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A systematic review of older adults' travel behaviour and mobility during COVID-19 pandemic: Lessons learned for sustainable transport provision and healthy ageing

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A systematic review of older adults' travel behaviour and mobility during COVID-19 pandemic: Lessons learned for sustainable transport provision and healthy ageing

Abstract

The COVID-19 pandemic caused significant disruptions to the travel and mobility of various population groups worldwide. These impacts were more pronounced for older adults, who, in various countries around the world, were instructed to quarantine for prolonged periods and avoid contact with others. The impact of these disruptions has been differently experienced between countries and geographical regions with levels of economic development and transport infrastructures playing a role. The aim of this article is firstly, to critically synthesise scientific literature about changes in travel behaviour and transport choices of older adults caused by the responses to the COVID-19 pandemic in various countries, secondly, highlight the main gaps in the literature and finally, provide avenues for future research and transport policies. Findings indicate inequalities in access to transport explained by built environment design and policies adopted by governments to control the pandemic, as well as socio-economic and developmental factors. The implications of these findings for transport provision and increased mobility for older adults in the post-pandemic world are outlined. Finally, we discuss the importance of active ageing policies, which could create more transportation options to support older adults' mobility needs and access in the post COVID-19 era in both high- and low-income countries.

Keywords: mobility, travel behaviour, older adults, travel inequality, COVID-19

1 Introduction

The COVID-19 pandemic significantly impacted transport and travel. Responses to COVID including quarantine and lockdown measures severely limited people's out of home mobility, with older people highly impacted because of the focus on their greater susceptibility to the disease (Carney et al., 2022; Jordan et al., 2020; Leppä et al., 2021; Liu et al., 2021). Lockdown policies designed to mitigate the spread of coronavirus and protect older adults, also acted to restrict life-space mobility in the environment beyond the home (Perracini et al., 2021; Portegijs et al., 2021). Older people globally were instructed or advised to quarantine for prolonged periods and avoid contact with others to a greater extent than other adults (Abootalebi et al., 2021; Hino & Asami, 2021). It is well established that out of home mobility and transport are

essential to continuing independence for older people and fundamental to physical and mental well-being. Transport and mobility are also vital to the social inclusion, economic and civic participation of older people (Chung et al., 2021; Pantelaki et al., 2021; Rogers & Musselwhite, 2023; World Health Organisation, 2018). Thus, reduced mobility is linked to adverse outcomes such as social isolation, reduced well-being, and negative health consequences (De Vos, 2020; Rogers & Musselwhite, 2023; Schwanen & Ziegler, 2011). Policies that potentially saved lives may have also caused harm in other ways through physical limitations and setbacks e.g., (Leppä et al., 2021; Zingmark et al., 2022) social isolation (Abootalebi et al., 2021) and mental health and well-being issues (Giebel et al., 2020; Liu et al., 2021). It is therefore important to examine the circumstances and impacts of COVID-19 responses and policies on older people's out of home mobility, in order to understand any negative consequences that these policies may have on older people across different regions globally. and where the balance point between protection and harm might be. If the global experience is to suffer further pandemics, then what lessons might be learned that would improve responses?

In this review, we set out to critically synthesise literature about older people's transport and mobility during the COVID-19 pandemic to highlight the main gaps and offer insight for future avenues of research and policy recommendations. Literature concerning the transport and mobility of older people during COVID-19 involves some clarification for the purpose of this review. The meaning and inextricable nature of transport and mobility are outlined in section 2 below, in that both mobility and transport can be necessary to facilitate community, social and economic activity. Inclusion was considered for papers referring to habitual transport (e.g., not air travel or tourism) and mobility (e.g., walking). The age range was set according to a WHO report regarding the definition of older people which states that while in most developed nations, older age is deemed to begin around the ages of 60-65 which is often the normal retirement age, the situation is less clear cut in some places such as sub-Saharan Africa, where people do not tend to record birth date or use retirement policy as delineators of ageing. Older age or 'elder' tends to apply to people between the ages of 50-65 (Kowal & Dowd, 2001). As this paper examines literature covering all global regions, the age of 50 and above was used to ensure capture of all delineations of older people.

Synthesis of the articles selected indicates a general decline in transport usage amongst older adults. Although some were able to use individualised modes of transport such as driving, walking, or cycling, an increase in social isolation brought about by lockdown measures was indicated. Access to transport could also be dependent on mode, and ability to choose a mode (Leppä et al., 2021; Shaer & Haghshenas, 2021a, 2021b; Zingmark et al., 2022). Safeguarding measures were investigated in various parts of the globe to understand the repercussions of reducing mobility for older people and findings highlight inequalities in access to transportation options across and within countries, whereby the already vulnerable tended to become even more vulnerable (Abootalebi et al., 2021; Carney et al., 2022; Giebel et al., 2020; Krauss et al., 2022; Liu et al., 2021). Access to transport and ability to choose mode was impacted not only by lockdown policies which varied greatly (for example Japan declared a State of Emergency not a lockdown (Hino & Asami, 2021), but also because the countries included were of low, middle and high income which in turn has implications for level of infrastructure and range of options available to support transport and services for older people. Transport and mobility options therefore varied greatly depending on combination of region, economic development of the country, and COVID-19 responses and policies.

