

Post-Pandemic Urban Robustness and Public Health in congested cities

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Abstract:

Purpose: Public health crises have been generated globally due to the fast spread of COVID-19 virus. However, the pandemic has focuses mostly on disease control with a little attention for trend in urban planning aiming to generate new model for our urban health. Thus, the purpose of this paper is to clarify threats facing unplanned green urban spaces in congested cities which had negative impact on human physical and mental health especially during the COVID-19 pandemic. It is always difficult to find proper solutions to insert more green urban spaces in overcrowded cities because of the land limitations. Thus, the paper explores several examples of congested cities that have succeeded in designing a green ribbon within their urban fabric to create healthier environment. It also investigates the challenges facing the application of urban robustness to support public health.

Design/methodology/approach: This paper analyzes the greenway park design in six different examples around the world. A comparative analysis between these examples of linear parks has shown the relationship between the width and the location of the green way park from the street level. The width was measured from google earth.

Findings: The paper presented an empirical study covering different examples of reshaped urban spaces to adapt with population growth and consequent urbanisation combined with competing demands for land use in overcrowded cities. It suggests that urban robustness is essential for the sustainability of urban development in congested cities. It also asserts that linear green park and green ribbon can became major contributor for human health regeneration in congested city with empty land limitation.

Research limitations/implications: This paper highlights major threats facing limitation of green urban spaces in overcrowded cities. However, it lacks attention from local authorities and public health teams for the importance of increasing provision of and equitable access to green urban spaces, as well as, growing the wider network of green infrastructure, particularly through the planning system in overcrowded cities.

Practical implications: It suggests that green ribbon and urban robustness strategies would help in reshaping the urban space in congested cities to adapted changes of human perception for open spaces. These strategies can help decision makers to develop more sustainable approaches in managing green urban to support general public health.

Keywords: Green ribbon, urban robustness, public health, open spaces during COVID-19.

1. Introduction:

The COVID-19 pandemic posed different changes in urban areas functionality globally (Herman K., Drozda Ł. , 2021). The pandemic has significantly underlined the role of public spaces in shaping urban robustness. This worldwide pandemic played a great role in increasing the number of people suffering from psychological disorders such as: posttraumatic stress disorder, anxiety and reactive depression. Several groups have been diagnosed by the posttraumatic stress disorder because of serious COVID-19 illness or experiencing the death of family members or friends because of the virus or witnessed others’ suffering and great number of death per day especially between the medical sector. The economic recession resulting from the total or partial lockdown have also negatively affected the mental health of a wide sector of people who have lost their job and income during this period. It was reported by the KFF health tracking poll that the number of adults in the U.S. that suffers from symptoms of anxiety or depressive disorder have been increased 4 time after COVID-19 pandemic to become 4 in 10 adults in January 2021 vs. 1 in 10 adults in January 2019 (see figure 1) (Panchal N. et al., Feb 2021).

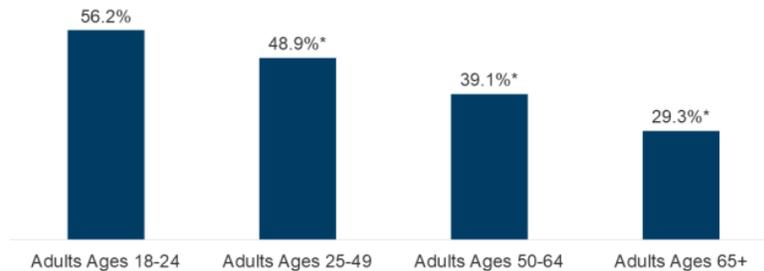


Figure 1: Average percentage of adults diagnoses with anxiety disorder and or depressive disorder symptoms, January-June 2019 Vs. January 2021. Source: NHS early release program and U.S. Census Bureau Household Pulse Survey. Available at: <https://www.kff.org/coronavirus-covid-19/issue-brief/the-implications-of-covid-19-for-mental-health-and-substance-use/>

Several researches have discussed that the social isolation imposed on society, to control the fast spread of COVID-19 virus, become a major contributor in the deterioration of human mental and physical health. The Statistic chart conducted by KFF analysis of the Household Pulse Survey shows that the young adults (average ages between 18-24) have experienced mental diseases related to pandemic consequence with a large share compared to older adults (See (Panchal N. et al., Feb 2021).

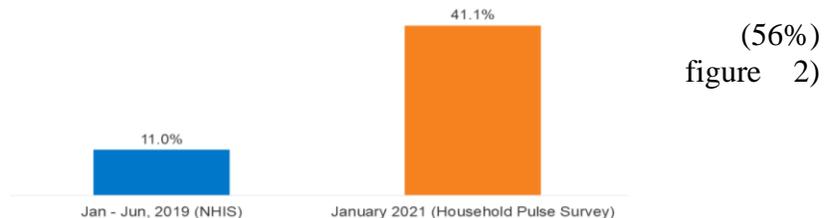


Figure 2: Statistic analysis shows percentages between adults different ages diagnosed with anxiety disorder and or depressive disorder symptoms during the COVID-19 Pandemic, December 2020. Source: NHS early release program and U.S. Census Bureau Household Pulse Survey. Available at: <https://www.kff.org/coronavirus-covid-19/issue-brief/the-implications-of-covid-19-for-mental-health-and-substance-use/>

It has been pointed out by the World Health Organization that green urban development and transformation became an important approach toward creating healthy Cities movement as well as providing an impetus for maintaining human mental health and well-being (Chen K., et. Al., 2021). Hence, the daily use of cities green infrastructure which include cities parks became a global demand. This collective appeal aims to reduce and prevent human psychological disorders caused by imposing social isolation to prevent the fast spreading of the pandemic virus. (Herman K., Drozda Ł. , 2021)

This research will address the importance of providing green urban spaces with equitable distribution in overcrowded cities as a main contributor for improving human physical and mental health. It also aims to raise people and decision makers awareness about the important role that urban robustness plays by adapting urban space with the required changes of human behavior for using them after the pandemic in order to maintain and enhance human physical and mental health.

