Evaluating the Applicability of the Stressless City Concept to Urban Resilience

Studia Regionalne i Lokalne
Nr 4(102)/2025

ISSN 1509-4995
E-ISSN 2719-8049
doi: 10.7366/15094995410206

Oliwia Wierucka
University of Lodz, Doctoral School of Social Science; ul. Matejki 22/26,
90-237 Lodz, Poland; e-mail: oliwia.wierucka@edu.uni.lodz.pl; ORCID: 0009-0001-6571-6304

Abstract

Despite the perception of cities as having positive aspects, city living also has negative aspects for individuals and communities. The challenge is to increase the advantages and decrease the disadvantages associated with urban life. Thus, to address this challenge, the article presents the concept of a *stressless city*. To fill the research gap, the urban stress concept regarding resilience was analysed based on existing literature and a pilot study. The research area is typically concentrated on countries or metropolitan cities, leading to a lack of publicly available data at the local level and an incomplete overview of the situation. Moreover, a complementary, systematic approach to evaluating resilience is necessary. To present a complete overview of the situation, an interdisciplinary approach is required, considering the links between psychology, health, and urban sciences. In this case, such studies on stress contribute to the assessment of urban living conditions by identifying factors that pose the greatest challenge to building urban resilience and highlighting the need for greater attention to residents' perspectives.

Keywords

city, stressless city, urban resilience, urban stress

Introduction

Cities are continually transformed by economic, social and spatial processes, responding to contemporary challenges, risks and needs. Since the beginning of the twenty-first century, cities have been the habitat of activity for most people worldwide (United Nations [UN], 2019). They are also intersections between distinct functions, activities and forms of development, the coexistence of which is considered an advantage and a determinant of improved urban living conditions.

However, cities also face civilisation challenges related to the environment (pollution, natural disasters, weather emergencies and climate change), social processes (increasing inequality and migratory movement causing social tension) and economic challenges (crisis vulnerability, decreasing livelihood security and shrinking city budgets). Although perceptions of cities tend to focus on positive aspects (Czepkiewicz & Jankowski, 2015), including personal growth or job opportunities, living in a city has negative aspects for individuals and communities. Thus, the challenge is to increase the advantages while decreasing the disadvantages associated with urban life.

This paper aims to present the concept of a *stressless city* as an approach that could enrich studies on urban resilience. Based on the existing literature and a pilot study on the perception of urban stress conducted in Zduńska Wola, a medium-sized Polish city, this work presents an inquiry conducted on the urban stress concept and its causes and factors.

This paper is organised into four sections. The following section presents the definitional approach to the concepts of *resilience* and *urban stress*, highlighting the interplay between these approaches from the theoretical perspective. In addition, the concept of a *stressless city* is presented. The next section describes the results of a pilot study conducted on perceived urban stress in Zduńska Wola in 2022, noting the research gaps and directions. The final section presents the discussion and conclusion.

Urban Resilience and Stress Factors from the Theoretical Perspective

Recently, various concepts that emphasise a systematic approach to cities have gained popularity. A central feature of these concepts is the increasing tendency to treat cities as complex socio-ecological systems. The necessity of highlighting the interrelationships between the environmental, social, economic, psychological or spatial aspects of the functioning of cities has been emphasised. Such studies reflect the citizens' uncertainty and the current unstable situation in the world, for example, the wars in Ukraine and the Middle East, the global trade war, the COVID-19 pandemic and climate change effects. Urban policies centred on risk assessment and dealing with specific challenges have shifted towards policies that improve the capacity of the urban system in the face of multiple risks (Arup, 2015, after McClymont *et al.*, 2022). Resilience is one of these increasingly important policies, especially given the growing frequency of unexpected political, social, economic, or natural events that cities face.

The first definition of the concept of resilience, from 1824, is provided in *Encyclopaedia Britannica* (Palekiene *et al.*, 2015, p. 180), which defines it as the ability to return to the original state after experiencing damage or stress, referring to the capacity to return to the status quo from challenges and smoothly adapt to difficult circumstances or changes. The term initially covered the response to natural phenomena (e.g., floods, droughts, and earthquakes) or longer-term disasters (e.g., climate change), which Timmerman (1981) highlighted in his framework of resilience.

This approach was later developed in human psychology as the ability to recover from various adversities and was subsequently adopted in other academic disciplines. In ecology, *resilience* means adaptability to environmental changes. In engineering, it refers to the durability and strength of structures. In psychology, resilience is the ability to cope with the effects of personal shocks. In economics, resilience reflects the adaptation of national, regional, and local economies to change. In geography, it indicates the spatial variation of the above aspects (Masik, 2022, pp. 279–280). Thus, various approaches to resilience have been developed (e.g., ecological or economic resilience). Over time, this term came to be employed in a broader, interdisciplinary context, exposing the relationship between natural, social and economic phenomena.

Holling (1973) viewed resilience as the persistence of several types of systems to absorb and cope with change, disturbance and recover from the shocks, popularising the systemic nature of the concept. Although his earliest publications focused on the resilience of ecological systems, he noted the necessity of building and maintaining ecological resilience and the social flexibility to adapt and innovate (Holling, 2001). Alberti *et al.* (2003) used similar rhetoric (the perception of the city as an ecological system), making resilience dependent on ecosystem services and human functions. In addition, Coles and Buckle (2004) described resilience as a community's participation, capacities, skills and knowledge in the recovery process.

Moreover, the United Nations Human Settlements Programme (UN-Habitat, 2018) highlighted the interdisciplinarity of the concept and the role of urban actors within it by defining urban resilience as the measurable capacity of an urban system and its inhabitants to maintain sustainability despite current shocks and stressors, while adapting to these conditions. Although this definition is quite complete, the United Nations Office for Disaster Risk Reduction (2009) emphasises the need for timeliness and efficiency by preserving and restoring basic essential structures and functions.

In contrast, Gilly *et al.* (2014) defined resilience as the ability to respond to critical events external to stakeholders and predict diverse events. The three characteristics of resilience Peng *et al.* (2017) identified are stability, self-recovery ability, and innovation. Moreover, Yamamoto (2011) discussed end-state resilience and resilience potential. The first concept relates to the actual system performance, and the author mentioned the problem of defining it. However, this article is focused on the resilience potential, which Holling (2001) also highlighted.

Based on these definitions, a resilient city should be perceived as a dynamic system that has a compensatory mechanism that can restore the balance on temporal and spatial scales (Borsekova *et al.*, 2018). Although some differences in interpretation exist, and resilience can be considered an outcome, a consequence of actions, or a dynamic process (Sudmeier-Rieux, 2014), several objectives of urban resilience have been widely acknowledged. According to Büyüközkan *et al.* (2022), the primary goals are to adapt to changes caused by negative situations and enable residents to

adapt and live without unexpected stressors. Apart from reacting after unexpected events, the ability to predict and prepare for external and internal stressors is critical (Figure 1).