2 Significance of older peoples' transport and mobility

The authors of this paper are members of the British Society of Gerontology's Transport and Mobility Special Interest Group. Though we hail from varying disciplines, we share a common interest in older people's transport and mobility. As a group we set out to understand and reflect on what was a shared experience of pandemic but managed and responded to in different contexts. Literature examining the global response to COVID-19 was investigated to compare and contrast the impact differing responses had on older people's mobility and transport, and the resulting effect on overall health and well-being of older people. World Health Organisation (2018, 2023) literature stipulates the inextricable nature of transport and mobility, especially within Age Friendly Cities and Communities (AFCC) initiatives, using the term transport and mobility in 2018, and transportation in 2023 with the caveat that transportation could be read as transport and mobility (World Health Organisation, 2023). This points to the need for both mobility and transport for many in order to access health, social, economic, and political activity. AFCC guidance defines mobility as "moving by changing body position or location or by

transferring from one place to another; by carrying, moving or manipulating objects; by walking, running or climbing; and by using various forms of transport” (World Health Organisation, 2023). Tranches of research have proven that older people’s engagement in sociocultural activity is related to their mobility (Fomiatti et al., 2013; Rosso et al., 2013). Within this review, then, we emphasise the role of transport, and its ability to function within other policy and infrastructural domains, along with other forms of out of home mobility, as fundamental to health, wellbeing, and participation for older people (World Health Organisation, 2018, 2023).

The role of older people’s transport and mobility involves more than reaching a destination, it holds emotional and social value for older people (Musselwhite et al., 2015; Rogers & Musselwhite, 2023). Inability to access social and emotional connections leads to social exclusion that has been identified as a major concern for ageing populations (Burns et al., 2012; Chung et al., 2021). The changes in travel behaviour, transport and mobility created by lockdown measures during the COVID 19 pandemic targeted older people more than other age groups due to more serious consequences of the disease for this group (Howe-Burris et al., 2022; Previtali et al., 2020; Shaygan & Bahadori, 2020). While policies were designed to mitigate the spread of coronavirus and in particular safeguard older people, it also restricted older adults’ life-space mobility in environment beyond the home more than other age groups (Perracini et al., 2021; Portegijs et al., 2021). This systematic review of the literature seeks to understand the research so far into the transport and mobility of older people during the COVID-19 pandemic and the learnings from this research, as it has wide reaching implications for the health and wellbeing of older people.

3 Search terms and Strategy

A preliminary search was conducted to identify keywords relevant to older people’s transport and mobility practices and behaviour during the COVID-19 pandemic. The agreed search terms were applied to title, abstract and keyword and searches were limited to peer reviewed articles, in English. No geographical limits were applied. Inclusion was considered for papers referring to habitual transport (e.g., not air travel or tourism) and mobility (e.g., walking) of older adults 50 years old and over. As this review seeks to understand out of home mobility and transport, articles with keywords of patients or physical activity in the home, or the mobility of coronavirus itself were excluded to avoid medical and rehabilitation focused articles. Publication date of

included articles was limited to dates commencing at the outbreak of the pandemic in 2019 to the last search conducted on 25th August 2022 when writing of this review commenced. Having agreed search criteria, 3 databases were searched. These were Scopus, Web of Science and TRID (Transport Research International Documentation). The final search criteria were as follows:

Databases: Scopus, Web of Science, TRID

Keywords:

	SYNONYMS OF OLDER PEOPLE	SYNONYMS OF COVID	SYNONYMS OF TRANSPORT
OR	"old* people"	pandemic*	transport*
OR	"old* adult*"	COVID	travel
OR	ageing	coronavirus	mobility
OR	aging		trip
OR	"later life"		transit
OR	elderly		
OR	senior*		
NOT	patient*		"physical activity"

Table 1. Preliminary searches for older peoples' transport during COVID-19

* indicates root word to allow all forms of word to be searched, "quotes" ensure phrase searched

Time frame: Every paper published ONLINE 2019 until August 2022

Searches in: Title, Abstract, Keywords.

The TRID database does not provide a facility to search 'title-abstract-keyword' so the search in this database was adjusted accordingly. Results from each database were listed on a spreadsheet where duplicates were removed using the sort function and to sort the articles alphabetically according to article title, then manually removing duplicates.

3.1 Inclusion and Exclusion Criteria

The inclusion criteria are listed below. These criteria were designed to ensure inclusion of peer-reviewed literature that explored the mobility, transport or travel habits and behaviours of older

people during the COVID-19 lockdown measures and beyond. Articles that discussed the consequences of changes to mobility and transport of older people were also within the scope of the review. This included literature which addressed all age groups so long as there was clear analysis of older people's transport and mobility as a distinct group.

Type of publication: Scientific articles published in peer-reviewed journals (not reports, book chapters, grey literature, conference proceedings)

Language of publication: English

Age limit of study participants: 50+ HEALTHY adults

Any literature with a medical focus, for example those examining the movement of coronavirus itself, examination of mobility inside the home, or rehabilitation and therapeutically focussed articles were excluded as these do not give any insight into the travel and transport choices or behaviour of older people.

3.2 Screening and data extraction

Records obtained from the selected databases were screened and data extracted through three stages. First title, then abstract, and finally the whole article to ascertain fit with the inclusion criteria. Following the PRISMA guidelines (Page et al., 2021), articles were identified and selected according to inclusion criteria, after which details were extracted. Sample size, target population, country in which research took place; transport modes that were investigated, research methodology, results, limitations, further research, and policy implications were all recorded on a spreadsheet.

