

Research paper

## Promoting Resilience and Health of Urban Citizen through Urban Green Space

Zile Huma<sup>1,2</sup>, Guangsi Lin<sup>1,3,4\*</sup>, Syed Lakhte Hyder<sup>2</sup>

<sup>1</sup>South China University of technology, <sup>3</sup>State Key Laboratory of Subtropical Building Science, <sup>4</sup>Guangzhou Municipal Key Laboratory of Landscape Architecture, South China University of technology, Guangzhou, Guangdong, China

<sup>2</sup>Department of Architecture, COMSATS University, Islamabad, Pakistan

### ARTICLE INFO

#### Keywords:

Architecture  
Urban health  
Urban resilience  
Urban sustainability  
Urban sustainability

#### \*Corresponding Author:

Guangsi Lin  
asilin@126.com

Received: 10 January, 2021

Accepted: 14 February, 2021

Available online: 28 February, 2021



This work is licensed under the Creative Commons Attribution 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

### ABSTRACT

Urban green space (UGS) is considered as a key item of urban life. It is not only stimulating urban beauty but also help to promoting resilience and health of urban citizen. There is a debate on the role of UGS on people's health and resilience. Therefore, this study intends to reveal the potential of UGS for promoting resilience and health of urban citizen. A PRISMA guided systematic review of literature has been conducted over the last 10 years. Finally, 29 most relevant documents have been identified from existing literatures. This study argues that UGS has a positive impact on promoting resilience and health of urban citizen. Though it is a little bit difficult to explain the extent of the relationship, but many studies support the interlink between UGS and health and resilience. This study also explores a number of resilience indicators that are directly connected with UGS promote adaptive, absorptive and transformative capacity of urban people. It recommends to set up UGS properly so that urban citizen get facilities from it and enhance their resilience.

### Introduction

A drastic demographic shift towards urbanization is taking place globally.<sup>1</sup> The number of urban citizen is probable to increase from 46.6% to 69.6% between 2000 and 2050 (WHO 2016). Urbanization presents problems through effects such as air pollution, injuries, heat island effects and climate change. This has flagged the need for multisectoral action to improve health (Baur 2018). Urbanization is growing at an unparalleled rate, and many people, with over half of the global people now living in cities, have little access to the green environment in which the human race has grown (Colding et al. 2020). Greenspace can ensure people's

good health, such as encouraging fitness, social works, and linking with nature. It is considered that urban greenspace is essential to well living, both psychologically and physically. There can also be healthy effects on psychological health and well-being, such as enhanced concentration, feelings of satisfaction and minimized stress (Dzhambov et al. 2018).

In order to preserve the social benefits given to city dwellers by urban green spaces (UGS), it is vital to preserve rising the quality of life of urban people (Enssle and Kabisch 2020). In order to reduce high summer temperatures in their grounds and surrounding areas, UGS are important and are crucial

in the elimination of air pollution and noise reduction (Kamruzzaman 2020). They are also highly known for the beneficial impact of encouraging the physical and mental health of their tourists and creating opportunities for social interaction and leisure (Hunter et al. 2019). Increasingly, the QoL benefits derived from UGS are fundamental to urban culture, so knowing the attitudes and expectations of UGS by tourists is important for informed urban planning. Exploring the experiences of tourists of green spaces, however, is difficult as it relies on cognitive, affective, and behavioral components and, thus, sensory perceptions vary individually (Jorgensen and Gobster 2010). Sensory dimensions and experiential environmental contacts are thus important building blocks of area-based beliefs, and subjective well-being is driven by unique environmental endowments of the region (Kamruzzaman et al. 2020).