Figure 1. Resilience potential process

Source: Author's elaboration.

Distinguishing between terms that operate in the context of stress and its experience is valuable. The literature is divided based on the duration of the influence or the predictability of factors or phenomena. For example, McCymont *et al.* (2022) highlighted two contrasting events: stresses (e.g., inequality or poverty) and shocks (e.g., floods). In contrast, Meerow and Newell (2019, p. 318) divided these events into those caused by 'long-term stress' (e.g., climate change) and disruptions (e.g., hurricanes). Figueiredo *et al.* (2018, p. 6) proposed a comprehensive classification, presenting and grading concepts according to their intensity.

1. Risks: the potential or probability of a hazardous event;
2. Hazards: natural or anthropogenic phenomena, events or conditions negatively affecting the community;
3. Shocks: sudden, often unexpected natural or anthropogenic phenomena with a negative influence on the community;
4. Disasters: events involving extensive loss and influence, exceeding the ability of the community to cope;
5. Stresses: longer-term trends that can accumulate, building up and undermining the efficiency of a community or system.

Based on these definitions, three categories of problems exist: 1) unexpected and urgent (shocks and disruptions), 2) long-term stresses and 3) risks, all of which may originate externally or internally to the urban system (Figure 2).

The stressors in the long-term category are defined as 'chronic pressures whose cumulative influences undermine city's capacity for resilience' (UN-Habitat, 2018, p. 18). These stressors interact and collectively affect urban dwellers, threatening their livelihoods and well-being. The variety and strength of their interactions may influence the perception of urban stress. Moreover, urban living and exposure to extreme events and phenomena may also be considered stressful. The results of many studies indicate an increasing problem with mental health, states of depression, and other disorders associated with living in an urban environment. In addition, the literature has highlighted the relationship between the process of urbanisation and the term *urban stress*, which originated as part of the 'population explosion' (Ustinov, 1988, p. 247). Thus, as urbanisation continues, more people are exposed to stress (Hernandez *et al.*, 2020; Pelgrims *et al.*, 2021).

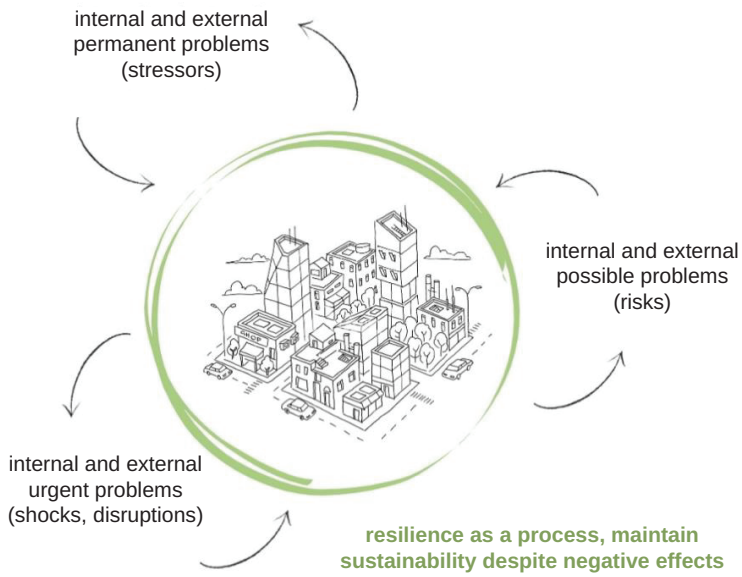

Figure 2. Challenges in building the resilience potential of the city

Source: Author's elaboration.

Glass and Singer first used the term *urban stress* in 1972. 'It is a category of environmental stress conventionally used to describe the large and diverse number of physical and social stimuli faced by an inhabitant of a modern large city' (Bańka, 2002, p. 222). The European Environment Agency (2025) defined urban stress as a 'state of bodily or mental tension developed through city living, or the physical, chemical, or emotional factors that give rise to that tension'. In contrast, Hernandez *et al.* (2020) referred to urban stress as the tension associated with living in an urban environment. Hence, urban stress is caused by adverse conditions, representing a real or perceived threat, which threatens the body's balance and is associated with human existence in the city. The phrase *urban stress* is also included in strategic documents (e.g., the 2030 National Environmental Policy and New Leipzig Charter). The second document also draws attention to the problem of resilience, presenting cities and urban systems as places requiring 'flexibility as well as the ability to respond to external disruptive events and chronic stress' (New Leipzig Charter, 2020).

Based on the available literature, a list of factors that may influence the perception of urban stress among urban dwellers was developed. These factors were divided into three categories: related to the environmental quality, social conditions and physical urban structure. However, identifying individual factors is challenging because they are interrelated and can be perceived multidimensionally.

The most dangerous and commonly analysed stressor in the urban environment is noise. Bańka (2002) emphasised that noise requires people to put forth extra effort via internal soundproofing, which has a psychological cost. As indicated, 'noise pollution, vehicle traffic, and crowdedness were the most important factors of stress among the users of space' (Sadeghpoor *et al.*, 2024, p. 243). Moreover, according to Burton (1990), noise can lead to collective social reactions that intensify or create other environmental stressors.

Another environmental factor with a proven influence on the experience of urban stress is pollution. Air pollution can activate the brain, releasing stress hormones as part of a stress response (Thomson, 2019). Polluted air is also 'associated with behavioral determinants of mental health such as spending less time outdoors, reduced physical activity and contact with nature' (Pelgrims *et al.*, 2021, p. 2), demonstrating the complexity and crossover of stressors in the city. This fact is critical because 'almost all of the global population (99%) breathe air that exceeds WHO guideline limits' (World Health Organization [WHO], 2025), and the fear of disease caused by pollution can also be stressful.