In the first stage, three authors independently screened all records obtained from different databases based on the publication's title to identify those with potential for inclusion discarding any that did not include the travel or out of home mobility of older people. This initial selection was recorded on a shared spreadsheet. The second stage involved appraising records based on their abstract to assess levels of fit with the inclusion criteria. Two researchers appraised each article with a third making a final decision in situations of non-agreement. Articles included after the second stage were imported into a new sheet containing the list of selected articles, at which

point articles were screened for a third time with reference to the full text. It is worth noting that the inclusion and exclusion criteria were piloted by authors prior to the screening process to ensure consistency and reduce bias during the screening process. The PRISMA diagram is shown in figure (1).

Two authors from the whole author group were allocated to read the full text and conduct a detailed analysis on the final list of full texts. Thus, each article was analysed by at least two, sometimes three independent reviewers. Data was extracted from articles and entered into a spreadsheet which held details from each article including geographical location, methodology, age range, findings, recommendations made, strengths and limitations of studies, along with notes regarding COVID responses, geographical contexts, or specific features of the studies. At this point, any common themes or points of comparison were sought. As there were only 21 studies across a wide global and economic context, with a variety of sample sizes and varying methodologies, it was decided that these contextual and methodological issues required some focus, so these are discussed in the results under sections 4.1 Participant and samples, 4.2, Geographical location and economic development and 4.3 Mode of travel. The comparable common threads shared by all or most of the articles are (1) reduced activity created by COVID-19 and (2) travel inequality, or inequality of access created by lack of travel either uncovered,

created, or exacerbated by COVID restrictions.

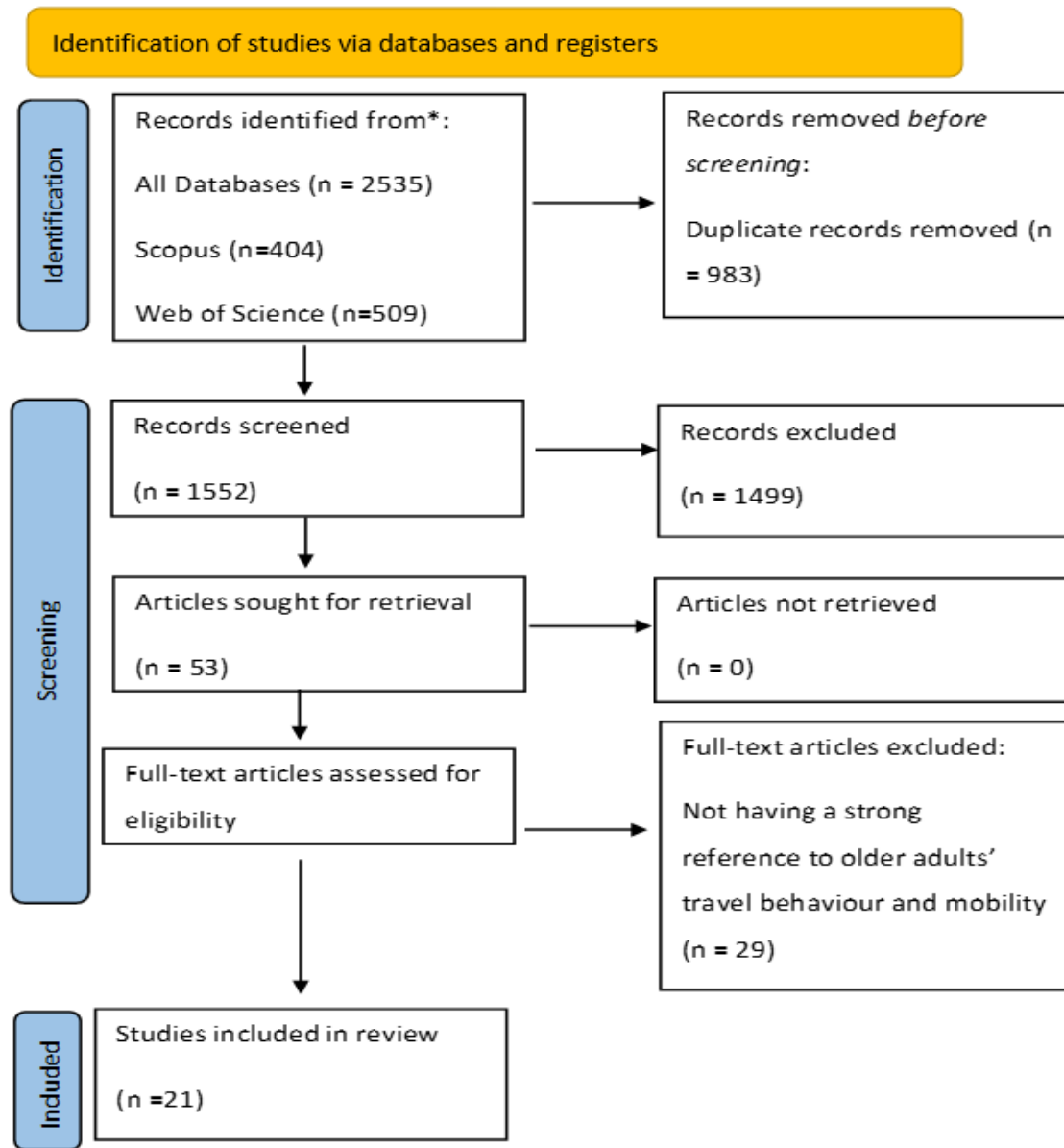


Figure 1. PRISMA diagram From Page et al, (2021) For more information, visit: <http://www.prisma-statement.org/>

4 Results

The results of searches found only 21 articles met the selection criteria as listed in Table 2, which highlights the methods, type of transport data collection type and age range of each study.

