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How COVID-19 reshaped quality of life in cities: A synthesis and implications for urban planning

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ABSTRACT

This paper synthesizes knowledge on how the Coronavirus disease (COVID-19) pandemic reshaped the relationship between cities and quality of life. The possible impacts of cities on seven domains of quality of life – travel, leisure, work, social relationships, residential well-being, emotional responses, and health – during COVID-19 are reviewed. Findings indicate that the role of transport and land use, urban nature, public space, facilities and services, housing, and information and communications technology (ICT) in quality of life in cities was transformed during COVID-19. Access to healthcare facilities and services and local amenities; opportunities for walking and cycling; COVID-19-secure public transport; access to a car; urban blue or green space and access to nearby nature; easy access to open public space; living in a dwelling of sufficient size and quality; private or communal outdoor areas; and ICT infrastructure and systems possibly helped to mitigate the negative impacts of COVID-19 on quality of life in cities. Implications for urban planning and policy arise from the COVID-19 crisis, shedding light on ways to address inequities, support vulnerable groups, and improve quality of life in cities in times of pandemics but also under normal circumstances.

1. Introduction

The Coronavirus disease (COVID-19) pandemic has affected the lives of most citizens around the world. Quality of life domains and health and well-being outcomes worsened due to the pandemic in several parts of the world (Brooks et al., 2020; Fiorillo and Gorwood, 2020; Li et al., 2020; Moreno et al., 2020; Patrick et al., 2020; Rogowska et al., 2020; Vatavali et al., 2020; White and Van Der Boor, 2020). Quality of life in cities has been challenged and transformed under COVID-19. Due to lockdown measures and restrictions in mobility, the role of the dwelling, the local neighborhood, different transport modes, and information and communications technology (ICT) in quality of life changed. Inequities in how the negative impacts of COVID-19 on quality of life were distributed among citizens also started to become evident (Hu and Chen, 2021; Sharifi and Khavarian-Garmsir, 2020).

Understanding how COVID-19 reshaped the links between cities and quality of life is crucial for urban planning and policy as well as research purposes. This understanding can guide planners, practitioners, policy makers, and decision makers on how to develop equitable, livable, and environmentally friendly cities that are also resilient to pandemics (Allam and Jones, 2020; Rice, 2020). This understanding can additionally guide current and future research efforts investigating matters

related to quality of life in cities under COVID-19. However, despite ongoing research on specific attributes of cities and their impacts on specific life domains, the complete picture of how COVID-19 reshaped the links between cities and quality of life is missing in current literature. There is a need to synthesize knowledge on cities and quality of life under COVID-19.

This paper makes an initial attempt to address this need by providing a synthesis of current knowledge and a framework to guide future research. Based on the outcomes of the review, potential implications for urban planning and policy during COVID-19 and future pandemics are discussed. The research question explored here is “How has COVID-19 reshaped the relationship between cities and quality of life?”. Since the topic is broad and empirical research is ongoing, the paper is based on a synthesis of early research findings and elaboration on possible pathways between cities and quality of life under COVID-19. The focus is on physical elements of cities including land use, transport, urban design, housing, infrastructure, and ICT. These elements are examined within urban regions, so urban-rural differences are not investigated in detail. The review is structured upon an adaptation of an earlier conceptual model on urban quality of life (Mouratidis, 2021). Links between cities and seven domains of quality of life – travel, leisure, work, social relationships, residential well-being, emotional responses, and health –

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are reviewed. The paper’s conceptual model and literature review aim at providing a new framework that may guide future research on cities and quality of life under COVID-19.

The review presented in the paper is a synthesis of literature providing an overview of the state of knowledge for each domain of quality of life. The aim of the paper is to elaborate on the pathways between cities and quality of life under COVID-19 and not to provide an exhaustive review of literature. Also, the broad scope of the topic is not suitable for a systematic literature review. The review focuses mostly on peer-reviewed journal articles, while a few reports and articles in online magazines are also included. The reviewed literature is all written in English. Around 100 studies are included in the review. Literature search was performed via two main strategies: search in Scopus and Google Scholar for relevant publications for each of the seven domains mentioned above and backward snowballing (i.e. using the reference lists of relevant publications to identify new literature). Naturally, the review has limitations since several relevant publications had to be excluded to keep the literature more manageable. Nevertheless, the paper is expected to present the main trends found in literature.

2. COVID-19 reshaping the links between cities and quality of life

This review is organized based on the model shown in Fig. 1. The model is adapted from a previous conceptual model explaining the relationship between cities and quality of life (Mouratidis, 2021). The model suggests that this relationship can be explained through domains of quality of life (see e.g. Sirgy, 2012) that represent mediating pathways between cities and overall measures of subjective well-being. Subjective well-being is the subjective measurement of quality of life and can be distinguished into three components: life satisfaction (i.e. overall contentment with life), emotional well-being (or hedonic well-being or affect – i.e. experience of feeling, emotion, and mood), and eudaimonia (i.e. self-actualization and meaning in life) (Diener et al., 2018; OECD, 2013; Sirgy, 2012; Veenhoven, 2012). The aim of the review is to improve the understanding of how COVID-19 reshaped the links between cities and domains of quality of life, as shown in Fig. 1. Cities are examined in terms of land use, transport systems, urban design, housing, infrastructure, and ICT. Domains of quality of life (or simply life domains) that are examined here are: travel, leisure, work, social relationships, residential well-being, emotional responses, and health. All

these life domains contribute to subjective well-being and may also influence one another (Diener et al., 2018; Mouratidis, 2020; Sirgy, 2012). Interlinks between life domains are not displayed in the model to reduce complexity but are explained in the review below. Since life domains may be interlinked, the link between cities and a specific life domain may also be indirect via another life domain, as also illustrated in the review.