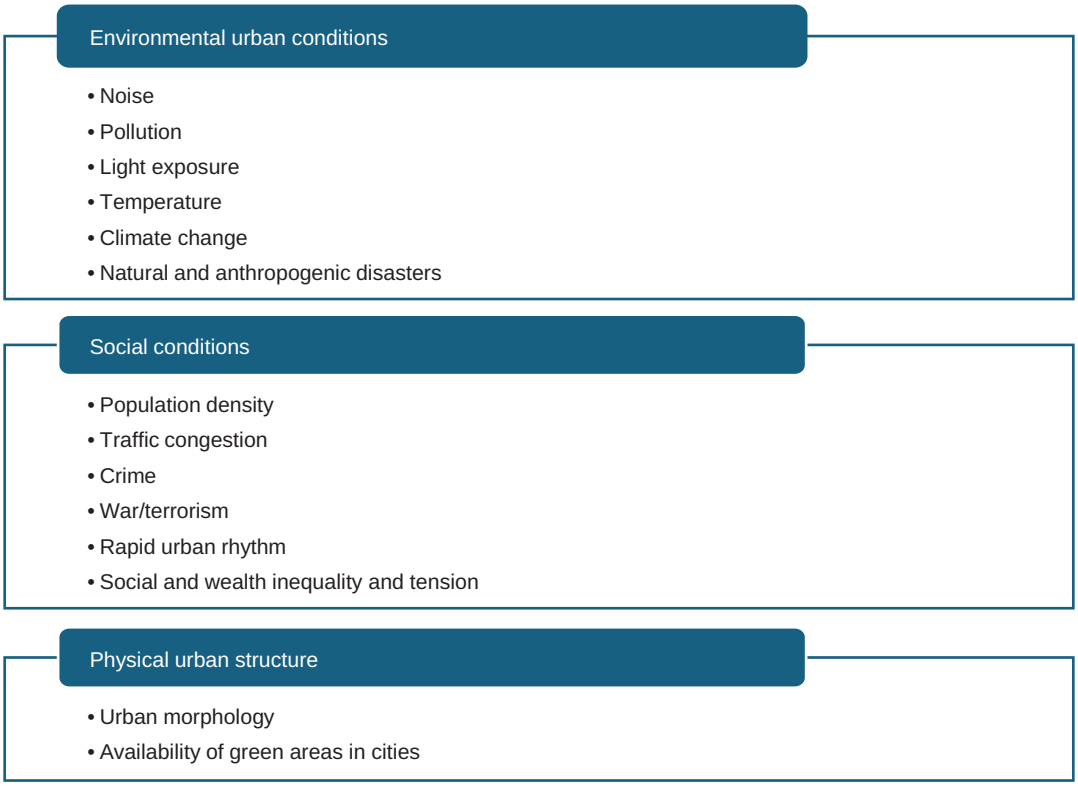

Figure 3. Urban stress factors

Source: Author's elaboration based on work by Bańka (2002), Greene *et al*. (2004), Gehl (2013) & Montgomery (2015).

Another environmental stressor is light exposure: the deficiency of natural light and excessive artificial lighting. As noted in the literature, 'an excess of light stimuli in the environment induces light stress' (Janosik, 2015).

Although Burton (1990), Roe *et al.* (2020) and Pelgrims *et al.* (2021) did not consider temperature, evidence indicates that exposure to temperatures that are too low or too high can cause stress (Arifwidodo & Chandrasiri, 2020; Marszałek, 2009). Moreover, the temperature can be intensified by the urban heat island in city centres.

The last factor is natural disasters resulting directly or indirectly from climate change, which is stressful, and cities are facing such disasters with increasing frequency. This interpretation leads to the conclusion that shocks and disruptions are also stressors. Furthermore, victims of a natural disaster are more prone to stress symptoms, and the lasting effects of such situations include post-traumatic stress (Greene *et al.*, 2004).

In the next category, social factors emerge. The first stressor is population density and congestion, defined as 'a mental state characterised by stress' (Greene *et al.*, 2004, 399). Large urban units are places of crime, making this another crucial stressor. *The Sage Dictionary of Criminology* (McLaughlin & Muncie, 2003) mentions the presence of the fear of crime, which is a rational or irrational state of tension and stress.

The definition of urban stress adopted in the article constitutes a real or perceived threat. Relative to the 2022 study, wars and terrorism have been added to this category, which are significant stressors that meet the criteria of trauma (Vargová *et al.*, 2024). Individualistic cultures (focused on personal success and achievement and competition between individuals) experience the stressful atmosphere of the pace of life, the rapid urban rhythm (especially in huge cities). Garhammer (2002) noted the correlation between the fast pace of life (including time pressure in work life) and higher stress levels.

Urban stress is often linked to existing inequalities, discrimination, and intolerance. Social tensions are particularly pronounced in cities, where diverse social groups coexist and interact. While these tensions can exacerbate stress, they also reveal how social differentiation and inequalities

shape individuals' experiences of it. Numerous studies have revealed that the following populations are more vulnerable to stress: women (Roe *et al.*, 2020), persons with innate sensitivity to stimuli, such as those with autism spectrum disorder (Bishop-Fitzpatrick *et al.*, 2015) and those with low income (Brondolo *et al.*, 2017).

The last group of characterised stressors are connected to the physiognomy and morphology of a city. The first factor is urban building morphology. Pelgrims *et al.* (2021, p. 5) employed the same category with two indicators to measure stress: the street corridor effect and street canyon effect. Research conducted in 2022 highlighted the lack of spatial regularity and lack of human scale in the city, identifying three elements: the social field of vision, size of the central angle, and four-story limit. These aspects involve a lack of proportion and chaos in space that can cause information overload, a sense of confusion or orientation problems, frequently leading to stress and anxiety. Alexander (2008) observed that substantial evidence suggests that skyscrapers may have adverse effects on mental health. The second factor, green areas, has a unique function. Although numerous studies have demonstrated the effect of green spaces on reducing perceived stress levels (Elsamahy & El-Fattah, 2018; Roe *et al.*, 2020; Li & Lange, 2023), green spaces can also reduce other stressors, suggesting that green spaces could be the foundation for building resilience to stress.

Based on the literature, this work proposes a definition of a *stressless city*. This concept is understood as a model of a stress-resistant city, placing people and their well-being at the centre, and comprising three sectors:

1. *Stressless public spaces* are based on green, compact city principles. These spaces emphasise the importance of greenery, the sustainable use of space, and the close proximity to the most important necessities and services (e.g., education, healthcare, work, and green areas) in a city, which is designed to protect people from urban stressors (Gehl, 2014).
2. *A stressless society* refers to community resilience, understood as individuals' perceptions of the ability of their communities to cope with stressors (Kimhi & Shamai, 2004), requiring solidarity in society, an awareness of the stressors and collective methods of handling them.
3. *Stressless management* is based on the definition of resilience (Büyüközkan *et al.*, 2022) and is focused on the ability of urban-response and crisis management systems to anticipate and prevent stressors, quickly return to a balanced state, and adapt to new conditions generated by stressors.

Moreover, similarly to perceiving resilience as a dynamic capacity (Holling, 1973; Yamamoto, 2011), the concept of a *stressless city* refers to a line of action for cities rather than a point to be achieved. Therefore, implementing a *stressless city* is understood as a process involving numerous actors and various activities.

The differences in how stressors are perceived and their strengths and influence indicate an urgent need for research in this area. The next section presents the pilot studies that requires further development in the future.