For full examination of data extracted, please see table at appendix A.

The scarcity of articles is a finding in and of itself considering the importance of transport and mobility to the health and well-being of older adults. See figure 2 for specific search counts.

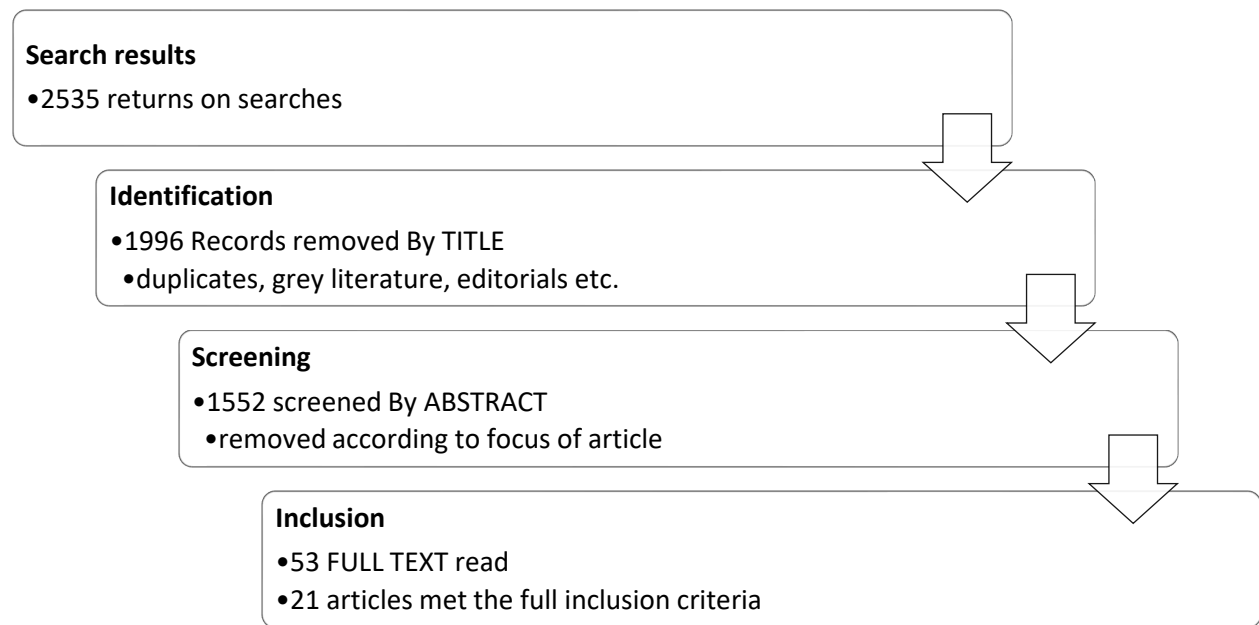


Figure 2. Search counts.

Quantitative methodologies were employed in thirteen articles, six used qualitative methods and two mixed methods, utilising various data collection methods from big data such as public transport smartcard data (Carney et al., 2022; Gramsch et al., 2022), to data from recording devices such as pedometers (Hino & Asami, 2021) and GPS and driving trackers (Roe et al., 2021). Questionnaires, surveys and counting technology were used to collect data for quantitative analysis (Leppä et al., 2021; Saunders et al., 2023; Shaer & Haghshenas, 2021a, 2021b). Mixed methods were utilised in two studies, both in the United States (US), one seeking to understand any changes to public transport ridership (Dinhobl et al., 2022) and one examining the impact of COVID-19 on the driving habits of older people in the US (Betz et al., 2022). The remaining six articles used qualitative methodologies to establish individuals' perceptions and experiences.

4.1 Participants and samples

The differing discipline and geographical context, as discussed in section 1, resulted in varying definitions of older adult. Seven studies collected data on all ages. Of these, 5 defined 65 and over as older age (Gramsch et al., 2022; Hino & Asami, 2021; Pullano et al., 2020; Wang et al.,

2021; Zhang et al., 2021), 2 chose 55 and over (Fischer et al., 2022; Krauss et al., 2022). Of the studies examining all age ranges, 6 utilised quantitative methodologies while Krauss et al., (ibid), used qualitative methodologies. The remaining 14 studies focused on older adults as the sole focus of study, again with varying demarcations. Martinez et al., (2020) and Zingmark et al., (2022) both used 55 as the delineator for old age, four studies (Abootalebi et al., 2021; Giebel et al., 2020; Shaer & Haghshenas, 2021a, 2021b) used 60, six studies (Carney et al., 2022; Dinhobl et al., 2022; Liu et al., 2021; Park & Cho, 2021; Roe et al., 2021; Saunders et al., 2023) used 65, Betz et al (2022) used 70 and Leppä et al. (2021) defined older age as 75 and over (see figure 3).