Generally, green space focuses on greenery in the countryside as well as spaces in urban settings that are maintained or reserved (Kondo et al. 2018). A complex ecosystem contingency in the continuous or periodic evolution of a natural world equilibrium based on environmental norms is demonstrated by the most contemporary definition of resilience (Sarker et al. 2020a). Resilience refers to the natural system's dignity, which appears to be assorted and capable of dealing with sudden change (Sarker et al. 2020c). It is an ability of complex systems with disruptions that the system can withstand and sustain equilibrium without altering the state (Carvalho et al. 2017). The resilience of the social environment is an integral part of the sudden changes in the adaptive capacity of people (Meerow et al. 2016). To preserve the resilience of the socio-ecological system, human systems learn and change their actions (Chen et al. 2019). As part of all ecosystems, resilience in socio-ecological environments requires human activity and can change feedback on environmental factors that varies from the adaptive capacity of ecosystems in which people do not participate. According to IPCC (2007), resilience is the ability of socio-economic and ecological structures to adjust with risky events, developments and instabilities and to react and restructure in order to retain their basic role, distinctiveness and structure while preserving adaptation, learning and transformation capacity. Resilience is affected by shifts in environmental and social factors (Vargas-Hernández and Zdunek-Wielgołaska 2020).

There is confusion as to perceive health benefits of UGS, such as parks and playgrounds, are an urban myth or fact, though urbanization obviously has health effects. Expensive schemes are urban developments. It is, therefore, critical that rigorous evidence informs urban design and planning

decisions. The previous studies have been focused on urban climate change (Cobbinah 2021), urban resilience (McGill 2020), green space (Shuvo et al. 2020), landscape (Agarwal 2019) and health (Branas et al. 2011), and well-being (Hunter et al. 2019), but specific focus on promoting resilience and health is still lacking. The study aims to broadly explore evidence of the benefits of UGS for the urban community for health and resilience. The findings of this study will provide a chronicle synopsis for health-related policymakers, planners, and urban administrators.

## **Methods and Analysis**

### *A. Research Design*

A literature review was conducted by following systematic approach under the direction of PRISMA. A search protocol was developed by following a scientific procedure (Sarker et al. 2019a). Besides, an inclusion and exclusion criteria were followed to guide the whole analysis procedure. Key results were then summarized thematically. The analysis was done in January 2021.

### *B. Search Strategy*

For research and analyses of the potential impact of UGS on health and resilience, a number of renowned databases have been used such as web of science, Scopus, ScienceDirect and SpringerLink. A few key search terms have been used such as green space, urban resilience, vulnerability, health, UGS. Physical and mental health are also considered during analysis.

### *C. Inclusion and Exclusion Criteria*

This study follows an inclusion and exclusion criteria for inclusion and exclusion of the documents. The main inclusion criteria were article published in English, article focused on UGS, and article published within last 10 years. The main exclusion criteria were articles published in other language, not focusing the UGS, health and resilience, and having no full text.

## **Results of the Study**

The PRISMA criteria have been used for this research (Moher et al. 2009). Initially, 653 records were identified at the identification point. Then, duplicates and irrelevant documents were removed by abstract screening, 161 documents were sorted. Once again, however, 117 documents were omitted from 161 documents for many reasons, such as no full text, no research based on utilizing learning and education technologies. Finally, 44 papers consisting of journal articles, work papers, book chapters, magazine articles, and books were reviewed to get the possible

and successful ways of using technology-based learning to ensure improved learning and education

(Figure 1).