3. Cities and quality of life during COVID-19: a review

3.1. Travel

Travel within cities has been strongly restricted during certain phases of the COVID-19 pandemic with lockdowns, restrictions of out-of-home activities, and closing of destinations in order to control the spread of infection (Flaxman et al., 2020; Hadjidemetriou et al., 2020; Zhang et al., 2021). Restrictive measures were imposed by governments and organizations. Self-restrictions were also applied by residents themselves. As a result, the number of trips and the total travel distances substantially declined (de Haas et al., 2020). However, trips with certain transport modes declined more than others. Public transport had the steepest decline during COVID-19 in several contexts (Bucsky, 2020; Hu and Chen, 2021; Jenelius and Cebecauer, 2020; Shakibaei et al., 2021; Teixeira and Lopes, 2020). The risk of infection was considered higher for trips with public transport and users were more negative towards public transport than towards other modes during COVID-19 (Shamshiripour et al., 2020). Although, residents often considered public transport a high-risk travel mode in terms of virus transmission, there is research indicating that public transport ridership was not associated with COVID-19 infection (Hamidi and Hamidi, 2021) and that car driving might have spread the disease more than public transport possibly because car drivers traveled more often, more freely, and longer distances during the pandemic (Furth, 2020; Levy, 2020). Residents’ perceptions towards public transport improved in areas where restrictions were lifted and life slowly returned to normal (Beck and Hensher, 2020). During the pandemic, a large proportion of residents stopped traveling by motorized vehicles while several residents switched from public to private transport modes (Pawar et al., 2020). It was observed that trips, and especially those with public transport, were more significantly reduced in areas of higher socioeconomic status (Hu and Chen, 2021). In areas of lower socioeconomic status, more people

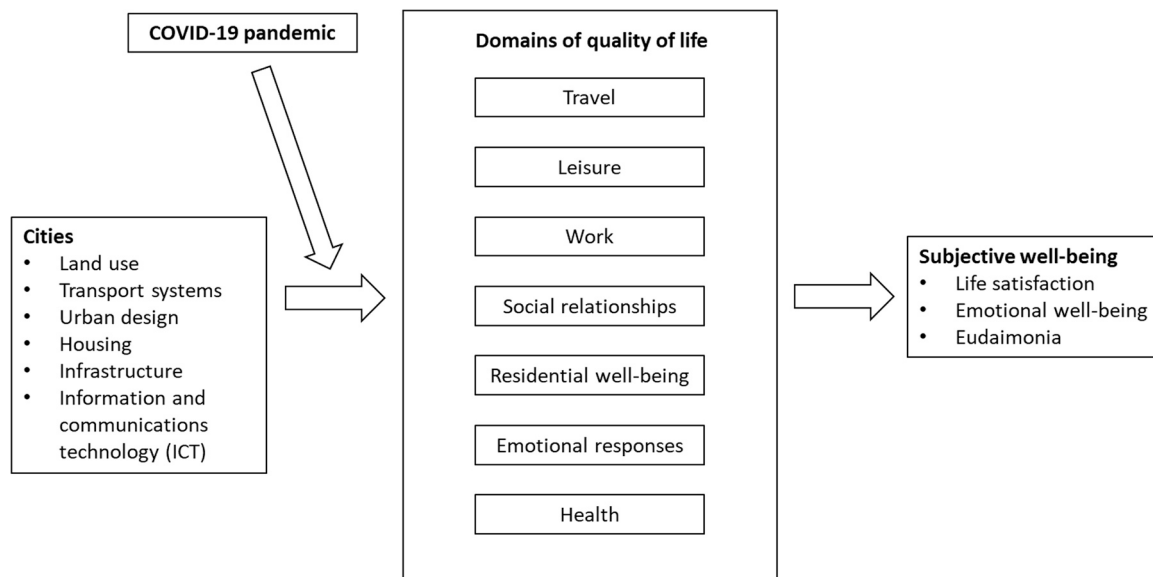


Fig. 1. COVID-19 reshaping the links between cities and quality of life. Adapted from Mouratidis (2021).

are occupied in jobs requiring physical presence, and therefore continued to travel to work when COVID-19 restrictions allowed it. Active travel modes such as walking and cycling as well as the private car were considered to pose a lower risk of infection and thus had a less steep decline in usage than public transport (Shakibaie et al., 2021; Teixeira and Lopes, 2020).