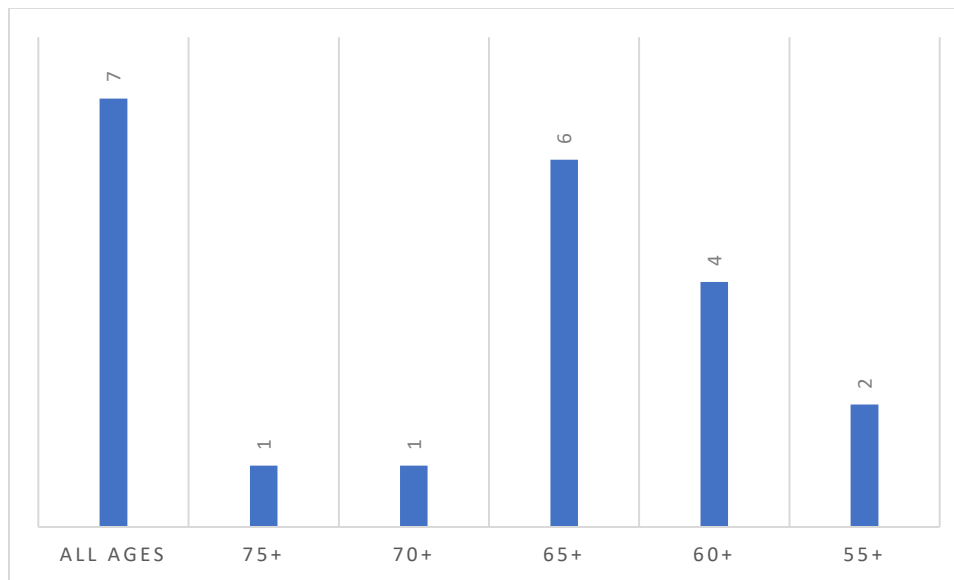


Figure 3. Age Range of Articles

The varied demarcations of older adult are likely to have a small impact on comparative results, however sample size is another methodological factor to account for when analysing and comparing articles.

Author	Sample	Method
Abootalebi et al., (2021).	15	qual
Betz, et al., (2022).	301	mixed
Carney, et al., (2022).	152061 card holders	quant
Dinhobl,et al., (2022).	26 Texas RTD leaders	mixed
Fischer et al, 2022)	women and older adults (+55) living in the City of Vancouver, British Columbia, Canada.	quant

Giebel,et al.,(2020).	30	qual
Gramsch et al., (2022).	8122 daily trips	quant
Hino & Asami (2021).	18,817	quant
Krauss, et al., (2022).	92	qual
Leppa et al, 2021)	809	quant
Liu, et al., (2021).	248	qual
Martinez, et.al., (2020).	10 gerontologists+ 52 participants aged 55 to 93+ 12 senior service providers	qual
Park, B., & Cho, J. (2021).	transport card transactions	quant
Pullano, et al., (2020).	1436	quant
Roe, et al., (2021).	214	quant
Saunders, S.et al., (2023).	247	quant
Shaer, A., & Haghshenas, H. (2021a).	453	quant
Shaer, A., & Haghshenas, H. (2021b).	453	quant
Wang et al (2021)	study area is North Carolina (NC), consisting of three large metropolitan areas, Charlotte Metro, Research Triangle Area, and Piedmont Triad.	quant
Zhang, et al., (2021).	272 million smart card uses were included	quant
Zingmark, et al., (2022).	820	qual

Table 2. Sample size of articles

There was a range of sample sizes and types from 15 participants to 272 million smart card uses as the largest sample. Big data, that is large, centralised, complex data sets, was used by 5 of the 21 articles (19%), of which 4 explored public transport (Carney et al., 2021; Gramsch et al., 2022; Park & Cho, 2021; Zhang et al., 2021). The fifth study examining big data analysed step count data obtained from participants of the Yokohama Walking Point Program (YWPP), a city authority health improvement programme which provides free pedometers to adults in the region to encourage exercise (Hino & Asami, 2021). In addition to the use of big data, 2 articles outlining mobility and movement of all kinds utilised mobile phone data to establish movements (Pullano et al., 2020; Wang et al., 2021). The sampling relates to areas rather than trips or individuals. One article exploring cycling activities in Vancouver, Canada makes use of data that tracks bicycle workouts alongside bicycle counters that count cycles as they go past (Fischer et al., 2022) to understand patterns of ridership and as such does not indicate a sample size. The

remaining articles have sample sizes ranging from 15 to 820 where the sampling approaches were more directed at the target groups.

The studies using big data, mobile or counter data indicate trends of movement rather than individualised practises. It is not possible with this type of data to discern trip purpose or multiple trips by the same person for example. There is a high probability, however, that a significant number of trips counted were for habitual or routine transport, The articles are therefore relevant for the review and provide necessary information. The distinction between this type of data collection which highlights trends, and more direct forms of data collection such as interview or survey which capture purpose of travel and routine of individuals is worth noting,

4.2 Geographical location and economic development

In terms of geographical distribution, 4 studies were focused on European countries (the United Kingdom (UK), France, Finland, and Sweden), 7 were conducted in North America, of which, 5 were drawn from the United States and 2 from Canada. One study was conducted in Chile, South America, and two were based in Africa (Mozambique and Uganda). The remaining 7 were conducted in Asia, with 3 studies in Iran and one each in South Korea, Japan, China, and Hong Kong.