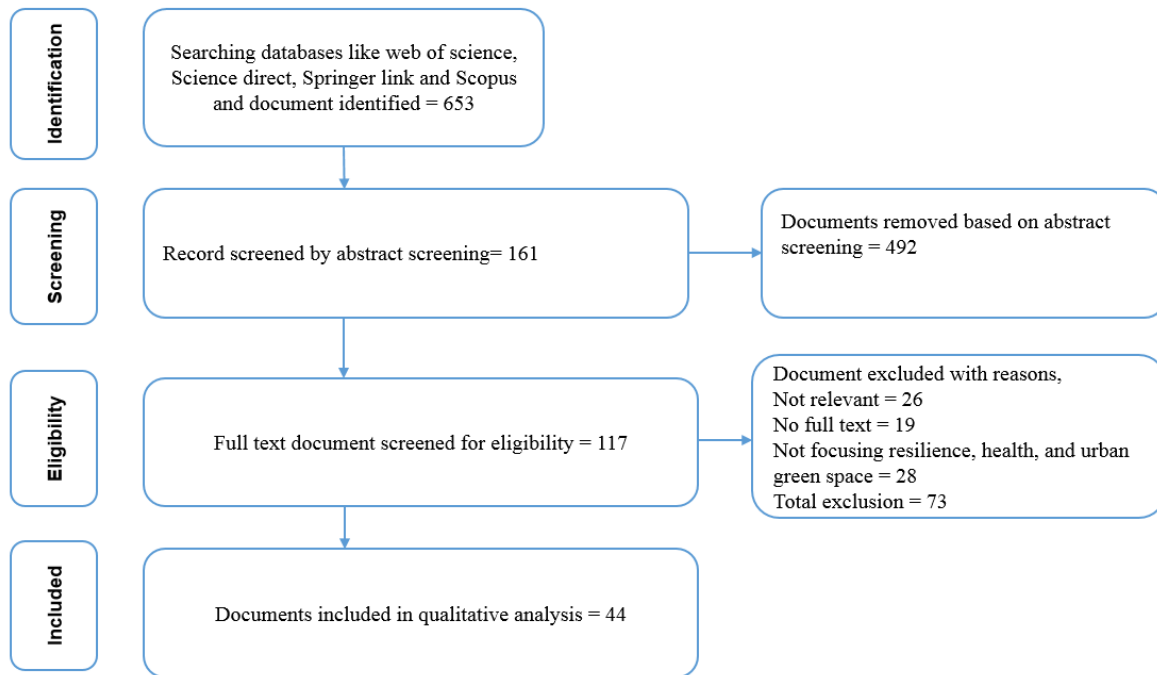


Figure 1. Qualitative document selection process under PRISMA.

## Results and Discussion

### A. Promoting Resilience for Managing Urban Crisis

Over Resilience is the capacity to adjust to a complex system's internal and external systemic destructive shocks which may be responded to the system's capacity. Resilience focuses on the system's capacity, despite disturbances, to be in balance with environment (Sarker et al. 2020b). It also helps people to return back to a steady condition after disruption. It deals with the ability to adapt and react over time to structural change. It is also defined as the moment of reoccurrence from instability to a stable condition. It is the capacity of the framework to satisfy the social expectations of sustainable goals (Borsekova et al. 2018). Resilience is a method for evaluating the potential and contextual shifts of experiences that impact urban structures. Resilience assesses current and expected potential climate change effects of weather-related and natural hazards and shocks on human wellbeing (Sarker et al. 2019b). It is a non-normative method that is useful in recognizing the changes in dynamic environments that encourage or hinder sustainability objectives (Sarker 2019).

Socio-ecosystems and green infrastructure, by ecosystem services, offer benefits for the improvement of people health and essential ecological and socio-economic services (Sarker et al.

2021). In the areas of electricity, water, air quality, transport and logistics, waste and materials, climate, etc. Green infrastructure design, biodiversity and ecological services can be integrated into green programs aimed at achieving economic and environmental benefits (Huq et al. 2020). Urban green spaces and facilities offer economic social and environmental benefits such as the mitigation of climate change and the effects of heat islands, the reduction and absorption of pollutants, the conservation of natural resources and landscapes, the improvement of urban landscapes' attractiveness and beauty, the connection between nature and sense of place, the improvement of quality of life, etc.

For properly understood and quantified urban beneficiaries, UGS has advantages that transcend many obstacles for becoming economically sustainable. Well-functioning and balanced environmental community services lead to the resilience of the region. Ensuring the robustness of urban environmental services and contributing to the growth of urban sustainability at the same time is critical. To do this, to increase quantity, efficiency and diversity and to broaden the usage of natural spaces and urban green infrastructure, resilient urban natural spaces have to be constructed (Lennon et al. 2017). Urban resilience focuses on the socio-ability of an ecosystems to maintain its vital structural

functions in a destructive urban sprawl. Urban sprawl habitats have many functions, including ecosystem services, to promote the creation of sustainable communities for disaster impacts, climate change and other disturbances (Wang et al. 2019). Urban habitats are used to relieve the effects of natural hazards.