The research is divided into two parts comprising both theoretical and analytical studies that serves the research objective: the first part reviews global approaches in urban robustness and the importance of providing sufficient amount of green open spaces or the benefit of general public health. A randomized clinical research in 2018 have suggested that transforming of vacant lands into green space can result in significative reductions for human psychological distress (South EC et. all, 2018). Thus, the second part explore two different examples of cities that adopted the Green Ribbon concept aiming to provide equitable and easy access to green spaces over the whole city. Other examples of elevated or depressed greenways have also been studied. A comparative analysis of the studied green parkways location in relation to vehicle street level has been deduced in order to help finding proper solution to provide a series of green open spaces where vacant lands are limited in overcrowded cities.

1. Role of outdoor green urban spaces in supporting public health:

The public health upheaval during the wide spread of the COVID-19 around the world has created significant impact on society and cities. There are recently, several researchers that have documented human psychological and emotional health benefits linked with being in direct exposure to the natural environment. Several studies have proven that spending time in parks and open green spaces help in decreasing stress disorder, as well as, being associated with improved overall human physical and mental health (Keniger L. E., et. Al., 2013). The complexity of the situation demands active cooperation among different disciplines where architect and urban planners play a major role in adaptation of the built environment and its open spaces (Beatriz Maturana B., et al., 2021). Generally, green environment has positive impact on human mental health such as: reducing anxiety and fatigue as well as decreasing depression levels. Since 2019, the fast spread of the COVID-19 pandemic has increased people need of outdoor open spaces to support and eliminate the increased number of mental health diseases especially among young adults. However, accessibility for green urban spaces in large congested cities is under threat because of the fast population growth and continuous urban sprawl. According to a study conducted by the Public health of England 2020, the total health cost could save £2.1 billion per year if every citizen could have a safe access to greenspace. It was also estimated that every £1 spent for parks and green spaces maintenance could save £34 in health costs (Public Health England, 2020). In this regards, cities public authorities should take action to provide a safe access to outdoor urban spaces in every neighborhood especially in congested cities. The public health of

England has identified 4 vital roles of local authorities in order to improve accessibility to green spaces (Public Health England, 2020).



Figure 3: diagram explain the roles of local authorities in improving access to green spaces. Source: the author, adapted from Public Health England, 2020

For a successful achievement of the previous outcomes, the collaboration of local authorities with urban planners, architects, local healthcare, parks and leisure management, transport providers and local residents who are targeted to use these outdoor urban spaces is required. Using these outdoor greenspaces regularly in daily life style will help in maintaining human physical and mental health as well as helping in accelerating phycological disorder recovery after the long social isolation period cause by the COVID-19 restrictions. It is also important to establish green social prescribing initiatives interventions to encourage people to allocate time for greenspaces usage in their daily schedule (Public Health England, 2020). Human mental health and welfare can be greatly supported through well-conceived and managed public green urban spaces and infrastructure. Maybe one of the foremost remaining legacies of the COVID-19 pandemic will be the renewed recognition for the value of high-quality open green spaces in cities. The need to provide healthy environment in cities has increased during and after the pandemic to maintain human mental and physical well-being. Urban robustness can be one of the strongest solution that can help in increasing cities’ resilience. In arranging such intervention, cities should take the equitable distribution of open green spaces into consideration to unsure that urban communities that currently have the slightest access to high-quality of open and green spaces are prioritized in the action plan (European Environment agency, 2021).

2. Urban robustness vs. urban resilience

According to Riegler J.and Bylund j. 2020, “urban robustness” is defined as: the way that prioritize sustaining city livability as much as possible and then work on its resilience. While, “urban resilience” indicates the capability to recover, “urban robustness” focus on the healthy ‘baseline’ of urban environment as a pre-condition of urban resilience during crisis-management. Thus, robustness has a wider meaning as an integrative principle that aims to achieve urban transformation and adaptation with crises management to sustain healthy and livable cities. In another mean, urban resilience after crisis doesn’t have certain effects on communities and neighbourhoods. Whereas, urban robustness will help in saving the human right of healthy environment during shifting grounds of long term (climatic changes) and short term crises (global pandemics such as COVID-19 virus) (Riegler J. et all, 2020).

2.1. Reshaping urban spaces uses and design to adapt with COVID-19

At the beginning of COVID-19 outbreak in Europe, many people suffered from loneliness and social isolation when they were imposed to stay at home (total lockdown) as a precautionary measure to reduce the spread of the pandemic disease. As a consequence, many psychological mental health problems have been increased. The pressure on public urban spaces in European cities have increased (during semi-lockdown) since they became the only way that can help ensuring the balance between public mental health restoration and keeping social distance to slow down the speed of the infections (Riegler J. et al, 2020). According to Stokes R. 2020 (minister of planning and public spaces in New South Wales), the social distance restriction of the COVID-19 Pandemic has essentially highlighted the urgent need for more safe access to open spaces in urban communities. For this reason, reshaping urban spaces to adapt with hygienic measurement of providing sufficient human distance became a key priority. The increased demand for high functional public urban spaces during the COVID-19 pandemic has resulted in a quickly actions around the world (short term adaptation). Several countries have adopted the urban robustness policy to adapt with COVID-19 pandemics social distance restriction (see table 1). This adaptation helped in managing and sustaining healthy and livable cities.

Table 1: Examples of urban spaces adaptation during COVID-19

The city	Urban spaces adaptation during COVID-19
The City of Bogotá (Columbia)	They opened 76km of temporary and 22km of new bike lanes (Wray, 2020).
The City of Barcelona (Spain), London (England), Paris (France), Milan (Italy).	Huge swathes of roadway are being transformed into cycling and walking spaces (Knight C., 2020).
New Zealand	The government announced plans to fund extra wide sidewalks (Orsman, 2020).
New South Wales, Australia	Australia parks and streets are reshaped to meet the requirements of social distance. Such as: creating new cycleway, road closure (car free streets for pedestrian only), wider the foot path and pop up outdoor dinning and market (Stokes R., 2020).
Vilnius, Lithuania	Bars and restaurants will be given access to more public space as the city moves to become a giant “open-air cafe” (Skorwid G., 2020)
Vancouver, Canada	Footpaths directly next to supermarkets and pharmacies are being widened to help customers more easily social distance (Stokes R., 2020)
Belo Horizonte, Brazil	“Complete streets” intervention in Belo Horizonte, Brazil, September 2019. transforming their streets to increase space for walking and cycling (Santos P. M. D., et al., 2020).
Porto Alegre, Brazil	The João Alfredo Street intervention in Porto Alegre included painted sidewalk extensions and bollards to improve safety for cyclists too (Santos P. M. D., et al., 2020).
New York	Domino Park introduces social distancing circles. They puts in place 30 circles: each circle is 8 feet in diameter and set 6 feet apart (Harrouk C., 2020)

The previous example (see table 1) explored how urban robustness during and after COVID-19 lockdown can help in boosting the local economy (job opportunities by turning the city's streets and squares into giant open air café), as well as, maintaining human physical (increasing spaces for cycling and gymnastics) and mental health (help people get around in public parks, squares and pedestrian streets, while maintaining social distancing).



