the consequences of disasters and return to the status quo ante, but adaptation and transformation approaches accept the possibility of system changes and gradually adapt the system to the post-event situation, accident, or any gradual change or more fundamental changes in the long run so that the system continues to operate and adapt to the existing condition or shift to a new regime. The more we rely on longer-term approaches and implement transformational approaches, the more likely we will strengthen the resilience of cities and urban environments and achieve sustainable development goals.

We believe that the result of this study clarifies some of the conceptual ambiguities associated with urban resilience. It provides a comprehensive conceptual framework for urban resilience, which helps urban resilience principles be easily operationalized in the future. This study can be helpful for planners, researchers, and policymakers to get more acquainted with various concepts when dealing with urban resiliency, leading to a more straightforward path in resilience studies and administrations.

However, since resilience is subjective and is deeply dependent on the context, urban resilience path and vision might differ slightly or entirely in different contexts. Thus, we suggest that more research should be carried out internationally on the localization and conceptualization of the urban resilience conceptual framework based on their different contexts.

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.

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