Perceived Urban Stress: A Pilot Study of a Medium-sized Polish City

This work presents a survey of the residents of a medium-sized Polish city to identify which stress factors from earlier studies and theoretical work are identified by urban dwellers and to answer whether and to what extent these factors influence urban resilience. Zduńska Wola was chosen as the research area for the following reasons:

1. Zduńska Wola was listed among the top 50 most-polluted cities in Europe in 2018 (Unearthed, Greenpeace, 2018). According to Polish Smog Alert,[1] the city was in the top 10 Polish cities in 2022 with the most days exceeding daily particulate matter $(PM)_{10}$ level standards and was in the top 10 in 2023 and in 2024 with the highest annual PM_{10} dust concentration in Poland.
2. The city is exposed to natural hazards connected with climate change (i.e. decreasing river flows, unstable and rapid rainfall resulting in flooding in the city, and heat waves). Similar to the

[1] Polish Smog Alert is an anti-smog social movement bringing together local citizen initiatives to improve air quality at local and national levels [https://polskialarmsmogowy.pl/].

Łódzkie region, this city is exposed to drought (Urban Climate Change Adaptation Plan for the City of Zduńska Wola). As indicated, the area is characterised by poor air quality. Two months before the survey, residents were notified of the risk of exceeding the 24-h average limit level of PM_{10} in the air (Warnings for Zduńska Wola, zdunskawola.pl).

3. The municipality of Zduńska Wola is involved in emission reduction and education and won the Innovative Local Government competition in 2022 in the urban municipalities category, which was organised by the Polish Press Agency.
4. Of the 1013 Polish cities (as of 1 January 2024), 37 have a population of at least 100,000 (about 28% of the Polish population, 10 million people). However, Poland has many medium-sized cities. In 2024, 348 cities had between 10,000 and 100,000 inhabitants, housing 25% of the population (about 9.5 million people; Statistics Poland, 2024). Therefore, researching urban stress in the context of resilience in such cities is justifiable, and this work conducts a pilot study in one of these cities.
5. Zduńska Wola is a medium-sized city with a reputation as a small, green bedroom community for the voivodeship of Lodz. The city lies within the influence of a larger city but takes advantage of this close proximity while building a reputation as a city free from the stressors (e.g., rapid urban rhythm or traffic jams) that are characteristic of large cities.

The research method employed a questionnaire survey, conducted between 22 April and 6 May 2022, collecting 276 surveys. The study of the inhabitants and public space users of Zduńska Wola covered all three areas of stress factors. The sampling was nonprobabilistic, based on availability. The snowball method and social media were applied to reach a group that met the research criteria. Moreover, 75% of the respondents lived in the city, and the others were urban users who commuted to work or school. More respondents were women (66%), corresponding to the population structure in the city (women represent 53% of the city's population). The largest age groups of respondents were ages 20 to 35 (98 people) and ages 33 to 55 (75 people). According to the Central Statistical Office, the average age of a city resident is 45 years old. The largest group of respondents has a higher education, and 41% of those who declared a per capita net household income were at more than 3,000 PLN.[2]

Respondents were asked, 'To what extent do the following factors influence the occurrence and perception of urban stress in Zduńska Wola?' and were asked to rate stressors on a Likert scale of 1 to 5. A limitation of this research method is asking leading questions, which can lead respondents to focus on urban stress, influencing the answers. This focus affects the data reliability, particularly in the context of the methodological difficulties associated with the precise study and operationalisation of the urban stress phenomenon. Due to these limitations and the limited number of participants, the survey should be considered a pilot and a basis for further analysis.

Among the stressors related to the quality of the city environment (first group of stress factors), pollution is the most stressful. Almost 80% of respondents indicated that this factor stresses them in Zduńska Wola. Most respondents (79%) noted the noise, which was a very stressful factor for only a small number of them. However, this reveals that urban space users are aware of urban phenomena. Most respondents indicated that natural disasters do not occur in this city and, therefore, are not perceived as stressful.

Regarding social stressors, more than half of the respondents indicated experiencing considerable work and responsibilities (63% of respondents). Another important aspect is social inequality and discrimination, which more than 40% of respondents found stressful. Around 50% of those surveyed point to congestion and the fast pace of city life, but these factors are only stressful or 'rather stressful' for around 25% of the total surveyed, and 33% of respondents did not consider them stressful.

In the last category, related to the physical urban structure, the most frequently indicated stressors were the state of the road infrastructure (e.g., the state of pavement and roads (62%) and the neglected, degraded spaces (52%)). Zduńska Wola has few high-rise buildings; thus, the stress of high-rise buildings does not occur or is not perceived by respondents (63%). Moreover, only 14% of respondents perceived living on the fourth floor or higher as stressful.

[2] The income question was not mandatory. Of the respondents, 196 (71%) completed this question.

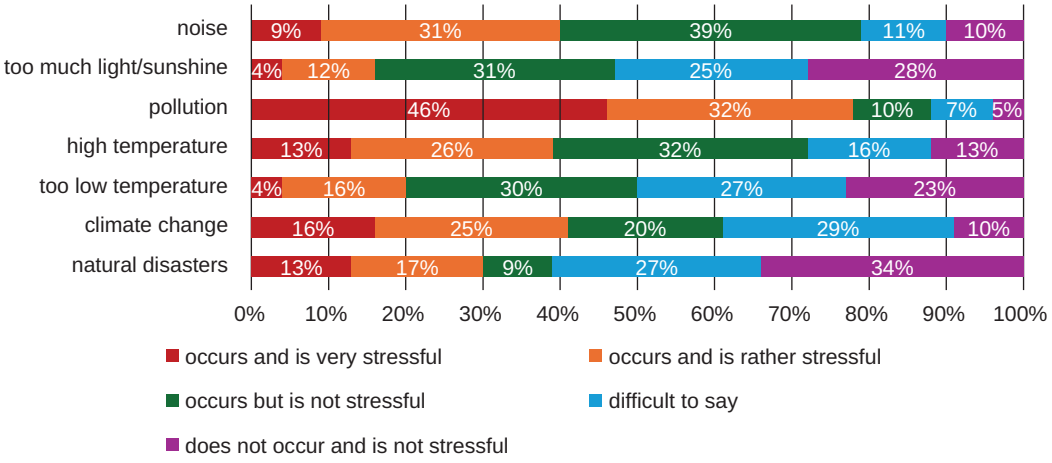

Figure 4. Perception of urban stressors related to environmental urban conditions in the pilot study

Source: Author's elaboration, Urban stress. A case study of Zduńska Wola.