4.2.1 Economic Development

Using the World Bank (2023) knowledge base, China is classified as an upper middle-income country, Iran lower middle income, Mozambique and Uganda are low income. The remaining 16 of the 21 studies are based in high income nations. The different levels of income of a country are reflected in the experiences of travel and mobility, that in turn impact on daily life. The studies in Africa highlight a difficulty in accessing basic needs such as food and basic medicine during lockdown while studies in middle- and high-income nations demonstrated more focus on some higher-level aspect of healthcare and more social aspects of living. These differences will be examined in further detail in the discussion.

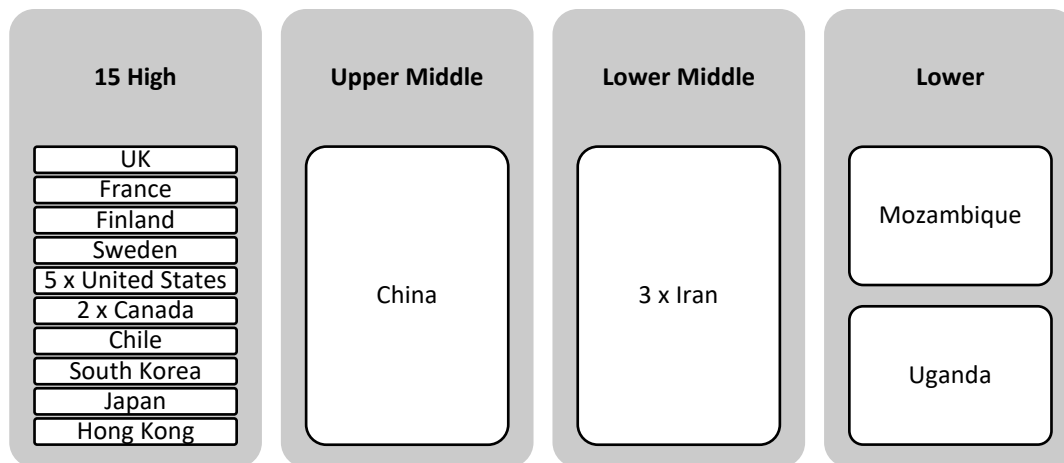


Figure 4. Economic development of nations of study

In line with the geographical location of the study, the economic development and transport infrastructure of the country in which each study is situated specifies situational context to the research. Such context provides deeper understanding of participants experiences and ability to access transport and be mobile during the lockdowns that occurred when the coronavirus pandemic spread across the globe.

4.3 Mode of travel

Of the 21 articles 8 did not specify the mode or were concerned with or referred to mobility in general. 5 studies focused on public transport use, 3 on driving or driving cessation, 3 walking, one cycling and another investigating both walking and cycling (see figure 5).