Cities and neighborhoods contributed to quality of life during COVID-19 by supporting certain transport systems over others. Walking and cycling were relatively safe during COVID-19, so walkable and bikeable environments enabled daily-life travel for short or mid-range distances. Walkability and bikeability also enabled walking and cycling as physical activity. This was especially important during COVID-19 when several other forms of physical activity were not possible. Compact urban environments tend to be more transit-oriented, walkable, and cyclable than low-density suburban-type environments. Residents in compact, walkable, transit-oriented areas often rely on active travel modes for local errands and therefore experienced relatively safe and carefree trips when traveling locally. These residents, however, are likely to be dependent on public transport for medium and long distances, thus possibly faced a risk of infection when using public transport modes, at least in certain contexts (Zheng et al., 2020). Self-restrictions were stronger and the necessity of reducing their travel was higher for those residents as they had to protect themselves from being infected. And when they had to travel by public transport, those residents might have been exposed to the virus and to related fear and stress. Longer commutes by public transport might have contributed to a higher risk of SARS-CoV-2 infection according to some studies (Hu et al., 2021). The quality of public transport services, their frequency, and the preventive measures used on board are also expected to have affected the risk of infection and related emotional well-being (Gkiotsalitis and Cats, 2020; Jones et al., 2020). Overall, urban compactness might have had counteracting effects on mobility-related quality of life during COVID-19: public transport dependency has been possibly negative, whereas walkability and bikeability have been possibly positive for quality of life during COVID-19. Empirical research is needed to reliably examine these relationships and their implications. Car-oriented environments have facilitated traveling longer distances by car within urban regions, when restrictive measures allowed, without being exposed to high risk and fear of infection, at least when traveling alone. Of course, access to a car was a prerequisite for that. Generally, those without access to a car had a relative disadvantage in terms of safe urban mobility for longer distances during COVID-19. However, as mentioned above, car driving might have contributed to virus transmission possibly because car drivers traveled more during the pandemic (Furth, 2020; Levy, 2020).

COVID-19 forced severe reductions in travel but also triggered a boom in online activities aiming at replacing in-person activities. Online activities (or teleactivities) such as telework, teleconferencing, online shopping, telehealth, online learning, and teleleisure increased during COVID-19 (e.g. Eurofound, 2020; Marcucci et al., 2021; Mouratidis and Papagiannakis, 2021; Pierce et al., 2021). These activities were performed mainly from home and replaced, at least to some extent, in-person work, meetings, shopping, health services, learning, and leisure. They also replaced related travel for physical participation in these activities (de Haas et al., 2020; Shamshiripour et al., 2020). The replacement of in-person activities and related travel would not have been possible if ICT did not allow people to remotely perform several types of activities. Replacing travel with online activities, however, was not possible for all types of activities. Overall, ICT and online activities have likely played a mostly positive role in mobility and quality of life during COVID-19 as they enabled at least some people to participate in some activities without being exposed to the risk of infection related to travel. This benefit, however, was not equally distributed. Numerous people worldwide did not have the opportunity to substitute in-person activities with online activities because of the type of employment (professions that require physical presence) or the lack of equipment,

resources, and infrastructure (e.g. lack of or poor internet connection, lack of personal computer or smartphone, small dwelling). The increasing use of ICT for daily-life activities triggered by COVID-19 may have negative impacts on the lives of certain groups of people, such as those with lower socioeconomic background who may not have access to a computer or internet, those who live in areas with limited or no internet connection, those who lack ICT skills, and those with disabilities that make ICT use less accessible (Dhawan, 2020; Maatuk et al., 2021). The substitution of in-person activities with remote online activities may also have negative implications for certain household types. Individuals who live alone and older adults might have experienced greater isolation during COVID-19 due to the lack of in-person interaction (Hwang et al., 2020). Families with small children, especially single parents, often faced difficulties performing daily-life activities when their children had to do online learning at home due to closed kindergartens and schools during lockdowns (Freisthler et al., 2021; UN Women, 2020; Westrupp et al., 2021).

3.2. Leisure

Cities enable leisure well-being mainly by providing access to facilities, green spaces, and open public spaces (Carmona, 2019; Mouratidis, 2019a). Although several facilities were closed during the COVID-19 in many cities worldwide, some facilities remained open in certain cases. The presence of and proximity to local facilities that could be used for leisure activities was important for leisure well-being during COVID-19 due to mobility restrictions and the risk of infection when traveling, especially by public transport. Green spaces were considered to be increasingly important during COVID-19 as they provided space for performing leisure activities with a lower risk of infection (Douglas et al., 2020; Shoari et al., 2020; Ugolini et al., 2020; Xie et al., 2020). When restrictive measures allowed, green spaces were used, among others, for physical activities, social activities, and cultural activities. Open public spaces such as public squares and streets were also important for similar purposes (Honey-Rosés et al., 2020). Private or communal outdoor spaces attached to housing might have fostered leisure activities such as gardening which was beneficial for well-being during COVID-19 (Corley et al., 2021). Cities and neighborhoods with good access to nearby nature – e.g. forest, sea, mountain – also facilitated leisure activities such as hiking, skiing, swimming, running, cycling, and socializing with low risk of infection, when lockdown measures allowed. Due to spending a significantly larger amount of time at home, the dwelling and its characteristics were more important for leisure during COVID-19 than before COVID-19. Larger dwellings might have facilitated daily-life activities and online leisure activities (teleleisure). Thereby, living in a larger dwelling might have provided well-being and mental health benefits during the pandemic (Amerio et al., 2020).