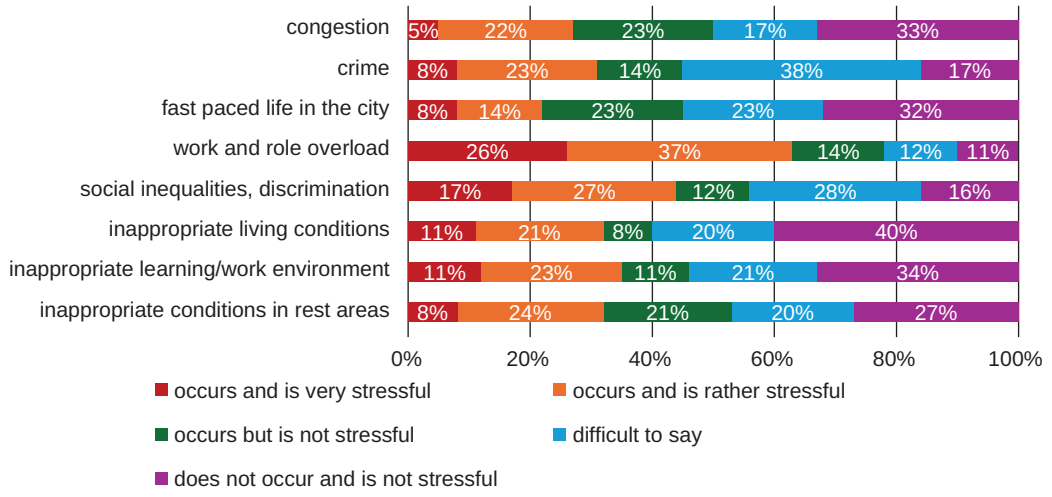

Figure 5. Perception of urban stressors related to social conditions

Source: Author's elaboration, Urban stress. A case study of Zduńska Wola.

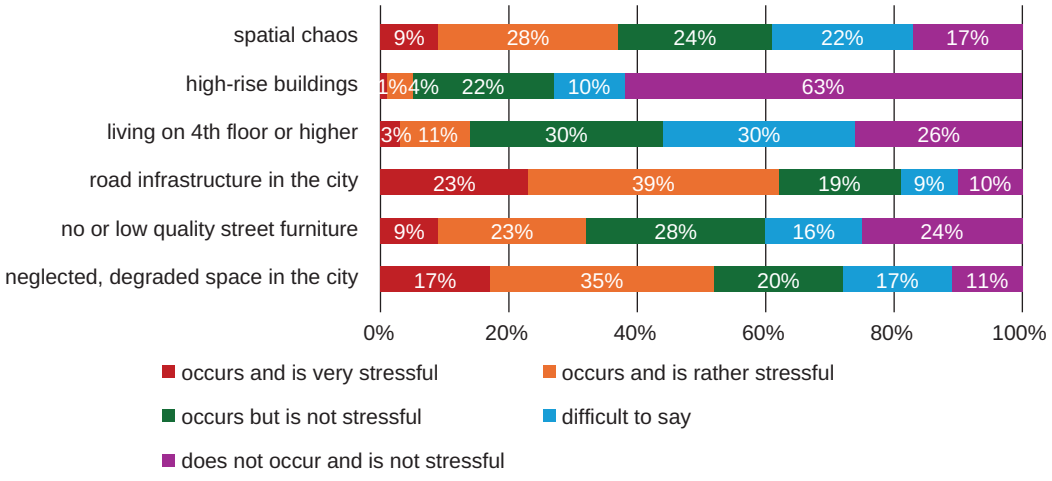

Figure 6. Perception of urban stressors related to physical urban structure

Source: Author's elaboration, Urban stress. A case study of Zduńska Wola.

Respondents were asked about the least stressful places conducive to relaxation in Zduńska Wola. They indicated Paprocki Forest, the area by the Kępina retention reservoir, and the city park, the largest green complexes in the city. In contrast, the most stressful places causing tension in the opinion of respondents were related to the road infrastructure. In particular, they pointed to the two busiest streets in the city, Łaska Street and Łódzka Street, which are characterised by a high accumulation of stressors, including pollution, noise, and congestion.

The study examines the relationships between demographic characteristics, subjective health assessment, net income/person in the respondent's households, place of residence, and stressor perceptions. For values of $p > 0.05$, the H_0 hypothesis was accepted (i.e. no relationship exists between stressor characteristics and perceptions). For values of $p \leq 0.05$, the H_0 hypothesis was rejected, and the H_1 hypothesis was accepted (i.e. a relationship exists between stressor characteristics and perceptions). Tables 1 to 3 present the results of the chi-square tests.

Table 1. Perception of stressors related to the natural environment and its condition

	Gender	Age	Education	Income	Subjective health assessment	Place of residence
Noise	0.400	**<0.001**	**0.002**	0.276	0.359	0.312
Too much light/sunshine	0.884	0.662	0.949	0.891	0.169	0.355
Pollution	**0.033**	**0.003**	**<0.001**	0.576	0.648	0.325
High temperature	0.805	0.376	0.090	0.988	0.858	0.637
Low temperature	0.857	0.711	0.066	0.323	0.251	0.975
Climate change	0.230	0.464	0.448	0.727	0.758	0.846
Natural disasters	0.051	0.541	0.237	0.878	0.710	0.667

Source: Author's elaboration, Urban stress. A case study of Zduńska Wola.

Table 2. Perception of urban stressors related to social conditions

	Gender	Age	Education	Income	Subjective health assessment	Place of residence
Congestion	0.093	0.362	0.363	0.179	**0.015**	0.867
Crime	0.051	0.123	**0.028**	0.281	0.044	0.245
Fast-paced life in the city	0.355	**0.003**	0.094	**0.007**	0.097	0.147
Work and role overload	0.093	**0.001**	0.191	0.734	0.269	0.738
Social inequality, discrimination	**0.002**	0.135	0.586	0.630	0.225	0.401
Inappropriate living conditions	0.059	0.871	0.350	0.545	0.069	**0.003**
Inappropriate learning/work environment	**0.012**	**0.010**	**0.012**	0.160	**0.003**	0.810
Inappropriate conditions in rest areas	**0.020**	0.551	0.815	0.711	**0.002**	0.382

Source: Author's elaboration, Urban stress. A case study of Zduńska Wola.

The chi-square analysis reveals that the perception of stressors (e.g., noise, pollution, congestion and others marked in the table) is often determined by sociodemographic characteristics. Women are more vulnerable to stress, as confirmed by studies (Matud, 2004; Roe *et al.*, 2020; Sinclair *et al.*, 2024). For stressors related to temperature, climate change, natural disasters or spatial chaos, the study revealed no correlation with the analysed characteristics of the respondents.

Table 3. Perception of urban stressors related to physical urban structure

	Gender	Age	Education	Income	Subjective health assessment	Place of residence
Spatial chaos	0.522	0.770	0.295	0.873	0.306	0.135
High-rise buildings	0.425	0.179	0.261	**<0.001**	**<0.001**	0.486
Living on the fourth floor or higher	0.970	**0.032**	0.200	0.174	0.128	0.140
Road infrastructure in the city	0.910	0.726	0.568	0.654	**0.014**	0.151
No or low-quality street furniture	0.171	**0.025**	0.902	0.420	0.870	0.576
Neglected, degraded spaces	0.327	0.090	0.545	0.256	0.797	**0.008**

Source: Author's elaboration, Urban stress. A case study of Zduńska Wola.