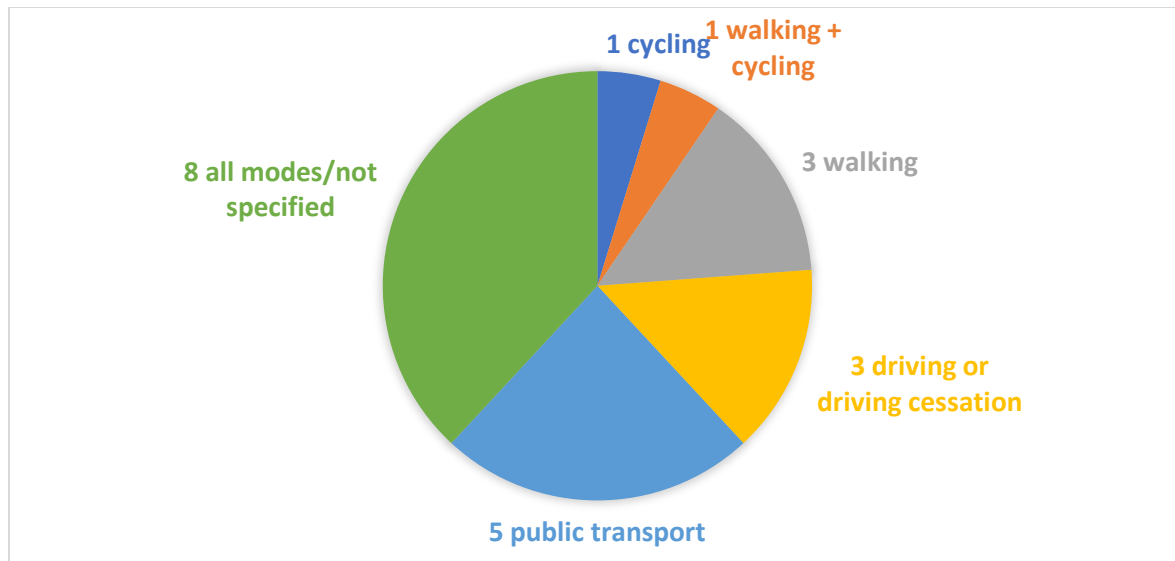


Figure 5. Modes of transport examined

One Canadian study focused on cycling, aiming to evaluate changes in patterns of cycling behaviour in Vancouver (Fischer et al., 2022), whilst an Iranian article studying walking and cycling, looked at changes in travel mode choices in the city of Isfahan (Shaer & Haghshenas, 2021b). The three studies of walking explored changes to walking behaviour and patterns occurring as a result of the pandemic (Hino & Asami, 2021; Leppä et al., 2021; Saunders et al., 2023). The examinations of driving behaviour were more disparate as they examined different aspects of driving. One in Shiraz, Iran evaluated the dual threat of the COVID-19 pandemic and driving cessation in older adults (Abootalebi, 2021). The other two studies were both from the United States (US), with one using an existing study to compare car use before and during the pandemic, along with self-reported scales of depression, social isolation, and emotional support to examine links between these concepts and reduced mobility (Betz et al., 2022). The other US driving study analysed how the COVID-19 pandemic affected driving practices and health outcomes in older adults using driving tracker and GPS data logging to identify changes to driving behaviour (Roe et al., 2021). Four of the five articles examining public transport used big data in the form of public transport records or travel card usage with related card holder demographics (Carney et al., 2021; Gramsch et al., 2022; Park & Cho, 2021; Zhang et al., 2021). The fifth public transport study used questionnaires and interviews to understand the ways in which COVID-19 had affected ridership (Dinhobl et al., 2022). Studies that did not specify a mode of transport either used mobile data to analyse mobility (Pullano et al., 2021; Wang et al.,

2021) or explored access to goods, services, and social requirements to understand the role of mobility in health and well-being (Giebel et al., 2020; Krauss et al., 2022; Liu et al., 2021, Martinez et al. 2020; Zingmark et al., 2022). 1 study examining multiple modes analysed the factors affecting travel mode choice in Iran during the pandemic (Shaer & Haghshenas, 2021a).

4.4 Findings of articles

The scope, geographical and economical context of the articles are wide ranging. Despite the huge disparity in approach and context, two common themes were apparent. Twenty of the twenty-one articles found reduced activity in the out of home mobility or transport practices of older adults during COVID restrictions. Some studies used the situation created by COVID-19 as pseudo experimental conditions while others emphasised travel inequality either uncovered, exacerbated, or created by COVID lockdown conditions. These studies compared pre-existing data to data collected during lockdown conditions (or state of emergency in Japan (Hino & Asami, 2021)) to compare differences in patterns of transport and mobility behaviour (Carney et al., 2022; Hino & Asami, 2021; Pullano et al., 2020; Roe et al., 2021; Zhang et al., 2021). A few studies set out to investigate health and well-being during the pandemic and mentioned the negative impact COVID travel restrictions had on older people (Giebel et al., 2020; Krauss et al., 2022; Leppä et al., 2021; Wang et al., 2021). Zingmark et al. (2022) examined factors relating to the concept of active ageing during the pandemic, and Martinez et al. (2020) considered age-friendly cities during global pandemic conditions. The remaining articles focused on the specific transport or mobility changes and their consequences brought about by COVID restrictions (Abootalebi et al., 2021; Betz et al., 2022; Dinhl et al., 2022; Fischer et al., 2022; Gramsch et al., 2022; Liu et al., 2021; Park & Cho, 2021; Saunders et al., 2023; Shaer & Haghshenas, 2021a, 2021b).

4.4.1 Reduced activity

Twenty studies report a decline in travel or out of home mobility, although four articles indicate an increase in physical activity despite reduced transport or travel activity. A study of cycling activity in Canada (Fischer et al., 2022) is the only article reporting increased mobility activity with no reductions in other forms of transport. Studies of public transport indicate decreases in use by older people. A study in Seoul, South Korea where social distancing was not mandatory but a recommendation indicated a drop in subway use by all age groups, with older people, who

have free subway travel, experiencing the greatest change (Park & Cho, 2021). In most cases older adults reduced their public transport use compared to younger age groups, for example Hong Kong metro use was reduced, by 48% for older adults compared to 42% for all other adults (Zhang et al., 2021). It was observed in at least one case that this was due to the need for younger age groups to travel to work (Park & Cho, 2021).

Older adults driving behaviour also decreased (Abootalebi et al. 2021; Betz et al., 2022; Roe et al., 2021). Capturing driving practices with GPS data loggers and the Driving Real World In-Vehicle Evaluations System (DRIVES), this study found that the proportion of days driven were reduced from .673 before the pandemic to .382 during lockdown conditions. Participants also took shorter trips (Roe et al., 2021). In another US driving study comparing pre-COVID-19 activity to pandemic driving activity within an ongoing randomised control trial evaluating a driving cessation aid, more participants reported reducing driving during COVID-19. Seventy percent of drivers ceased driving during covid compared to 26% in the observation before the pandemic. In addition, the most reported reason for reduction or cessation of driving before Covid were medical or emotional. Whereas during Covid there was an increase in those reporting a decline in desire to go out. Forty-nine-point 4 percent of participants stated they were at least moderately concerned about family and friends becoming infected with COVID-19. The US is a high-income nation, but a third investigation into the dual consequences of driving cessation and COVID-19 travel restriction in Shiraz, Iran highlights the situation in a middle-income country. Although the aim of the study was different in that it looked at participants who were already giving up driving, this study indicates a reduction in driving exacerbated by inability to access public transport because of travel restrictions which led to both social isolation, mental health disorders and potentially the increase of a sedentary lifestyle leading to physical decline (Abootalebi et al., 2021)

The authors of two articles relating to transport mode choice in Iran conclude that accessibility and safety of public transport in times of public health emergencies should be considered, as older people avoided public transport fearing the spread of coronavirus in crowded conditions (Shaer & Haghshenas, 2021a, 2021b). Conversely, older people in China were not so fearful of the spread of the disease to begin with and continued with their daily mobility activities despite local government travel restrictions, village isolations, community

lockdowns and public transport shutdowns. Many still travelled to access essential needs but could not access markets because of public transport restrictions (Liu, 2021). Two hundred and thirty-six of 248 respondents stated the food they could access inside community stores rather than markets they used to travel to was substandard and expensive, thus reduced transport accessibility impacted on ability to access quality nutrition. Eleven of the twelve older people who did not mention food quality or safety issues were older than 85 and likely to be living with family or have help with shopping. More than 80% considered the restrictions to be a greater negative influence on daily life than the disease itself because of the connection between walking and well-being (Liu et al., 2021).