3.3. Work

Cities may influence work-related quality of life by enabling or restricting job opportunities and work activities (Brenner et al., 2009; Glaeser, 2011; Glaeser et al., 2001). Some cities were more severely affected by COVID-19 than others. City size might have played a role in COVID-19 infections. Larger urban regions were related to more infections in the beginning of the pandemic (Hamidi et al., 2020; Ribeiro et al., 2020; Stier et al., 2020). Urban density was not associated with the spread of COVID-19 in several contexts (Carozzi, 2020; Hamidi et al., 2020; Sharifi and Khavarian-Garmsir, 2020), while it was linked to higher COVID-19 spread in certain contexts (Bhadra et al., 2021). Cities and residential areas that were more severely affected by COVID-19 possibly experienced more severe economic damages (Sheridan et al., 2020). Residents living in such cities and areas were thus more likely to have experienced reductions in work activity, loss of income, suspension from work, and unemployment. These, in turn, possibly had substantial

negative impacts on quality of life (Blanchflower et al., 2014; Diener et al., 2018). The impacts of the COVID-19 economic crisis tend to be more negative for women as they are likely to have lower income and fewer savings, they are more likely to be informal workers, they are more likely to be undertaking unpaid care and domestic work thus having to leave their jobs, and they are more likely to be single parents (Bahn et al., 2020; UN Women, 2020).

Moreover, some professions were more strongly affected by the COVID-19 pandemic and subsequent economic damages. For example, manual work, informal work, and certain critical-worker occupations (involved in health and social care, education and childcare, key public services, local and national government, food and other necessary goods, public safety, and national security, transport and border, utilities, communication, and financial services) require face-to-face and physical interactions and specific locations, while information jobs tend to require minimal physical interactions and have flexible locations, such as working at home. Professions differ across cities and residential locations. The concentration of residents whose professions were less resilient to COVID-19 in certain cities and residential areas may then result in lower overall well-being in these cities and areas.

Cities also contribute to work-related quality of life indirectly by providing or restricting access to workplaces, physically and, more recently, virtually. Transport systems, land use, and urban design collectively contribute to providing physical access to workplaces. The implications for quality of life of different types of access to destinations during COVID-19 have been explained in detail in Section 3.1 above. Cities favoring access to workplaces by public transport might have had negative implications for quality of life during COVID-19, while cities favoring access to workplaces through walking, cycling, but also car had possibly positive implications for quality of life during COVID-19. Long commute times by public transport were likely to have negative health and well-being implications during COVID-19 (Hu et al., 2021; Shamshiripour et al., 2020). Cities favoring longer commutes by public transport thereby might have negatively affected work-related and overall quality of life. Also, enabling virtual access to workplaces was particularly important during COVID-19. Cities and areas with good ICT infrastructure and systems were able to provide opportunities for telework, replacing physical access to workplaces for certain professions. This allowed to some extent the continuity of economic activity and mitigation of unemployment and suspension from work, which would have a substantial negative influence on quality of life (Blanchflower et al., 2014). The dwelling also played a role in telework and work-related quality of life. Living in a larger, high-quality dwelling provided more opportunities to perform work-related activities at home without disruption and stress.

3.4. Social relationships

Social relationships and social well-being were negatively affected by COVID-19 and especially for vulnerable groups (Brooke and Jackson, 2020; Macdonald and Hülür, 2020; Thoresen et al., 2021). Cities contribute to social well-being by enabling or restricting social interaction and the formation of social ties on different spatial scales (Mouratidis, 2018a; Small and Adler, 2019; Williams and Hipp, 2019). This role of cities was largely disrupted due to the pandemic. Some attributes of cities however were particularly important and possibly more important during COVID-19 than before COVID-19. Open spaces, such as public squares, parks, gardens, and pedestrian zones were crucial for social interaction with a lower risk of infection. They often offered the only space for in-person social interaction during lockdowns in cities. In certain periods and certain contexts, some “third places” – such as cafes, restaurants, shops, cultural spaces, and libraries – remained open during the pandemic. These places provide opportunities for social interaction and the formation of new social ties (Mouratidis, 2018a; Oldenburg, 1999; Williams and Hipp, 2019) and continued to provide such opportunities during the pandemic, when accessible and open. Third places

with outdoor areas also provided space for social interaction with a lower risk of infection. ICT was very important for virtual social interaction during the pandemic. Cities with good ICT infrastructure positively contributed to that aspect, mitigating related negative implications of the pandemic such as isolation, loneliness, and mental health issues. Finally, larger dwellings enabled socializing with greater social distancing and a somewhat lower risk of infection. In contrast, living in a small dwelling might have prevented residents from holding social gatherings at home, when these were allowed, or might have exposed them to insufficient social distancing when gatherings were held. Dwellings with private open spaces might have also fostered social interaction with a lower risk of infection.