The study indicated that, although various stressors are present in urban dwellers' daily lives, only some were identified as primary sources of stress. This finding indicates a certain resilience to stress and the possibility of adjusting to demanding situations that have become part of everyday city life. The results may reflect individual adaptation mechanisms to urban life, developed in response to predictable and relatively constant features of the urban environment. In contrast, structural and functional characteristics of a medium-sized city may be influential, which may make residents perceive life in cities of this scale as less stressful. Due to the diverse perception of stressors (based on age, gender, social and economic factors), residents employ diverse strategies (i.e. acceptance, escape or action for change). In this context, managing these processes becomes crucial, including the role of an efficient local government.

Discussion and Conclusion

Increasingly, researchers have addressed the topic of urban resilience and its measurement (Yang *et al.*, 2021). However, a review of the results indicates some gaps. First, existing publications are concentrated on theoretical frameworks (Meerow & Newell, 2019) and conceptual attempts (Suárez *et al.*, 2016; Gharai *et al.*, 2018; Büyüközkan *et al.*, 2022), whereas empirical or experimental research is still in the early stages. The lack of publicly available data at the local level (WHO, 2022) is also problematic, making comparative research more challenging. The research area is commonly concentrated at the country level or in metropolitan cities (Rockefeller Foundation, 2016). This limited sensitivity to the lower territorial levels and the lack of balance between the number of large-scale versus local studies lead to an unclear, incomplete overview of the situation.

The next aspect is the shortage of a complementary, systematic approach to evaluating resilience. To present a complete picture of a situation, an interdisciplinary approach is required, considering the links between psychology, social and health sciences, for instance. The literature indicates the problem of using measurable, easily available data to construct resilience indicators, despite the awareness of other aspects that are potentially more important but more difficult to capture (Carpenter *et al.*, 2009). Further, most studies have focused on individual disasters or shocks (Büyüközkan *et al.*, 2022). Moreover, references to ecosystems and biodiversity are largely missing (WHO, 2022).

Some studies have also highlighted that the topic of urban resilience does not reach the wider public (de Vries, 2020; Sokołowicz, 2020). Therefore, the discussion of the problem is limited to a narrow circle of experts, reducing the effectiveness of instruments to strengthen it. Researchers have recognised the deficiency of practical approaches, although several urban resilience frameworks have been developed. Research has focused on defining the concept and its features rather than on determining how to implement policies that promote resilience (Büyüközkan *et al.*, 2022; Angheloiu & Tennant, 2024).

Finally, in resilience studies, references to the problem of urban stress are rare. For example, one of the more comprehensive indices, the City Resilience Index (Rockefeller Foundation, 2016), comprises 52 indicators responding to 12 targets of four dimensions, but the 'health and well-being dimension' does not include urban stress. The research deficiency is noticeable in Polish cities, where only one project on urban stress in the context of urban resilience (a stress-resilient city) was identified. Its aim was to develop a model of a pandemic stress-resilient city based on the experience of COVID-19 (Wdowicka *et al.*, 2024). However, the study considered only three cities in the Wielkopolskie Voivodeship, and only in terms of one threat, the pandemic. Moreover, due to its significant influence on the well-being and functioning of city dwellers, urban stress should be considered a crucial element of resilience. Thus, this paper presents a conceptual proposal of linking these problems by proposing a definition of urban stress.

The pilot study in Zduńska Wola reflects the situation of many (especially medium-sized) cities in Poland, illustrating the problems they face. The study offers a potential method of researching urban stress in other cities, rather than just the largest cities. A medium-sized city is an interesting research area, and the study results could have a true influence on the building and management of a city's resilience. The study focuses on internal stressors; thus, residents can determine the most urgent, most stressful elements of urban life (e.g., air pollution, noise or the state of the road and pavement infrastructure). Based on the respondents' answers and the assessment of individual stressors, urban stress is a significant phenomenon that requires decisive actions to prevent it.

This study draws attention to factors that could mitigate or prevent urban stress, which is crucial in building urban resilience to stress. To illustrate, special attention should be focused on the greening of the city because these places cause the least stress and allow relaxation. The types of stressors may depend on the character of the city (e.g., air pollution is likely stronger in post-industrial, traffic-dense cities) and the sociodemographic characteristics of the residents, which should be considered and require further research.

Anthropogenic disasters, wars, and terrorism were not included in this study. However, these critical factors can cause stress and should be included in future studies. More emphasis was placed on the place of work, study and rest and their conditions, which are more related to the interior of a building rather than the city space. This study focuses on the psychosocial aspects of perceived urban stress, with less consideration of the economic dimension of residents' functioning. For example, information on the respondents' livelihoods, work situations or spatial mobility (i.e. whether they work in the city or commute to other locations) was not included. These factors affect the daily experience of the urban environment and the overall perception of quality of life. This finding also provides a crucial direction for future analyses. Including an economic aspect with the data could allow for a broader understanding of the complexity of the relationship between the urban environment and the experienced stress, and it could capture potential variations between occupational or migrant groups in the city.

Due to its assessment of a single city, this study cannot be applied to the general population. Thus, comparative studies should be conducted on the subject in both smaller and larger cities. This framework may capture a more complex picture of resilience, including the missing aspect of urban stress. The necessity of returning to Zduńska Wola and repeating the study is also noted because it was conducted only once in 2022, providing a point-by-point idea.

With these considerations, the development of a *stressless city* has a potentially high value, which, in line with the urban resilience problem, can be developed by focusing on reducing the phenomenon of urban stress. The concept of a *stressless city* is still evolving and is centred on defined stressors. This concept is a response to the challenge of shaping urban resilience, focusing on minimising urban stress and preventing it from occurring in residents and urban space users. The concept is based on a measure of how the public feels about certain factors, not just their awareness of them. Residents can be aware of the presence of various stressors (e.g., air pollution) but not stressed about it. Urban policies should be focused on eliminating or reducing city stressors and should consider the needs and well-being of stakeholders.

The highlighted research directions on urban stressors and the influence of urban spaces on residents' stress and health offer a promising perspective for future scientific work in this area. However, this study offers the first definition of urban stress and requires further research. Such

inquiries may foster a better understanding of the mechanisms affecting urban resilience and the development of more precise tools to support mental health in the urban context.

The interpretation and perception of urban stress, as demonstrated, is diverse. Researchers and local authorities should constantly monitor living conditions in cities, especially those indicated by residents. Studies focused on stress can make principal contributions to the assessment of urban living conditions and identify factors that pose the greatest challenge to building urban resilience.

References

Alberti, M., Marzluff, J. M., Shulenberger, E., Bradley, G., Ryan, C., & Zumbrunnen, C. (2003). Integrating humans into ecology: Opportunities and challenges for studying urban ecosystems. *BioScience*, *53*(12), 1169–1179.

Alexander, C. (2008) *Język wzorców*. Gdańskie Wydawnictwo Psychologiczne.