A city of resilience has sustainability objectives, frameworks to support these goals and the management of adaptive capacities as components (Sarker et al. 2020d). The process which modifies ecological resilience is adaptive capability. The

#### *B. Ensuring health through UGS*

A vital element of urban health and citizen's life quality is urban green space (UGS). Instead of grey infrastructure, UGS and parks will ensure a compatible framework capable of sharing the support of multi-functional green infrastructure, combining numerous functions and delivering additional socio-ecosystem facilities and environmental reimbursements, enhancing the resilience of the ecosystem while decreasing the impacts of natural hazards (Abass et al. 2020). Local environmental policy, arising from the engagement of local scholars, practitioners, and investors who can invest for the implementation of UGS in city, promotes sustainability and urban governance. The incorporation of UGS and guidance on eco-biodiversity into sustainable urban design and planning of sites will reinvent the usual environment and its roles (Chen et al. 2020). It is important to remember that poorer groups of people frequently live in communities with limited green space availability. Research has shown that people who are socio-economically underprivileged incline to advantage from increased access to UGS. The reduction of socio-economic gaps in UGS availability will thus help to lessen health inequality and other socio-economic factors (Zhang and Tan 2019).

#### *D. Mental Health and Wellbeing*

During the past few decades, rapid urbanization has significantly changed the way people live. The probability of urban inhabitants coming into touch with UGS has also been decreased (Zhang et al. 2020). As a result, the detrimental effect of decreased interaction with UGS on public health and the health benefits of green space exposure have been discussed in several studies. It has been shown that regular access to healthy, local as well as good

#### *E. Socioeconomic Benefits of Green Space*

Exposure to UGS may affect on differences in urban socio-economic health. Studies also found that participation in outdoor leisure activities is less likely to be identified by inner-city and disadvantaged

adaptive cycle takes ecological urban design as an ecological insight that urban planners use as model for resilient urban infrastructure. The various forms of resilience are grounded on norms that are based on many stable conditions. In terms of vulnerability to the environment and climate change, resilience assumes only one stable state. Multiple equilibrium resilience focuses on the socio-ecological system's disruption extent, which is typically absorbed without restoring or moving to a new equilibrium (Knobel et al. 2019).

#### *C. Physical Health*

The UGS provides a number of opportunities to urban people such as natural environment, landscape, garden, walking space, playground and cycling facilities. Public open spaces are a shared area for physical activity that a wide variety of individuals may use to enhance their wellness. However, a combination of self-reports and types of diversification has been used in research on the relationship among parks, environment, and physical movement, which can contribute to mixed findings. It has been stated that urban green open space helps encourage physical activity and reduce a variety of chronic diseases. There is a relationship between factors of the built environment, household density, recreational green and open spaces, and the amount of street inter-sections and walking activity (Wang et al. 2019). Several reports support this view and there is some agreement that 'physical activity may be encouraged or limited by the built environment.' Other physical advantages may also be present (Thompson Coon et al. 2011). With regard to physical health, there is an increasing number of evidence showing that the benefits of UGS have a major impact on physical health outcomes (Lennon et al. 2017).

quality UGS encourages advanced levels of physical action among people and has psychological health assistances as well. Moreover, the indication shows that these advantages are really greater in UGS than less natural conditions (WHO 2016). A study on urban development, the environment and health by WHO (WHO 2016) notes that UGS can absolutely influences on physical, and psychological matter, enhance air quality as well as minimize noise exposure.

communities (Frantzeskaki et al. 2017). For instance, teenagers living in poor communities have limited admittance to parks. Though it is considered healthy and thus less likely than teenagers in more affluent neighborhoods to engage in physical activities.