Figure 4: Painted sidewalk extensions and bollards to improve safety for cyclists in painted sidewalk extensions and bollards to improve safety for cyclists. Source: Santos P. M. D., et al., 2020.

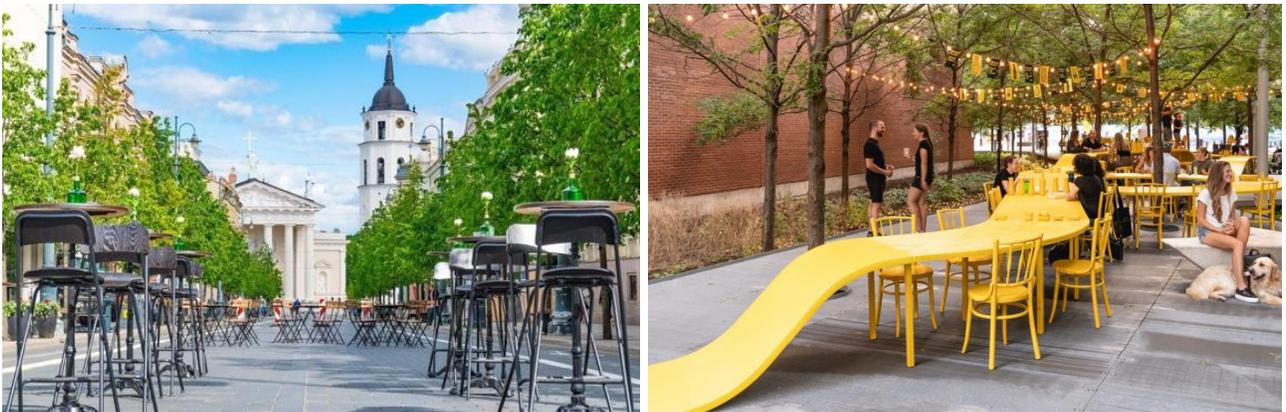


Figure 5: Pop up open air bars and restaurants in Vilnius, Lithuania to adapted with the COVID-19 pandemic. Source: Skorwid G., 2020



Figure 6: Painting circles in public parks (domino park, New York) to keep social distance between visitors in respond to COVID-19 restriction. Source: Cutieru A., 2020

According to Stokes R. 2020 (minister of planning and public spaces in New South Wales), the social distance restriction of the COVID-19 pandemic has essentially highlighted the urgent need for more safe access to open spaces in urban communities (see figure 7).



Figure 7: New South Wales street adaptation to help human depression disorder recovery during and after COVID-19 isolation and social distance restriction. Source: the researchers, adapted from NSW government, August 2020.

The NSW government has responded to the changes of urban communities everyday habits and transportation patterns as a result of the COVID-19 sanitary measures. People became more interest in walking and cycling for recreation as well as safe mood of transportation for small distances. Social distancing restrictions also continue to affect the daily activities that need gathering in urban streets. The example of NSW urban spaces adaptation has explained that a collaboration between several sectors of the government is needed for better application. The Department of Transport for NSW and the Planning, The Industry and Environment Department have worked together with the NSW councils and industry to develop and examine the best practice of temporary urban spaces treatments during and after COVID-19 (NSW government, August 2020).

2.2. Digitalization in urban spaces to adapt with the Pandemic

Urban public spaces have been also reshaped by using digital tools such as inserting the internet of things (IOT) in outdoor spaces to create an easy tracking for all visitors of the space. COVID-19 pandemic differs from previous viruses because it has recorded fast spreading by everyday contact with other people. Thus, measures such as lockdowns, social distance and people tracing were implemented around the world in order to reduce and block the spread of the Virus.

The social isolation has generated different secondary urban and regional problems. In order to minimize the social isolation, government of South Korea has introduced the Smart city technologies in June 2020 by using the QR code-based Visitor Lists (QR-VL) system to record and provide contact information for crowded facilities. The application of QR-VL uses an encrypted one-time QR code for every visitor. The QR code is recorded and saved for many weeks for epidemiological purposes. (Kang M., et al. 2020)

2.3. Changing preferences and expectations about green spaces post COVID-19

The current COVID-19 pandemic has profoundly changed human relationship with the public urban spaces. The quarantine measures have changed people perception of the open spaces as they became more attached and feel intimate with city public places such as squares, parks, alleys, river fronts. However, there is a large variation of people perceptions which is influenced by several circumstances such as age, gender as well as the severity of the lockdown measures during the pandemic among other correlates (Honey-Rosés J., et al., 2020).