Angheloiu, C., & Tennant, M. (2024). Mind the gap: Defining urban resilience knowledge-implementation gaps. *Journal of City Climate Policy and Economy*, *2*(3), 316–358. https://doi.org/10.3138/jccpe-2023-0013

Arifwidodo, S. D., & Chandrasiri, O. (2020). Urban heat stress and human health in Bangkok, Thailand. *Environmental Research*, *185*, 109398. https://doi.org/10.1016/j.envres.2020.109398

Bańka, A. (2002). *Społeczna psychologia środowiskowa*. Wydawnictwo Naukowe Scholar.

Bishop-Fitzpatrick, L., Mazefsky, C. A., Minshew, N. J., & Eack, S. M. (2015). The relationship between stress and social functioning in adults with autism spectrum disorder and without intellectual disability. *Autism Research*, *8*(2), 164–173. https://doi.org/10.1002/aur.1433

Borsekova, K., Nijkamp, P., & Guevara, P. (2018). Urban resilience patterns after an external shock: An exploratory study. *International Journal of Disaster Risk Reduction*, *31*, 381– 392. https://doi.org/10.1016/j.ijdrr.2018.05.012

Brondolo, E., Byer, K., Gianaros, P. J., Liu, C., Prather, A. A., Thomas, K., & Woods-Giscombé, C. L. (2017). *Stress and health disparities: Contexts, mechanisms, and interventions among racial/ethnic minority and low socioeconomic status populations*. American Psychological Association. Available at: http://www.apa.org/pi/health-disparities/resources/stress-report.aspx

Burton, I. (1990). Factors in urban stress. *The Journal of Sociology & Social Welfare*, *17*(1), 79–92.

Büyüközkan, G., Ilıcak, Ö., & Feyzioğlu, O. (2022). A review of urban resilience literature. *Sustainable Cities and Society*, *77*, 103579. https://doi.org/10.1016/j.scs.2021.103579

Carpenter, S. R., Folke, C., Scheffer, M., & Westley, F. (2009). Resilience: Accounting for the noncomputable. *Ecology and Society*, *14*(1), 13. https://www.jstor.org/stable/26268046

Coles, E., & Buckle, P. (2004). Developing community resilience as a foundation for effective disaster recovery. *The Australian Journal of Emergency Management*, *19*(4), 6–15. https://search.informit.org/doi/10.3316/informit.375435145094637

Czepkiewicz, M., & Jankowski, P. (2015). Analizy przestrzenne w badaniach nad jakością życia w miastach. *Ruch Prawniczy, Ekonomiczny i Socjologiczny*, *77*(1), 101–117. https://doi.org/10.14746/rpeis.2015.77.1.6

Encyclopaedia Britannica (2013). Ecological resilience. Available at: https://www.britannica.com/science/ecological-resilience

Elsamahy, E., & El-Fattah, R. (2018). Designing non-stressed psychological public spaces. *BAU Journal – Health and Wellbeing*, *1*(3), 11.

European Environment Agency (2018). Urban stress. Available at: https://www.eea.europa.eu/help/glossary/gemet-environmental-thesaurus/urban-stress

Figueiredo, L., Honiden, T., & Schumann, A. (2018). *Indicators for resilient cities* (OECD Regional Development Working Papers No. 2018/02). OECD. https://doi.org/10.1787/6f1f6065-en

Garhammer, M. (2002). Pace of life and enjoyment of life. *Journal of Happiness Studies*, *3*(3), 217–256.

Gehl, J. (2013). *Życie między budynkami*. Wydawnictwo Ram.

Gehl, J. (2014). *Miasta dla ludzi.* Wydawnictwo Ram.

Gharai, F., Masnavi, M. R., & Hajibandeh, M. (2018). Urban local-spatial resilience: Developing the key indicators and measures, a brief review of literature. *Bagh-e Nazar*, *14*(57), 19–32.

Gilly, J. P., Kechidi, M., & Talbot, D. (2014). Resilience of organisations and territories: The role of pivot firms. *European Management Journal*, *32*(4), 596–602. https://doi.org/10.1016/j.emj.2013.09.004

Greene, T. C., Baum, A., Bell, P. A., & Fisher, J. D. (2004). *Psychologia środowiskowa*. GWP.

Hernandez, D. C., Daundasekara, S. S., Zvolensky, M. J., Reitzel, L. R., Maria, D. S., Alexander, A. C., Kendzor, D. C., & Businelle, M. S. (2020). Urban stress indirectly influences psychological symptoms through its association with distress tolerance and perceived social support among adults experiencing homelessness. *International Journal of Environmental Research and Public Health*, *17*(15), 5301. https://doi.org/10.3390/ijerph17155301

Holling, C. S. (1973). Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics*, *4*, 1–23.

Holling, C. S. (2001). Understanding the Complexity of Economic, Ecological, and Social Systems. *Ecosystems*, *4*(5), 390–405. https://doi.org/10.1007/s10021-001-0101-5.

Janosik, E. (2015). Pozytywne i negatywne aspekty oddziaływania światła na człowieka. *Kosmos. Problemy Nauk Biologicznych*, *64*(4), 617–623.

Kimhi, S., & Shamai, M. (2004). Community resilience and the impact of stress: Adult response to Israel's withdrawal from Lebanon. *Journal of Community Psychology*, *32*(4), 439–451. https://doi.org/10.1002/jcop.20012

Li, L., & Lange, W. K. (2023). Assessing the relationship between urban blue-green infrastructure and stress resilience in real settings: A systematic review. *Sustainability*, *15*, 9240–9268.

Marszałek, A. (2009). Wpływ zimnego środowiska na organizm człowieka. *Bezpieczeństwo Pracy. Nauka i praktyka*, (1), 10–12.

Masik, G. (2022). Koncepcja odporności: definicje, interpretacje, podejścia badawcze oraz szkoły myśli. *Przegląd Geograficzny*, *94*(3), 279–305. https://doi.org/10.7163/PrzG.2022.3.1

Matud, M. P. (2004). Gender differences in stress and coping styles. *Personality and Individual Differences*, *37*(7), 1401–1415. https://doi.org/10.1016/j.paid.2004.01.010

McClymont, K., Bedinger, M., Beevers, L., Visser-Quinn, A., & Walker, G. H. (2022). Understanding urban resilience with the urban systems abstraction hierarchy (USAH). *Sustainable Cities and Society*, *80*, 103729. https://doi.org/10.1016/j.scs.2022.103729

McLaughlin, E., & Muncie, J. (Eds.) (2003). *The Sage Dictionary of Criminology*. Sage.

Meerow, S., & Newell, J. P. (2019). Urban resilience for whom, what, when, where, and why? *Urban Geography*, *40*(3), 309–329. https://doi.org/10.1080/02723638.2016.1206395

Montgomery, C. (2015). *Miasto szczęśliwe. Jak zmienić nasze życie, zmieniając nasze miasta*. Wydawnictwo Wysoki Zamek.