3.5. Residential well-being

Residential well-being refers to “residents’ perceptions of quality of life of their community” (Sirgy, 2012, p. 303). It can be evaluated on different spatial scales ranging from the dwelling, the neighborhood, and the city or urban region. Local amenities, green space, and open public space all play an important role in residential well-being (Kent and Thompson, 2014; Mouratidis, 2018b; Pfeiffer and Cloutier, 2016; Zhang et al., 2017). These attributes were particularly important during COVID-19. Walkable access to a variety of local amenities enabled participation in activities and facilitated healthcare provision (Guida and Carpentieri, 2021; Hamidi et al., 2020; Litman, 2020). Green spaces and open public spaces were used for physical activities, social activities, and cultural activities and helped mitigate the negative implications of COVID-19 for quality of life (Honey-Rosés et al., 2020; Pouso et al., 2021). Safety is also a key factor for residential well-being. During COVID-19 lockdowns, crime rates dropped in several parts of the world (Ashby, 2020; Gerell et al., 2020; Halford et al., 2020; Neanidis and Rana, 2021) and this drop was particularly large in city centers, according to research from the United Kingdom (Langton et al., 2021). The importance of housing characteristics and housing conditions for quality of life substantially grew during COVID-19. People spent more time and performed a larger number of activities at home. Thus, larger dwellings might have positively contributed to residential well-being during COVID-19. For the same reasons, private open spaces such as gardens and balconies, attached to homes, might have also positively contributed to residential well-being during COVID-19 (Lehberger et al., 2021; Poortinga et al., 2021).

3.6. Emotional responses

The built environment may influence emotional responses (affective experiences) in the city through several mechanisms including blue and green space, travel, noise, and dwelling attributes (Chatterjee et al., 2020; Markevych et al., 2017; Mouratidis, 2019b; Wang and Wang, 2016). Due to mobility difficulties during COVID-19 that prevented people from traveling for leisure and nature visits, local blue-green space possibly had an even more important role in triggering positive emotional responses (Cheng et al., 2021; Pouso et al., 2021). Private green space such as private gardens and balconies as well as the view of blue-green space from the dwelling might have provided stress-reducing and mental restoration benefits, especially when lockdown measures were strict (Ugolini et al., 2021). Travel was more stressful during COVID-19 due to the risk of infection, so cities promoting safer travel (see Section 3.1 for details) were likely to contribute to less negative emotional responses to travel. Cities, and especially high-density areas, were less noisy than usual during COVID-19 and this might have had positive implications for emotional well-being (Basu et al., 2021; Rumpler et al., 2020). Larger, high-quality dwellings might have been less stressful and more pleasant during COVID-19 lockdowns, thus contributing to more positive – or less negative – emotions (Amerio et al., 2020).

3.7. Health

The links between cities and health might be affected by COVID-19 through many of the mechanisms related to the other life domains above but also through additional mechanisms. The spread of COVID-19 appeared to be faster in larger cities in the beginning of the pandemic (Hamidi et al., 2020; Ribeiro et al., 2020; Stier et al., 2020) but then progressed to smaller cities and rural areas (AbouKorin et al., 2021; Cuadros et al., 2021; Paul et al., 2020). The density of cities was not related to COVID-19 spreading in some contexts (Carozzi, 2020; Hamidi et al., 2020; Sharifi and Khavarian-Garmsir, 2020), but it was related to faster COVID-19 spread in other contexts (Bhadra et al., 2021). Evidence from New York suggests that crowding and point-of-interest destinations, but not population density, have facilitated the spread of SARS-CoV-2 virus within the city (Hamidi and Hamidi, 2021). Access to appropriate healthcare facilities and services was crucial for health outcomes during COVID-19. Larger cities are likely to provide more healthcare infrastructure and services and compact urban form provides easier access to healthcare. Large city size and higher urban compactness might have thus helped manage the disease and mitigate negative health impacts (Guida and Carpentieri, 2021; Hamidi et al., 2020; Litman, 2020; Ribeiro et al., 2020). Rural areas, on the other hand, often had higher death rates from COVID-19 due to older populations, less developed healthcare services, and greater distance to hospital (Dobis and McGranahan, 2021).

COVID-19 test facilities in cities were crucial for managing and limiting the spread of the virus but also for residents to be able to resume a more normal life during the pandemic (Peto, 2020). It is therefore important that cities provide good access to test facilities especially in the most vulnerable neighborhoods where residents may not have access to proper healthcare (Lieberman-Cribbin et al., 2020).

Green spaces (e.g. parks, gardens) and open public spaces (e.g. public squares, pedestrian zones) became more essential during COVID-19 than before as they often provided the only urban space that could be used for physical activities, social activities, and cultural activities (Honey-Rosés et al., 2020; Ugolini et al., 2020). Important benefits of blue and green spaces for emotional well-being and mental health were reported during COVID-19 (Poortinga et al., 2021; Pouso et al., 2021; Shoari et al., 2020; Xie et al., 2020). Good access to nearby nature – e.g. forest, sea, mountain – also enabled urban residents to perform leisure activities and enjoy restorative and stress-reducing benefits. Due to these functions, ensuring good access to urban blue-green space and nearby nature was among the major strategies recommended to mitigate the physical and mental health impacts of COVID-19 in cities (Douglas et al., 2020; Slater, et al., 2020).