People are more likely to tolerate low levels of operation in low-income households and are less well served by accessible facilities (Bertram and Rehdanz 2015). Whereas, wealthier people would like to live in the proximity of UGS to avail facilities. In many health outcomes, socioeconomic differentials in physical inactivity are consistent with socioeconomic gradients and can reflect a main mechanism by which

*F. Accessibility of Urban Citizen*

The correlation of ease and comfort of access with either utilitarian types of physical activity or leisure-time physical activity has been consistently documented by most studies to date. Both adults and children were influenced by this observation. It was more likely to be used by people having access to beautiful UGS. In addition, compared with non-users, users were also more likely to meet the prescribed levels of operation. Increased levels of physical activity were also correlated with residential proximity to green spaces and the existence of obstacles. Its usage may also have an impact on the efficiency and availability of green space. This aspect covers issues relating to the management and facilities which affect the attractiveness of UGS (Wu et al. 2019). Not only for its attributes, but also for the state of certain facilities and features, people chose to use UGS or not. Moreover, because of an inferred correlation with sabotage and misconduct in public space, adolescents may encounter hostile attitudes in

## Conclusion

In recent years, the benefits of UGS to people's health and urban resilience have been of great concern. UGS help to do physical exercise, social activities, mental stimulation, and stress and heat relief simpler, resulting in direct and indirect mental and physical health benefits. Ecosystem services are a utilitarian mechanism that promotes the protection of urban biodiversity, habitats and connections between people and nature for urban resilience. The capacity to adapt to disturbances and disasters can be conceived as regional and urban resilience, combining the psychological, physical, social, systemic and environmental elements. The available evidence outlined in this paper indicates that psychological stimulation and stress lessening, increased social solidity and mental connection to the

## References

Abass, K., D. Buor, K. Afriyie, G. Dumedah, A. Y. Segbefi, L. Guodaar, E. K. Garsonu, S. Adu-Gyamfi, D. Forkuor, A. Ofosu, A. Mohammed, and R. M. Gyasi (2020). "Urban sprawl and green space depletion: Implications for flood incidence in Kumasi, Ghana." *International Journal of Disaster Risk Reduction* 51:101915.

health is influenced by socioeconomic status (Zhang et al. 2020). Any cross-cultural differences in people's usage could account for the uneven distribution of green space. Although access to UGS tends to be indirectly associated with scarcity level (Hunter et al. 2019).

some places. Therefore, the inconsistencies of the various age groups in the usage of green space suggest a more complicated (Zhang and Tan 2019).

There were also recorded gender disparities in the use of green space. Instead of doing exercise, women usually like to walk decisively. Park usage studies also mention that it was less likely that racial minorities and people with disabilities would use green spaces. The perception of 'protection' was one reason given for these differences (Vujcic et al. 2019). The relationship between socio-economic factors, gender, cast and disability, however, is multifaceted and confuses associations. Several enabling factors were established that were positively correlated with increasing walking as well as physical activity. It includes elevated people motivation, a positive mindset toward physically activity. On the other hand, there are also personal obstacles, like overweight, lazy to exercise, elderly, scarcity of time, illness, accident, and environmental issues.

urban environment, and increased physical activity are possible causal factors contributing to people health advantage of UGS. Health facilities are based on the inclusive greenness of housing areas and may be given by suitable frameworks for urban planning. Facilitated by physical exercise in UGS, the health benefits be contingent on the provision of public open spaces for healthy recreation and physical health. In order to allow planners, administrator, and policymakers to determine the demand for change and to find particular areas where UGS initiatives are necessary, it is imperative to setup and apply harmonized approaches to UGS measurement. The findings can help related stakeholders to make effective strategy during planning green space interventions.

Agarwal, R. (2019). "Environmental impacts of urban green space." *Van Sangyan* 6(11):37–40.

Baur, J. W. R. (2018). "Urban green spaces, recreation and spiritual experiences." *Leisure/Loisir* 42(2):205–229.

Bertram, C., and K. Rehdanz (2015). "The role of urban green space for human well-being." *Ecological Economics* 120:139–152.

Borsekova, K., P. Nijkamp, and P. Guevara (2018).