The New Leipzig Charter (2020). The New Leipzig Charter. The transformative power of cities for the common good. Adopted at the Informal Ministerial Meeting on Urban Matters on 30 November 2020. Available at: https://urbact.eu/sites/default/files/2023-05/new_leipzig_charter_final.pdf

Palekiene, O., Simanaviciene, Z., & Bruneckiene, J. (2015). The application of resilience concept in the regional development context. *Procedia – Social and Behavioral Sciences, 213*, 179–184. https://doi.org/10.1016/j.sbspro.2015.11.423

Pelgrims, I., Devleesschauwer, B., Guyot, M., Keune, H., Nawrot, T. S., Remmen, R., Saenen, N. D., Trabelsi, S., Thomas, I., Aerts, R., & De Clercq, E. M. (2021). Association between urban environment and mental health in Brussels, Belgium. *BMC Public Health*, *21*(1), 635. https://doi.org/10.1186/s12889-021-10557-7

Peng, C., Yuan, M., Gu, Ch., Peng, Z., & Ming, T. (2017). A review of the theory and practice of regional resilience. *Sustainable Cities and Society*, *29*, 86–96. https://doi.org/10.1016/j.scs.2016.12.003

Rockefeller Foundation (2016). *Measuring City Resilience*. ARUP.

Roe, J., Mondschein, A., Neale, Ch., Barners, L., Boukhechba, M., & Lopez, S. (2020). The Urban Built Environment, Walking and Mental Health Outcomes Among Older Adults: A Pilot Study. *Frontiers in Public Health*, 8, 575946. https://doi.org/10.3389/fpubh.2020.575946

Sadeghpoor, F., Ranjbar, E., Esmaeilinasab, M., Valiloo, M. H. S., & Nieuwenhuijsen, M. J. (2024). Streets and stress: A pilot study on how quality and design of streets impacts on urban stress. *HERD: Health Environments Research & Design Journal*, *17*(1), 224–248. https://doi.org/10.1177/19375867231200584

Sinclair, R. R., Graham, B., A., & Probst, T. M. (2024). Economic Stress and Occupational Health. *Annual Review of Organizational Psychology and Organizational Behavior*, *11*, 423–451.

Sokołowicz, M. E. (2020). Siła przekonywania – wykorzystanie ekonomii behawioralnej i architektury wyboru w działaniach na rzecz ochrony środowiska w samorządach. *Przegląd Geograficzny*, *92*(4), 569–589. https://doi.org/10.7163/PrzG.2020.4.6

Statistics Poland (2024). *Powierzchnia i ludność w przekroju terytorialnym w 2024 roku*. Główny Urząd Statystyczny. Available at: https://stat.gov.pl/obszary-tematyczne/ludnosc/ludnosc/powierzchnia-i-ludnosc-w-przekroju-terytorialnym-w-2024-roku,7,21.html

Suárez, M., Gómez-Baggethun, M., Benayas, J., & Tilbury, D. (2016). Towards an urban resilience index: A case study in 50 Spanish cities. *Sustainability*, *8*(8), 774. https://doi.org/10.3390/su8080774

Sudmeier-Rieux, K. I. (2014). Resilience – An emerging paradigm of danger or of hope? *Disaster Prevention and Management*, *23*(1), 67–80. https://doi.org/10.1108/DPM-12-2012-0143

Thomson, E. M. (2019). Air pollution, stress, and allostatic load: Linking systemic and central nervous system impacts. *Journal of Alzheimer's Disease*, *69*(3), 597–614. https://doi.org/10.3233/JAD-190015

Timmerman, P. (1981). *Vulnerability, Resilience and the Collapse of Society*. *A Review of Models and Possible Climatic Applications*. Institute for Environmental Studies

UMZDW (2025). *Miejski Plan Adaptacji do zmian klimatu dla Miasta Zduńska Wola*. Available at: https://zdunskawola.pl/dla-mieszkancow/miejski-plan-adaptacji-do-zmian-klimatu/miejski-plan-adaptacji-do-zmian-klimatu-dla-miasta-zdunska-wola/

UMZDW (2022). Ostrzeżenia dla Zduńskiej Woli. Available at: https://zdunskawola.pl/aktualne-ostrzezenia/?fbclid=IwZXh0bgNhZW0CMTAAYnJpZBExU1E2MFNJZHNPQkpOY3pkcQEeTGb0hfCYIBT-1WV2njIz1FF8Pq-yOGCH-bdQ9I1eO8GsoQPZpUKYgqnyd6e0_aem_mcrNF-a_YoqJ3BLvpnOECw

UN-Habitat (2018). *City resilience profiling tool. A guide*. Available at: https://urbanresiliencehub.org/wp-content/uploads/2018/02/CRPT-Guide.pdf

Unearthed, Greenpeace (2018). Five things we learned from the world's biggest air pollution database. *Unearthed*. Available at: https://unearthed.greenpeace.org/2018/05/02/air-pollution-cities-worst-global-data-world-health-organisation/

United Nations (2019). *World urbanization prospects: The 2018 revision*. United Nations.

United Nations Office for Disaster Risk Reduction (2009). *2009 UNISDR terminology on disaster risk reduction*. Available at: https://www.undrr.org/publication/2009-unisdrterminology-disaster-risk-reduction

Ustinov, P. (1988). Urban stress: Myth or reality? *Ekistics*, *55*(331/332), 247–258. Available at: https://www.jstor.org/stable/43623046

Vargová, L., Jozefiaková, B., Lačný, M., & Adamkovič, M. (2024). War-related stress scale. *BMC Psychology*, *12*(1), 208. https://doi.org/10.1186/s40359-024-01687-9

Vries, G. de (2020). Public communication as a tool to implement environmental policies. *Social Issues and Policy Review*, *14*(1), 244–272.

Wdowicka, M., Mierzejewska, L., Szejnfeld, M., Modrzewski, B., Sikorska-Podyma, K., Wronkowski, A., & Lechowska, E. (2024). How to create healthy, stress-resilient postpandemic cities. *Sustainability*, *16*(9), 3644. https://doi.org/10.3390/su16093644

World Health Organization (2022). Review of indicator frameworks supporting urban planning for resilience and health. World Health Organization – European Centre for Environment and Health. Available at: https://urbanresiliencehub.org/wp-content/uploads/2022/09/Urban-resilience-indicator-frameworks_WEB.pdf

World Health Organization 'Air pollution'. Available at: https://www.who.int/healthtopics/air-pollution#tab=tab_1

Yamamoto, D. (2011). Regional resilience: prospects for regional development research. *Geography Compass*, 5(10), 723–736. https://doi.org/10.1111/j.1749-8198.2011.00448.x

Yang, Q., Yang, D., Li, P., Liang, S., Zhang, Z., & Wu, G. (2021). Resilient city: A bibliometric analysis and visualization. *Discrete Dynamics in Nature and Society*, 5558497, 1–17. https://doi.org/10.1155/2021/5558497