3. Urban green spaces and human mental health improvement

Several recent researches indicate that people who live near green spaces may prevent depression disorder and support their general physical and mental health (Astell-Burt H., Feng X., 2019). It was stated by the World Health Organization's Mental Health Action Plan 2013-2020 that "*good mental health enables people to realize their potential, cope with the normal stresses of life, work productively, and contribute to their communities.*" (World Health Organization, 2013, p.5). Open Green urban space represents an important modifiable environmental factor that help promoting human mental well-being and enhancing mental ill-health recovery (World Health Organization, 2016) (Astell-Burt H., Feng X., 2019). A randomized clinical trial research in 2018 has suggested that transforming of vacant lands into green space can result in significant reductions for human psychological distress (South EC et. all, 2018) (Astell-Burt H., Feng X., 2019). Greening of public outdoor urban spaces within cities could boost human mental health through various pathways such as: capacities restoration, building human capacities, and physical and mental harm reduction (Astell-Burt H., Feng X., 2019). People who are daily exposed to green space by being in, within the area or having view to a greenery area may have a greater chance to enhance their capability for fast recovery from mental ill-health especially during pandemic periods (Hartig T., et. all, 2014) (Astell-Burt H., Feng X., 2019). Some researches in Australia suggested that green spaces containing high density of tree canopy are more preferable and attractive for walking and social recreation for older adults than simple large plain, flat grassy areas. These researches concluded that tree canopy density, is accompanied with higher levels of social communication rather than the existing of plain grass area (Harris V. et. all, 2018) (Astell-Burt H., Feng X., 2019). Another study suggested that people exposed to tree canopy was associated with less psychological disorder such as depression or anxiety. Sustaining the biodiversity is also more effective when providing large tree canopy in the open urban spaces rather than just creating open grasslands. Some recent studies have underlined that providing a great level of biodiversity, instead of large green grass, was related with favorable levels of mental well-being (Astell-Burt H., Feng X., 2019). Moreover, trees canopy in urban areas are estimated to have long-term benefits more than twice their cost of planting and upkeeping. Well designed and managed of green urban spaces can be considered as successful methodologies that offer assistance in tending to prompt challenges of COVID-19 (United Nations Human Settlements Programme, 2021).

4. Reshaping green spaces planning, uses and practice in cities

A shift toward healthy cities tend to be accompanied by remarkable effort to create greener environment in existing cities not just when planning new ones. The COVID-19 pandemic can accelerate the action needed to be taken in order to modify the distribution of green spaces within the cities. During the pandemic lockdown people have experienced changes in their perception of open green spaces and their preferences within the urban space. Cities decision makers with urban planners should plan a long term management for landscape and parks to re-assess the green infrastructure distribution within the crowded cities. Creating new or expanding the existing green spaces within the urban fabric of the city became an urgent need to fulfill the increase demand of the open public space (Honey-Rosés J., et al., 2020).

4.1. Urban green space distribution for healthy cities

Plentiful scientific literature has recorded the wellbeing benefits of using green spaces, whereas, other current works still being generated to understand the pathways and mechanisms need to be implement in cities to improve community health outcomes (Gascon *et al.* 2015, van den Bosch and Rojas-Rueda *et al.* 2019 and Honey-Rosés J., et al., 2020). Urban and city planning should adopt the new approach of connecting the “right of human health” with the “right of the city natural and build environment” in order to unsure equitable, accessible and better distribution of public green open spaces for healthier environment and active lifestyles. This approach aims to tackle chronic non-communicable diseases such as mental illness which have witnessed fast spread worldwide especially during the period of COVID-19 social and hygienic restrictions. There is a study estimated that the use of green urban open spaces for outdoor recreational activities have increased by 291 per cent during COVID-19 pandemic lockdown in accordance with the average usage during the past three years for the same days. Another online study, conducted for 9 different countries with 5,218 responses, found that the probability of reporting symptoms of depression and anxiety was reduced while maintaining human contact with nature (green-blue area) during lockdown. These researches have proved that merging parks and nature into all cities quarters is considered a public health measure which has psychological benefit on human wellbeing. COVID-19 pandemic has highlighted the urgent need to respect this aspect as a preventative and responsive aspect to human mental and physical health. To realize this benefit for all citizen and to achieve the principle of social justice, the UN-Habitat advocates that green public space should be accessible for all social groups and distributed within a 5 minutes’ walk in each neighborhood. In this regards and for a healthier environment, the neighborhood should be designed according to the following principles: providing accessible green public space, continuous blue-green networks, safe pedestrian streets and bicycle lanes (United Nations Human Settlements Programme, 2021). Cities which has been planned with an existing decentralized network of small green urban spaces are more likely prepared to provide an equitable and easy accessible opportunity for all residents to be daily connected with the beauty of nature. However, large parks with a continuous networks of green spaces are more valuable than separated green patches as it offers a balanced natural environment while preserving the biodiversity (Forman 1995). Visual access to green open spaces has also been shown to provide physical and mental health benefits (Velarde et al. 2007). This continuous visual access be achieved if cities are planned with a continuous ribbon of green spaces along the main spines of the city (Honey-Rosés J., et al., 2020).

4.2. Inequities and Exclusions

In several cities, there are group of people that suffer from inequity or exclusion of using the urban space not just because of the inequitable distribution of the open spaces but also due to cultural measurements. For instance, Woman may avoid using the open public spaces for recreation as they may be subjected to cultural dangers of being seen as improper and the hazard of verbal badgering by men. There is other social exclusion possibility which is achieved when some public open spaces are owned by private sector (United Nations Human Settlements Programme, 2021). These factors should be considered when planning for a re-shaped urban space aiming to adapt with increased need of equitable access of urban spaces in a post-pandemic world.

5. Crowded cities and need of green urban spaces

The COVID-19 pandemic has directed planners and designers to see the importance of create a new vocabulary or typology to describe places in terms of social density, distances, crowding, or public health risks in order to find proper distribution of open green spaces within the urban fabric of the cities (Honey-Rosés J., et al., 2020).

5.1. Emerald Necklace as a model of green network in cities

Amid the Industrial Revolution, as cities got more crowded, tension around congestion and the treat of bad quality of air and the natural environment developed. Consequently, closing to the 19th century, there was an overwhelming desire for dwelling and open public spaces that provide considerable fresh air and natural light (United Nations Human Settlements Programme, 2021). It was believed by Frederick Law Olmsted (father of American landscape architecture) that congested cities have negative impact on people behavior such as being nervous and warring to each other as well as being more subjected to mental and physical diseases. Therefore, he thought that citizens need to be daily exposed to the natural environment in order to maintain their physical health and mental quietism. Trying to achieve this goal, Olmsted proposed that linked series of parks could be favorable than large central park in the city as it gives all citizens the opportunity to have continuous contact with the natural environment during their everyday routine. He envisioned that linear linked park would satisfy the whole city need without being limited only to neighborhoods nearest to the large central park. Olmsted designed the Boston chain Parks (1878 - 1895) which permitted Bostonians to travel long distances encompassed by the beauty of greenery. The distance between Boston Common and Franklin Park is approximately 7 miles traveling by foot or bicycle through the linear parkway. As a crowded city, there were narrow area with limited spaces for parks. In these areas, Olmsted designed a linkage between the small parks and called it as “parkways”, which was planted with overhanging trees (see figure 8). This chain of small connected park was called “The Green Ribbon” and it is recently known as “the Emerald Necklace” which became the model for urban landscape design. This expression “Emerlad Necklace” was used to describe a chain of parks, greenspace, trails, and stream forming a necklace around downtown. The greenway concept has also been used in rural areas as a green strategy that help in protecting and preserving the wilderness areas. This green ribbon provided Bostonians with an easy access to a green open space after finishing their working day or when they want to stroll for

a break hour during the day far from the haste and jostle of the streets (Zaitzevsky C., 1982) (National Park Service, 2021).