The quality and frequency of public transport services and the preventive measures on board might have contributed to virus transmission (Gkiotsalitis and Cats, 2020; Jones et al., 2020). Some studies suggest that public transport contributed to higher virus transmission during the COVID-19 pandemic (Zheng et al., 2020) while others find no association between public transport ridership and virus transmission (Hamidi and Hamidi, 2021). Residents using public transport in cities were, nevertheless, more exposed to the virus and its negative health effects compared to those who walked, cycled, or drove a car alone. Travel might have also played a role in emotional well-being and mental health during COVID-19 as it was generally more stressful due to the risk of infection. Cities enabling walking, cycling, and car use during COVID-19 might have managed to mitigate some of this travel-related stress.

Noise levels, a frequent problem in cities, were considerably lower during COVID-19 due to restricted urban mobility and this might have positively contributed to emotional well-being and mental health (Basu et al., 2021; Rumpler et al., 2020). Air pollution was also considerably lower during COVID-19 (Sharifi and Khavarian-Garmsir, 2020) with possible positive impacts on physical health.

The importance of housing characteristics and housing conditions substantially increased during COVID-19. More infections were reported

in overcrowded dwellings possibly due to the difficulty in maintaining social distances and quarantine in tight spaces (Hu et al., 2021). Since residents spent a greater amount of time at home, dwelling size and quality might have also contributed to mental health during the pandemic. Larger, high-quality dwellings were likely less stressful, more functional, and more pleasant during COVID-19 lockdowns, resulting in better mental health outcomes (Amerio et al., 2020). Ventilation was also important for the indoor spread of COVID-19; poorly ventilated indoor spaces were more likely to contribute to virus transmission (Bhagat et al., 2020; Sun and Zhai, 2020). Dwellings with green or blue nature view from the windows and access to private outdoor spaces such as a garden or balcony were linked to better mental health and subjective well-being during the pandemic, especially in cases where public green spaces were not available or were restricted (Poortinga et al., 2021; Pouso et al., 2021).

ICT was particularly important for health during COVID-19. ICT infrastructure and related services provided options for managing COVID-19 but also other health issues remotely through telehealth (North, 2020; Perrin et al., 2020; Pierce et al., 2021). ICT also had several other crucial functions during COVID-19 as it enabled people to perform a number of daily-life activities remotely without the risk and stress of infection. Such remote online activities were teleworking, teleconferencing, online learning, online shopping, teleleisure, and online socializing (Mouratidis and Papagiannakis, 2021). Although these activities were not always possible and could not always completely substitute in-person activities, they helped mitigate the negative impacts of COVID-19 on well-being and mental health. However, as explained in Section 3.1, these benefits of ICT were not enjoyed by all groups of people; the increasing use of ICT might have had even negative impacts on the lives of certain groups or household types.

4. Summary and discussion of urban planning implications

The review provided in Section 3 has attempted to synthesize early findings on how COVID-19 reshaped the relationship between cities and quality of life. Theoretical elaborations have also been included, offering a discussion of possible mechanisms through which COVID-19 might have reshaped this relationship. Quality of life has been organized in seven life domains: travel, leisure, work, social relationships, residential well-being, emotional responses, and health. Possible impacts and pathways between cities and quality of life under COVID-19 are summarized in Table 1.

Table 1 also presents potential implications of the review for urban planning and policy in times of COVID-19 as well as future pandemics. COVID-19 has substantially reshaped quality of life in cities but has also provided important lessons for pandemic-resilient urban planning and policy. It has also unveiled that the negative impacts of pandemic events on quality of life in cities may not be equally distributed. Residents without access to healthcare facilities and services and other amenities, without opportunities for walking and cycling, without access to a car or to COVID-secure public transport, without access to urban blue-green space or nature, without a dwelling of sufficient size and quality, without access to a private or communal outdoor area, or without access to ICT infrastructure and systems have most likely endured lower overall quality of life due to COVID-19 pandemic compared to more privileged residents. Researchers, planners, practitioners, and policy makers should reflect upon these challenges and take action to address inequities, support vulnerable groups, and improve quality of life in cities for everyone in times of pandemics as well as under normal circumstances. In Table 1, there has been an attempt to present potential implications for urban planning and policy based on the outcomes of the review. These implications are explained below.

The impacts of *land use and transport* on quality of life were reshaped during COVID-19. Public transport was challenged during the pandemic. This of course should not imply that public transport should be weakened or neglected under pandemic periods or post-COVID-19 times. On

Table 1
Cities and quality of life under COVID-19 and potential implications for urban planning and policy.