- "Urban resilience patterns after an external shock: An exploratory study." *International Journal of Disaster Risk Reduction* 31:381–392.
- Branas, C. C., R. A. Cheney, J. M. MacDonald, V. W. Tam, T. D. Jackson, and T. R. Ten Havey (2011). "A difference-in-differences analysis of health, safety, and greening vacant urban space." *American Journal of Epidemiology* 174:1296–1306.
- Carvalho, D., H. Martins, M. Marta-Almeida, A. Rocha, and C. Borrego (2017). "Urban resilience to future urban heat waves under a climate change scenario: A case study for Porto urban area (Portugal)." *Urban Climate* 19:1–27.
- Chen, G., X. Liu, Y. Wang, C. Tu, and M. M. Kamruzzaman (2019). "Measurement of environmental pollution sources by electron microscope remote sensing image algorithms." *Acta Microscopica* 28:1185–1194.
- Chen, G., L. Wang, and M. M. Kamruzzaman (2020). "Spectral classification of ecological spatial polarization SAR image based on target decomposition algorithm and machine learning." *Neural Computing and Applications* 32:5449–5460.
- Cobbinah, P. B. (2021). "Urban resilience in climate change hotspot." *Land Use Policy* 100:104948.
- Colding, J., Å. Gren, and S. Barthel (2020). "The Incremental Demise of Urban Green Spaces." *Land* 9:162.
- Dzhambov, A., T. Hartig, I. Markevych, B. Tilov, and D. Dimitrova (2018). "Urban residential greenspace and mental health in youth: Different approaches to testing multiple pathways yield different conclusions." *Environmental Research* 160:47–59.
- Enssle, F., and N. Kabisch (2020). "Urban green spaces for the social interaction, health and well-being of older people— An integrated view of urban ecosystem services and socio-environmental justice." *Environmental Science and Policy* 109:36–44.
- Frantzeskaki, N., S. Borgström, L. Gorissen, M. Egermann, and F. Ehnert (2017). *Nature-Based Solutions Accelerating Urban Sustainability Transitions in Cities: Lessons from Dresden, Genk and Stockholm Cities*. Pages 65–88.
- Hunter, R. F., C. Cleland, A. Cleary, M. Droomers, B. W. Wheeler, D. Sinnett, M. J. Nieuwenhuijsen, and M. Braubach (2019). "Environmental, health, wellbeing, social and equity effects of urban green space interventions: A meta-narrative evidence synthesis." *Environment International* 130.
- Huq, M. E., Q. Cheng, O. Altan, A. Z. M. Shueb, M. A. Hossain, M. N. I. Sarker, N. Saleem, A. Javed, X. Longg, A. A. Al Dughairi, M. M. P. Rana, A. Al Mamun, and M. M. Rahman (2020). "Assessing vulnerability for inhabitants of Dhaka City considering flood-hazard exposure." *Geofizika* 37:97–130.
- IPCC. 2007. *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Cambridge University Press, New York, NY 10013-2473, USA.
- Jorgensen, A., and P. H. Gobster. (2010). "Shades of Green: Measuring the Ecology of Urban Green Space in the Context of Human Health and Well-Being." *Nature and Culture* 5:338–363.
- Kamruzzaman, M. M. (2020). "Architecture of Smart Health Care System Using Artificial Intelligence." Pages 1–6 2020 IEEE International Conference on Multimedia & Expo Workshops (ICMEW). IEEE.
- Kamruzzaman, M. M., S. A. Alanazi, M. Alruwaili, N. Alshammari, M. H. Siddiqi, and M. E. Huq (2020). "Water resource evaluation and identifying groundwater potential zones in arid area using remote sensing and geographic information system." *Journal of Computer Science* 16:266–279.
- Knobel, P., P. Dadvand, and R. Maneja-Zaragoza (2019). "A systematic review of multi-dimensional quality assessment tools for urban green spaces." *Health and Place* 59:102198.
- Kondo, M., J. Fluehr, T. McKeon, and C. Branas (2018). "Urban Green Space and Its Impact on Human Health." *International Journal of Environmental Research and Public Health* 15:445.
- Lennon, M., O. Douglas, and M. Scott (2017). "Urban green space for health and well-being: developing an 'affordances' framework for planning and design." *Journal of Urban Design* 22:778–795.
- McGill, R. (2020). "Urban resilience – An urban management perspective." *Journal of Urban Management* 9:372–381.
- Meerow, S., J. P. Newell, and M. Stults (2016). "Defining urban resilience: A review." *Landscape and Urban Planning* 147:38–49.
- Moher, D., A. Liberati, J. Tetzlaff, and D. G. Altman (2009). "Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement." *PLoS Medicine* 6:e1000097.
- Sarker, M. N. I. (2019). *Administrative Resilience: Potential Approach for Disaster Management*. Pages 1–5 in A. Farazmand, editor. *Global Encyclopedia of Public Administration, Public Policy, and Governance*. Springer Nature Switzerland AG.