Figure 8: Modern map of the Emerald Necklace (plan of the Boston Park System by Olmsted in 1894). Source: Marks A., et a.,2015



Figure 9: Rose Kennedy Greenway measures 1.5 miles through downtown Boston (opened in 2008). Source: <https://www.bostoncentral.com/fun-things-to-do-rose-kennedy-greenway>

The Rose Fitzgerald Kennedy Greenway is considered as a tree-lined boulevard in Boston's downtown (see figure 9). This linear park was provided after replacing the old elevated Central Artery (six-lane elevated highway with an underground expressway) with series of parks including 900 different types of trees, water features and other amenities (see figure 10). The green Nowadays, the Artery is re-directed through the newly constructed O'Neill Tunnel (Commonwealth of Massachusetts, 2022).



Figure 10: To the left the Elevated Highway dissecting the City of Boston, before the Greenway; to the right an Aerial view of the Rose Kennedy Greenway. Source: https://www.abettercity.org/docs/about_pr_wharfdistrictparks.pdf

Following Olmsted vision of green ribbon, Jacksonville Emerald Necklace was envisioned in the early twenties' century after the Great Fire of 1901 by the American architect Henry Klutho (see figure 11).

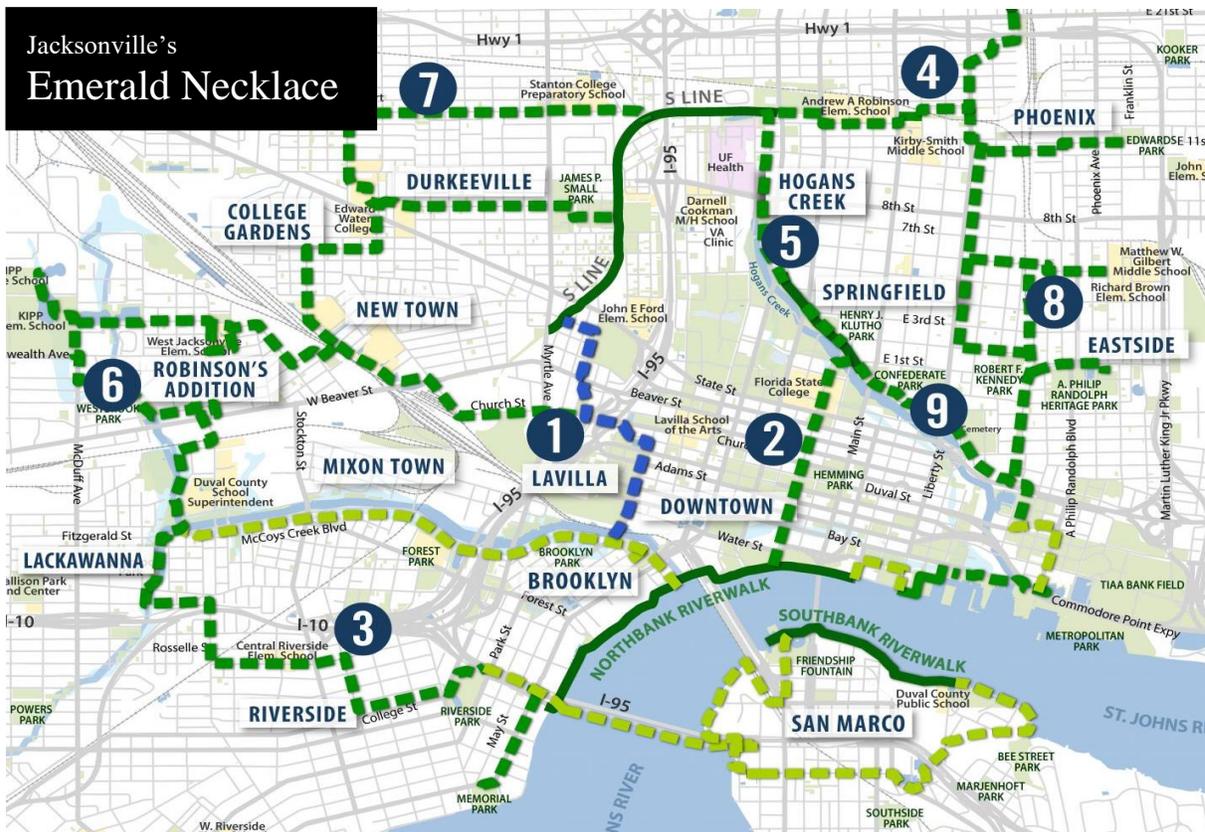


Figure 11: The Jacksonville Emerald Necklace aims to connect every side of city with an easy accessible walking and cycling path way surrounded by landscape elements. Source: <https://www.904happyhour.com/article/emerald-trail-model-project-to-break-ground-this-fal>

The Jacksonville Emerald Necklace” Master Plan was developed by Groundwork with the collaboration of the PATH Foundation (an organization in charge of building more than 280 miles of trails in Georgia) and KAIZEN Collaborative (one of the Southeast’s leading trail planning and design firms). The Jacksonville City Council has approved developed master plan in 2019 and estimated to be completed within 10 years with an approximated cost of \$31 million for design and construction excluding land acquisition. The proposed greenway parks (connecting 30 mile of trails within the existing urban fabric of Jacksonville) aim to boost economic revivals in the downtown of Jacksonville is the heart of Florida city as well as reconnection citizens with the natural environment while creating a healthy lifestyle that depend on walking, cycling while preserving the biodiversity (see figure 12) (Arbus, 2019).