Theme	Cities and quality of life under COVID-19	Urban planning and policy for COVID-19 and future pandemics
Transport and land use	<ul style="list-style-type: none"> - Higher risk of infection in public transport compared to other modes according to some studies - Public transport ridership was not associated with COVID-19 infection according to other studies - Public transport more negatively perceived by residents than other modes and had the steepest decline among transport modes - Residents' perceptions towards public transport improved in areas where restrictions were lifted, and life slowly returned to normal - Residents dependent on public transport, especially those with jobs requiring physical presence, were likely exposed to more health risks and more travel-related stress - Walking, cycling, and the private car (when driving alone) were safer and less stressful - Residents with access to a car had the opportunity to travel longer distances to participate in activities with a lower risk of infection and less travel-related stress - Walkability and bikeability were particularly important as they enabled safer travel combined with physical activity - Quality and frequency of public transport services and preventive measures on board might have contributed to virus transmission and emotional response to travel - Long commutes were linked to a higher risk of infection and possibly had negative health and well-being implications - Compact urban form might have had contrasting travel-related impacts: public transport dependency was possibly negative, whereas walkability and bikeability were possibly positive for quality of life during COVID-19 - Reduced mobility and reduced activity in general resulted in lower noise levels and air pollution in cities 	<ul style="list-style-type: none"> - Maintain frequent public transport services especially during rush hours - Good air ventilation in public transport vehicles, frequent disinfection of public transport vehicles, strict measures to maintain social distancing on board, wearing face masks on board, and prevent overcrowding on board by setting limits on the number of passengers - Walkability and bikeability improvements - Facilitate bikesharing and e-scooter sharing during pandemics - Enable carsharing options during pandemics for those who do not own a car - Additional carsharing support during pandemics for poorer households that do not own a car
Urban blue-green space and nearby nature	<ul style="list-style-type: none"> - Urban blue-green space and nearby nature provided essential space for performing physical activities, social activities, and cultural activities with a lower risk of infection - Private outdoor spaces might have fostered leisure activities such as gardening and social interaction with a lower risk of infection - Due to travel restrictions, access to local blue-green space might have had an even more important role in triggering positive emotional responses - Private green space such as private gardens and balconies as well as the view of blue-green space from the dwelling might have provided stress-reducing and restorative benefits, especially when lockdown measures were strict - Important benefits of blue and green spaces for emotional well-being and mental health were reported 	<ul style="list-style-type: none"> - Develop/maintain urban blue-green space, trees, and other types of vegetation - Preserve nearby nature - Ensure good access to urban blue-green space and nearby nature - Develop/maintain private or communal green space attached to housing
Open public spaces (public squares, pedestrian zones, streets)	<ul style="list-style-type: none"> - Provided essential space for performing physical activities, social activities, and cultural activities with a lower risk of infection 	<ul style="list-style-type: none"> - Develop/maintain accessible, inclusive open public spaces
Facilities and services	<ul style="list-style-type: none"> - Access to appropriate healthcare facilities and services was crucial for health and well-being during the pandemic - Larger cities are likely to provide more healthcare infrastructure and services which might have helped manage the disease - Compact urban form might have provided easier access to healthcare facilities and services - Due to mobility restrictions and the risk of infection when traveling by public transport, local facilities that could be used for leisure activities were important for leisure and residential well-being - "Third places" – such as cafes, restaurants, shops, cultural spaces, and libraries – might have provided opportunities for social interaction and formation of new social ties during the pandemic, when accessible and open - Third places with outdoor areas also provided space for social interaction with a lower risk of infection 	<ul style="list-style-type: none"> - Ensure good access to healthcare infrastructure and services - Mix residential and commercial land uses and develop local neighborhood centers to provide walkable access to a variety of local facilities and third places - Establish test facilities especially in the most vulnerable neighborhoods
Housing	<ul style="list-style-type: none"> - COVID-19 test facilities in cities allowed residents to be able to resume a more normal life during the pandemic - More infections were reported in overcrowded dwellings possibly due to the difficulty in maintaining social distances and quarantine - Larger dwellings have facilitated daily-life activities and teleactivities including telework, teleconferencing, and online leisure activities - Larger dwellings might have enabled socializing with greater social distancing and a somewhat lower risk of infection - Poorly ventilated indoor spaces were more likely to contribute to virus transmission - Larger, high-quality dwellings might have been less stressful, more pleasant, and more functional during lockdowns, thus contributing to 	<ul style="list-style-type: none"> - Establish housing standards to ensure adequate housing conditions and sufficient ventilation - Set minimum dwelling sizes and provide housing support to poorer households to prevent overcrowded dwellings - Develop appropriately designed multifunctional shared spaces in neighborhoods with smaller dwellings where residents can perform activities with a low risk of infection

(continued on next page)

Table 1 (continued)

Theme	Cities and quality of life under COVID-19	Urban planning and policy for COVID-19 and future pandemics
Information and communications technology (ICT)	<p>more positive – or less negative – emotions and better mental health outcomes</p> <ul style="list-style-type: none"> - ICT infrastructure and systems provided options for managing COVID-19 but also other health issues remotely through telehealth services - ICT enabled people to perform several of their daily-life activities remotely without the risk of infection and the related psychological stress - Thus, remote online activities including teleworking, teleconferencing, online learning, online shopping, teleleisure, and online socializing helped mitigate the negative impacts of COVID-19 on quality of life - Benefits of ICT were not enjoyed by everyone; certain groups or household types might have experienced negative impacts 	<ul style="list-style-type: none"> - Develop and maintain sufficient ICT infrastructure, systems, and services - Provide material and educational ICT-related support to vulnerable groups to prevent the exclusion from participating in teleactivities

the contrary, public transport should be supported even further to ensure equitable and sustainable mobility. Possible suggestions for ensuring lower virus transmission and lower travel-related stress for those who cannot avoid using public transport during pandemics are to maintain frequent public transport (especially in the busiest times), provide proper air ventilation in public transport vehicles, disinfect public transport vehicles on a frequent basis, apply strict social distancing measures on board, ensure that passengers wear face masks on board, and prevent overcrowding in public transport by setting limits on the number of passengers. Walkability and bikeability contribute to pandemic-resilient mobility since walking and cycling offer a low risk of infection together with health and well-being benefits. Bikes sharing and e-scooter sharing could be facilitated during pandemics as substitutes for (a part of) public transport use. Carsharing options could be considered as an alternative for necessary mid- or long-distance travel for those who do not own a car. Additional carsharing support could be provided to poorer households that do not own a car to reduce inequities related to transport-related impacts of pandemics.