- Sarker, M. N. I., M. S. Islam, M. E. Huq, G. M. M. Alam, and M. L. Raihan (2020a). Big data-driven disaster resilience. Pages 165–185 Information and Communication Technologies for Humanitarian Services. Institution of Engineering and Technology, US.
- Sarker, M. N. I., Y. Peng, C. Yiran, and R. C. Shouse (2020b). "Disaster resilience through big data: Way to environmental sustainability." International Journal of Disaster Risk Reduction 51:101769.
- Sarker, M. N. I., J. Wen, B. Yang, S. Yusufzada, N. Huda, and F. Mahbub (2021). "Assessment of environmental governance in disaster vulnerability context of rural Bangladesh." Growth and Change:grow.12482.
- Sarker, M. N. I., M. Wu, G. M. Alam, and M. S. Islam (2019a). "Role of climate smart agriculture in promoting sustainable agriculture: a systematic literature review." International Journal of Agricultural Resources, Governance and Ecology 15:323–337.
- Sarker, M. N. I., M. Wu, G. M. Alam, and R. C. Shouse (2020c). "Livelihood resilience of riverine island dwellers in the face of natural disasters: Empirical evidence from Bangladesh." Land Use Policy 95:104599.
- Sarker, M. N. I., M. Wu, R. C. Shouse, and C. Ma (2019b). Administrative Resilience and Adaptive Capacity of Administrative System: A Critical Conceptual Review. Pages 1–13 in J. et al. Xu, editor. Lecture Notes on Multidisciplinary Industrial Engineering. Springer Nature Switzerland.
- Sarker, M. N. I., B. Yang, Y. Lv, M. E. Huq, and M. M. Kamruzzaman (2020d). "Climate Change Adaptation and Resilience through Big Data." International Journal of Advanced Computer Science and Applications 11:533–539.
- Shuvo, F. K., X. Feng, S. Akaraci, and T. Astell-Burt (2020). "Urban green space and health in low and middle-income countries: A critical review." Urban Forestry and Urban Greening 52:126662.
- Thompson Coon, J., K. Boddy, K. Stein, R. Whear, J. Barton, and M. H. Depledge (2011). "Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A systematic review." Environmental Science and Technology 45:1761–1772.
- Vargas-Hernández, J. G., and J. Zdunek-Wielgołaska (2020). "Urban green infrastructure as a tool for controlling the resilience of urban sprawl." Environment, Development and Sustainability 23:1335–1354.
- Vujcic, M., J. Tomicevic-Dubljevic, I. Zivojinovic, and O. Toskovic (2019). "Connection between urban green areas and visitors' physical and mental well-being." Urban Forestry and Urban Greening 40:299–307.
- Wang, H., X. Dai, J. Wu, X. Wu, and X. Nie (2019). "Influence of urban green open space on residents' physical activity in China." BMC Public Health 19(1):1–12.
- WHO. 2016. Urban green spaces and health. WHO Regional Office for Europe, Copenhagen, Denmark.
- Wu, Z., R. Chen, M. E. Meadows, D. Sengupta, and D. Xu (2019). "Changing urban green spaces in Shanghai: trends, drivers and policy implications." Land Use Policy 87: 104080.
- Zhang, J., Z. Yu, B. Zhao, R. Sun, and H. Vejre (2020). "Links between green space and public health: A bibliometric review of global research trends and future prospects from 1901 to 2019." Environmental Research Letters 15(6): 063001.
- Zhang, L., and P. Y. Tan (2019). "Associations between urban green spaces and health are dependent on the analytical scale and how urban green spaces are measured." International Journal of Environmental Research and Public Health 16(4): 578.