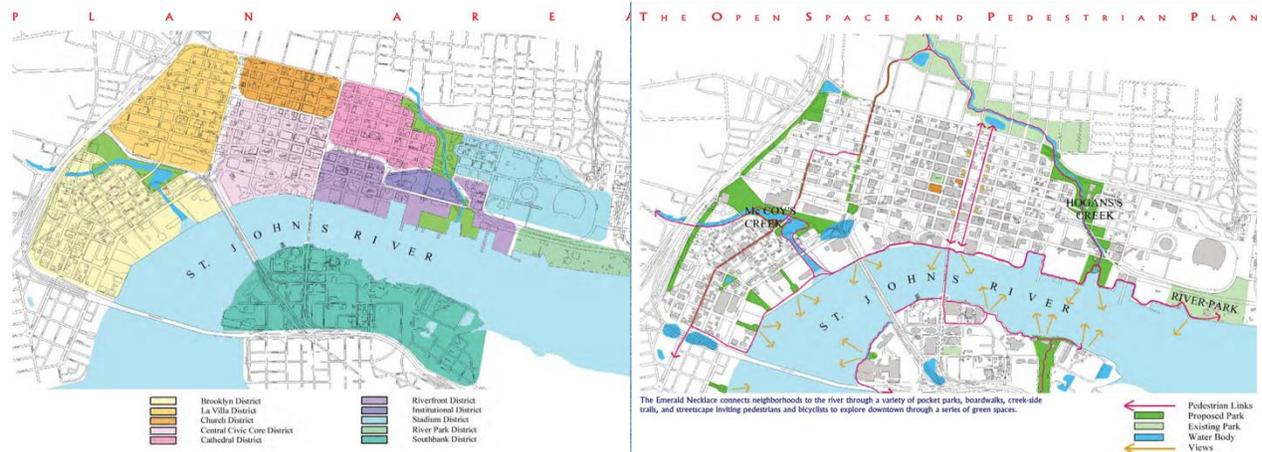


Figure 12: To the left show the existing plan area (Brooklyn and downtown); to the right the proposed mater plan of the green network. Source: (City of Jacksonville Florida) <https://groundworkjacksonville.org/wp-content/uploads/2015/02/1-jacksonville-master-plansmall-copy.pdf>

The proposed greenway of Jacksonville that connect 14 urban neighborhoods with pedestrian pathways and bike trails aims to provide a healthy environment where Downtown workers can be in direct connection with the nature during they daily life schedule such as: walking/jogging before work time or during their lunch hour; bike riding along the blue/green network; family gathering during weekend and vacation to get fresh air and exercise (Arbus, 2019).

The Cheonggyecheon stream (which means clear Stream) restoration project in Seoul (competed 2005) could represent another example of parkway where a successful urban intervention have changed the use of a highway cars bridge into a sunken pedestrian linear recreational space in the crowded city of Seoul (the capital of South Korea). The project has helped promote a new healthy image of the congested city of Seoul by engaging all citizens with the natural landscape through a long blue/green way along the city. The site passed through several transformation, it was first (1392-1910) a historic stream, then in early 1940s the stream was covered and transformed to a vehicle, afterward in the 1970s, a high way vehicle bridge was built over the road, and finally the bridge was demolished and a linear blue/green way park (approximately 11 km in length) was completed in 2005(see figure 13). This linear park became major public open space that offers respite from the crowdedness of the city which aims to improve

the quality of life and sustainability (see figure 14, 15) (Rowe et al. 2010; Marshall 2016; Kim E. J., 2020).



Figure 13: The Cheonggyecheon stream which was transformed from a high way bridge into a linear park. Source: <https://www.landscapeperformance.org/case-study-briefs/cheonggyecheon-stream-restoration>



Figure 14: The Cheonggyecheon stream provides pedestrian access along approximate 11km in the city of Seoul. Source: <https://blogs.worldbank.org/sustainablecities/how-seoul-korea-transforming-smart-city>

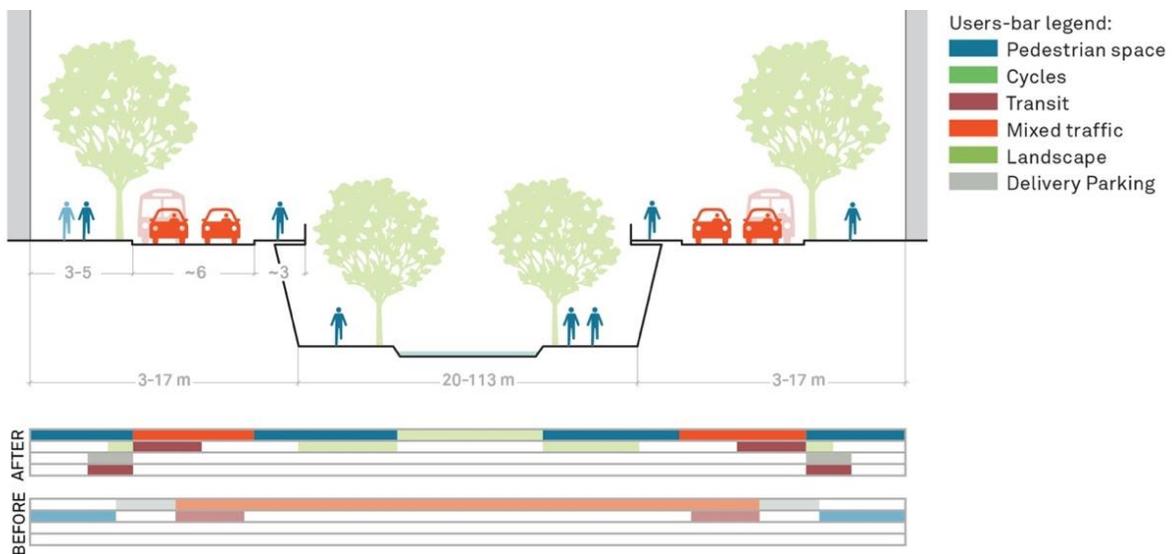


Figure 15: Cross section through the Cheonggyecheon stream (pedestrian path has increased by 76%) and the surrounding streets (Vehicle street). Source: <https://varlamov.ru/3563022.html>; <https://blarrow.tech/revisiting-cheonggyecheon-stream-korea/>

5.2. Living bridges (sky garden) as a model of green network in congested cities

An elevated unused historical railway line has been transformed into a linear park on Manhattan’s west side in New York City (2006-2014). The park is approximately 1.5 miles long (see figure 16). The design of this elevated linear park has succeeded as it offers a continuous green outlet which is connected with many neighbors where people live in small apartments. The design of this elevated linear park has succeeded as it offers a continuous green outlet which is connected with many neighbors where people live in small apartments. The high density of Manhattan’s west side enabled the High Line elevated linear greenway project to become a catalyst for real estate development and also became a model for other cities in the US and abroad trying to replicate its concept (Ascher K., Uffer S., 2015).