Urban blue-green space and nearby nature were crucial for mitigating the negative impacts of COVID-19 on quality of life by providing safe a space for activities together with emotional and mental health benefits. Cities would need to develop or maintain urban blue-green space, trees, and other types of vegetation and preserve nearby nature. Facilitating access to blue-green space and nature is also key so that residents can enjoy their health and well-being benefits. Regulations and planning laws could also consider the additional benefits of ensuring some type of private or communal green space attached to housing.

Open public spaces such as public squares, pedestrian zones, and streets were essential during COVID-19 as they provided space for performing physical activities, social activities, and cultural activities with a lower risk of infection. The necessity of open public spaces was highlighted especially in cities and neighborhoods that lack such spaces. Residents of compact urban areas that lacked open public spaces often had to encounter stricter lockdown measures and more home isolation because gathering in the limited open public spaces did not allow safe social distancing. These implications of COVID-19 suggest that urban planning should strive to develop and maintain accessible, inclusive open public spaces for all urban residents.

Facilities and services contributed to quality of life under COVID-19 in two main ways. Healthcare facilities and services provided healthcare to residents, while other types of amenities, when open, enabled the participation in some daily-life activities including education, social interaction, culture, recreation, and physical activities. To maintain these functions, cities need to ensure that they provide good access to quality healthcare facilities and services and to a variety of local amenities.

The importance of *housing* for quality of life in cities dramatically grew during COVID-19 as urban residents had to spend substantially larger amounts of time at home. The quality of life of residents of small,

overcrowded, and poor-quality dwellings likely endured more negative impacts from COVID-19. This highlights the need to address inequities in housing by establishing housing standards that ensure adequate housing conditions, sufficient ventilation, and minimum dwelling sizes and by providing additional housing support to poorer households to prevent overcrowded dwellings. Moreover, multifunctional shared spaces, specifically designed for pandemics, could be developed in neighborhoods with smaller dwellings allowing residents to perform daily-life activities with low risk of infection.

ICT was boosted by the COVID-19 pandemic. Teleactivities were institutionalized and ICT infrastructure, systems, and skills all expanded due to the important mitigating role of teleactivities during COVID-19. ICT enabled telehealth (or telemedicine) that helped manage COVID-19 as well as other health issues, replacing some part of in-person healthcare services. Additionally, ICT enabled people to perform several of their daily-life activities remotely without the risk of infection and the related psychological stress via remote online activities (teleactivities) including teleworking, teleconferencing, online learning, online shopping, teleleisure, and online socializing. To ensure that this mitigating role of ICT is enjoyed by all residents, cities would need to develop and maintain sufficient ICT infrastructure, systems, and services and provide relevant material and educational support to vulnerable groups.

The links between cities and quality of life under COVID-19 as well as under normal circumstances may vary based on the context. The implications discussed here should be interpreted with caution considering the particularities of the local context. Customized context-specific recommendations need to be developed to guide urban planning and policy around the world.

5. Conclusions

COVID-19 has affected the quality of life of almost every urban resident worldwide. This paper has tried to synthesize early knowledge on how COVID-19 reshaped the relationship between cities and quality of life. The review has presented possible impacts of different physical elements of cities on seven domains of quality of life – travel, leisure, work, social relationships, residential well-being, emotional responses, and health – during COVID-19 and has elaborated on potential pathways linking cities to these life domains during the pandemic.

Outcomes from the review highlight that the role of transport and land use, urban blue-green space and nature, open public space, facilities and services, housing, and ICT in quality of life in cities has changed during COVID-19. Access to healthcare facilities and services and local amenities; opportunities for walking and cycling; COVID-19-secure public transport; access to a car; urban blue or green space and access to nearby nature; open public space; living in a dwelling of sufficient size and quality; private or communal outdoor areas; and ICT infrastructure and systems have possibly helped to mitigate the negative impacts of

COVID-19 on quality of life in cities. Lessons from COVID-19 underline the need to address inequities, support vulnerable groups, and improve quality of life in cities in times of pandemics and under normal circumstances.

Further research is needed to obtain a more complete picture of how COVID-19 reshaped the links between cities and quality of life. Empirical research is ongoing. Several pathways have not been yet empirically examined. Research evidence on other pathways is not yet mature. Systematic reviews of literature for specific life domains are needed when empirical evidence is more complete and more mature. Future context-specific reviews will also be useful to provide a more concrete understanding of local contexts.

CRedit authorship contribution statement

Kostas Mouratidis: Conceptualization, Methodology, Investigation, Formal analysis, Visualization, Writing – original draft, Writing – review & editing.

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