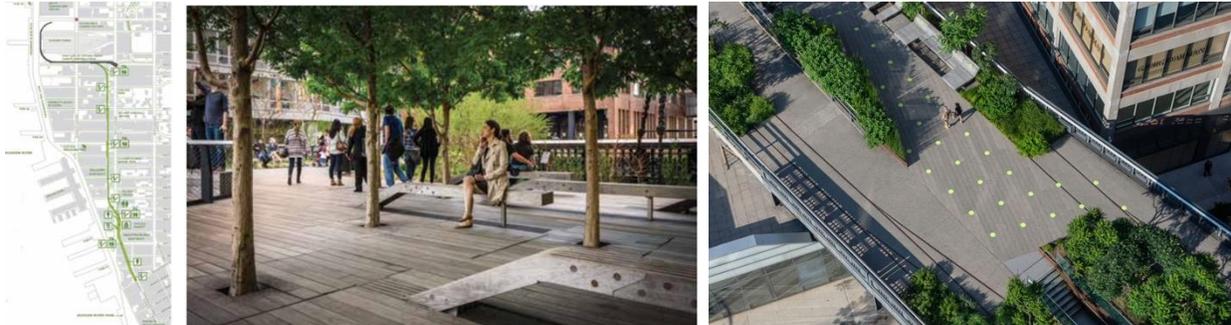


Figure 16: The high line elevated park provides a pedestrian access along approximate 1.5 mile long. Source: <https://global.ctbuh.org/resources/papers/download/2463-the-high-line-effect.pdf> and <https://www.pentagram.com/work/high-line-reopening/story>

Following the success of the New York high line elevated linear park, a living bridge (pedestrian park called Seoulo7017) was realized in the heart of Seoul city (south Korea) on a former overpass highway nearby Seoul station. The pedestrian linear park was opened for public in May 2017. The bridge has a length of 983m and accommodate a variety of Korean plants and species including 50 different types of trees, Shrubs and flowers (see figure17).

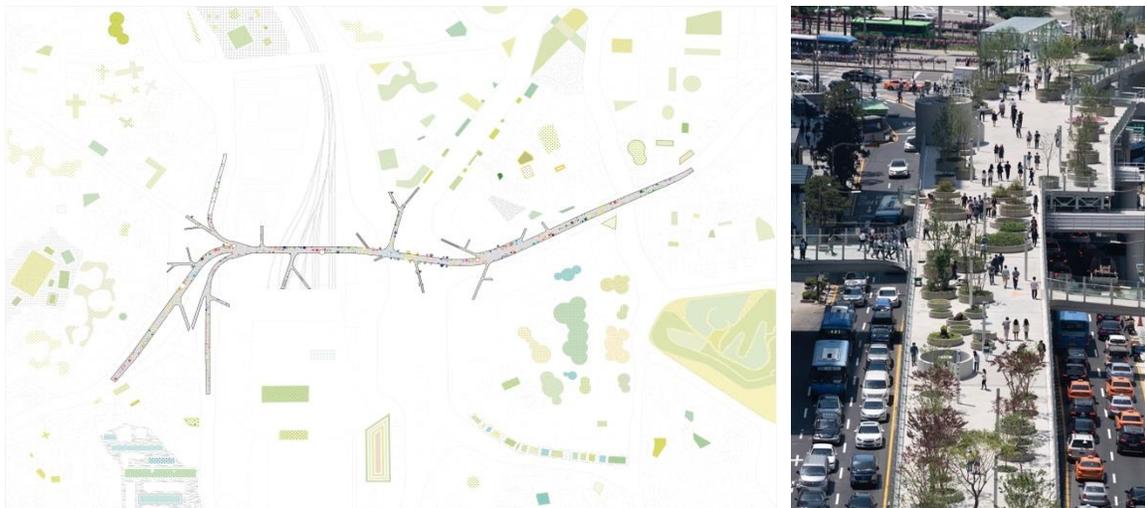


Figure 17: Shows the highway overpass in the heart of Seoul after being converted to a sky garden for a regenerative urban environment. Source: <https://www.mvrdr.nl/projects/208/seoulo-7017-skygarden>

The project passed over some debatable issues during the transformation process such as include traffic and economic circumstances of neighboring commercial districts caused by the high way street closure. A lot of stockholders believed that the idea of converting this overpass into a linear pedestrian park would promote more connections between the East and West parts of the city aiming to provide a healthy neighboring urban environment. Whereas, Others were against the idea as they were not convinced that this linear park would function well in connecting all city’s neighborhood together (Cho, 2015). This elevated linear park measures 8.4m wide and 17m in height, and has 17 points of connection (stairs, elevators, escalators, ramps) connecting the green promenade with the ground level (see figure18). The linear elevated park also providing easy and safe pedestrian access to Seoul’s attraction placed such as Namdaemun and the nation’s largest traditional market. This sky garden was designed to be enmeshed in the existing urban fabric of the city (Choi J. et al., 2019).

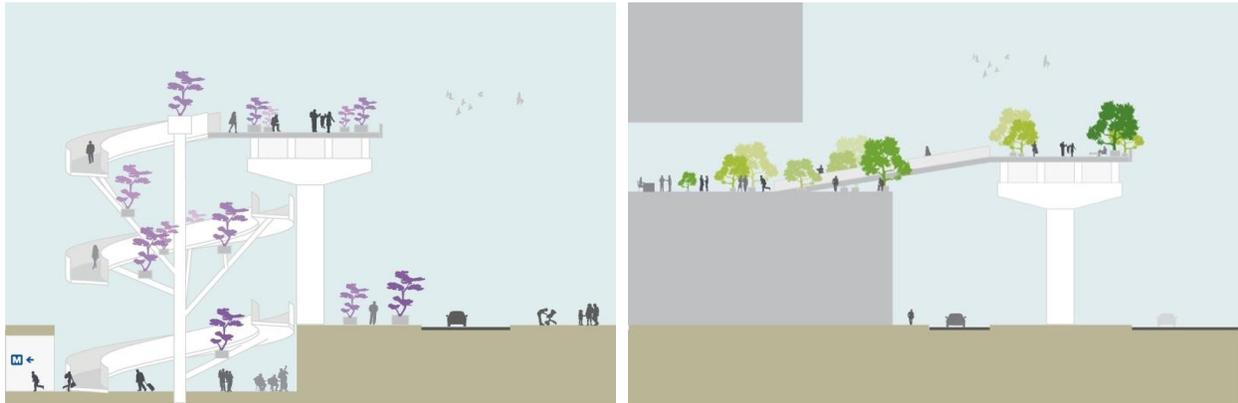


Figure 18: Shows the highway overpass in the heart of Seoul after being converted to a sky garden for a regenerative urban environment. Source: <https://www.mvrdv.nl/projects/208/seullo-7017-skygarden>

According to a research studying people behaviors in Seullo 7017 during COVID-19, the main behaviors were sitting for a night view and walking. The research suggested that opening and promoting different programs and festivals can vary people behavior. Seullo 7017 became an attractive place for Seoul residents during the COVID-19 pandemic as people have found a good place to travel and walk alone when other public multi-use facility and group activities were restricted during the peak of the Virus. Accordingly, in a situation like the COVID-19 pandemic, (Woo, Kyung-Sook W., Joo-Hwan S. 2020)

6. Comparative analysis of green parkways location in relation to vehicle street level

The approximate width of the mentioned linear park has been measured from google earth. The following table show the relationship between the width and the location of the green way park from the street level (see table 2).

Table 2: the relationship between the width and the location of the green way park from the street level

	Emerald Necklace Boston	Rose Kennedy Greenway Boston	Emerald Necklace Jackson Ville, Florida	Cheonggyecheon stream (South Korea)	Manhattan High line park (New York)	Seoul 7017 park (South Corea)
Same street level	W: 31m smallest width (at back bay fens)	W: 33m to 63m	Not competed			
Elevated from the street level					H: 5.5 to 9 m above street level W: 9 to 15 m	H: 17m above street level W: 8 to 13 m
Below street level				H: 2.5 to 6 m below the street level W: 20 to 113m		

The previous table indicates that the elevated linear park needs the least width as it is surrounded by open space far from the visual and air pollution of the vehicle street. The sky garden could also have a smaller width on the surface of the street level that can get larger in the upper part depending on the bridge structure. This solution sounds appropriate in congested cities where lands are limited but the city still search for continues green spaces that link its neighborhood together aiming to provide a healthy environment for its inhabitants.

7. Summary and Conclusion

The COVID-19 lockdown restriction has created negative impact on human physical and mental health, however, it has also positive consequences in helping people witnessing the way in which they are re-discovering their pleasure when they are exposed to direct connection with their surrounding natural environment by using their bicycle or walking in street or park. Consequently, the growing number of people that went out for open spaces during the Covid-19 restriction searching for mental and physical health improvement has exposed the limitation of old city design and the availability of public spaces within the urban fabric. Hence, the paper highlighted the linear parks approach envisioned by Olmsted as a solution that can help in re-shaping and adapting the urban space with the increased desire of providing parks and public spaces in overcrowded cities especially during and post pandemic of COVID-19. The continuous green ribbon aims to engage all dwellers with the natural landscape in their daily life through a long blue/green way along the city. In general, the continuity of the linear park will help in achieving the social distancing requirement as all citizen can find green open space in their neighborhood rather than having few chance to find place in the city central park. The discussed example of elevated linear park (Manhattan High line park / Seoul 7017 park) or depressed Blue/green way (Cheonggyecheon stream) has shown that people capacity in linear park can be easily controlled as park accessibility in this case will be through several gates using elevators, escalator ramps or stairs. QR Code entry system can also be used to record visitors data for a couple of month to ensure safety and security of users. One way direction can also be controlled in this case with providing floor dotes markers to unsure social distancing (as shown in the COVID-19 urban adaptation in the highline park). Hence, Green way linear park can be seen as an important approach that can boost “urban robustness” in congested city aiming at prioritizing and sustaining citizen physical and mental health especially with the changes of human perception for urban green spaces during the COVID-19 period. Reshaping urban spaces has become also a must for economic consumption and urban

conviviality. The design of creative livable public urban spaces is highly recommended, respecting existing characteristics of cities and their specific needs, as public spaces can act like external living spaces to improve residents' quality of life. This requires balance by different needs in different locations and how to cater for safety and security concerns without expanding management spaces. Therefore, digitalization is increasingly intrinsic in urban planners designs in order to improve controlled public spaces. Thus, digital transitions related to new urban economies is able to create circular economy elements such as sharing cities/economies and other social innovations. Digitalization also enhance sustainable energy and mobility transitions. This new technology helps improving a secure use for public spacing in both safety and health needs, by giving the opportunity of controlled accessibility, capacity limitation and social distance considerations.

8. Recommendations:

Urban robustness became a key element that can help in improving human physical and mental health. Hence, in order to create more healthier quality of life, there are some specific guidelines to be followed. These are:

- Considering health arguments in Urban planning.
- Respecting social connection for better mental health.
- Involving stakeholders in the urban reshaping design process to adapt the required changes of human behavior in using the urban space.
- Respecting the needs of women, children, elder users and disabilities for a safe access to green and public spaces.
- Achieving justice in distribution of urban spaces for different social levels.
- Developing solutions for crowded cities and transform them into healthier zones.
- Reshaping public urban spaces in order to improve consumption and urban conviviality.
- Developing digitalized control systems for green public spaces.
- Reviving all unused spaces in cities and create livable green ways.
- Studying solutions for crowded cities and transform them into healthier zones (Linear parks/ elevated or depressed greenways)

There are also some guidelines concluded form studying urban spaces adaptation during COVID-19 in different countries to help in increasing the access to green open spaces. These are:

- Creating of car-free/pedestrian zone
- Designing wider side walks
- The use of special cycleway
- Developing social distancing circles in public parks and squares
- Using QR code entry system
- Free online reservation to control users' capacity in the open public space

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