Care must be taken when considering accessibility of the built environment for older adults in terms of active ageing solutions such as walking or cycling as not all older adults are able to be physically active enough to walk or cycle to destinations (Shaer & Haghshenas, 2021a). Both studies in Africa underline the inability to access transport not only caused difficulties accessing food and services, but also income (Giebel et al., 2020 Krauss et al., 2022). Thirty people aged 60 and over in the Mukono district of Uganda (25 kilometres from Kampala) were interviewed (Giebel et al. 2020) and thematic analysis of their responses generated five overarching themes, of which four were mainly caused by lack of access to transport; (1) economic impacts – inability to sell goods or reach employment; (2) lack of access to basic necessities and potential poverty; (3) impact on healthcare utilization – caused by lack of transport and lack of income; (4) social impacts and (5) violent reinforcement of public health restrictions (Giebel et al., 2020). Nearly every participant in this study raised the issue of transport difficulties impacting on their daily lives and needs, in particular those who were house bound as they no longer received visits from family members with necessities and company. Research in Mozambique mirrored these findings of older people being vulnerable to loss of income because of transport restrictions.

4.4.1.1 Increase in some mobility. Findings of increased mobility are limited to walking and cycling, and only found in three articles, but are mentioned here for the sake of full analysis. As mentioned above, Fischer et al. (2022) found an increase in cycling patterns in Vancouver, Canada. Two other articles reported an increase in physical activity even though there was a decline in transport overall. In Iran, despite a decrease in the average frequency of trips per

week, an increase in the share of walking and cycling modes was recorded, indicating the resilience of walking and cycling in critical situations (Shaer & Haghshenas, 2021a, 2021b). However, this requires some attention from authorities, firstly, because older people's ability to walk and cycle can diminish with age and increasing senescence. Secondly, infrastructure such as cycle paths and pavements are not always conducive to safe or willing access, in terms of infrastructure such as wide pavements, street lighting and signposts (Shaer & Haghshenas, 2021a).

4.4.2 Travel related inequality

Inequalities in access to transport and the subsequent implications were highlighted in 6 articles. (Abootalebi et al., 2021; Carney et al., 2022; Giebel et al., 2020; Krauss et al., 2022; Liu et al., 2021; Wang et al., 2021). In Africa, older people had less support from government due to a lower level of infrastructure, policy, and finance available (Giebel et al., 2020; Lloyd-Sherlock et al., 2020) than was the case in higher income countries. In Uganda and Mozambique restrictions led to older people being unable to access income and travel restrictions that inhibited the possibility of family members visiting to bring goods (Giebel et al., 2020; Krauss et al. 2022). Older people in Uganda are amongst the poorest members of society without a steady income or state pension system (Kowal et al., 2010), and the transport that was available increased greatly in cost, therefore exacerbating the inequality of access. Moreover, any attempts to access goods or income past a 7pm curfew were met with violence (Giebel et al., 2020). In Mozambique, non-pharmaceutical interventions, the terminology used by Krauss et al (2022) for Covid-19 interventions such as transport restrictions and social distancing, put more burden on people with precarious incomes such as older people, exacerbating those pre-existing inequalities (Krauss et al., 2022). While older people in China did not report reduced income, inequalities were exacerbated or created by pandemic conditions. In a country steeped in tradition and culture of respecting elders, older people began to experience negative attention from younger people in public transport settings even after restriction had been lifted. The authors state "Going beyond existing studies, we revealed that the pandemic amplifies the impact of age-unfriendly social environments on elderly immobility" (Liu et al., 2021 p96).

COVID-19 measures also exacerbated inequalities in high income countries. Two articles associated bus use with lower income individuals (Carney et al., 2022; Gramsch et al., 2022) and commented on the reduced choice of alternative transport these individuals have when they feel

buses are not safe, as in times of contagion. Carney et al.'s (2022) UK study sought to understand the effect of COVID restrictions on older people who used buses for essential trips. Using the Area Level Income Deprivation Among Older People Index (IDAOP), the research identified a correlation between a decrease in area deprivation and high car ownership. High car ownership results in lower public transport service because of reduced demand, so essential transit users living in such areas can be transport disadvantaged despite the perceived affluence of the area. Reduced public transport services during COVID-19 pandemic led to reduced access to transport. Moreover, social isolation advice which particularly targeted older people led to fear of using this form of transport (e.g. Abootalebi et al. 2021).

Reductions in public transport during pandemic measures increased the inequality of access to goods and services. Goods and services were much more accessible to those with access to private vehicles compared to those reliant on public transport, whereby social isolation is more difficult especially for a population of older people told they are more vulnerable to infection. Similarly, In North Carolina, US, mobile device data was accessed to explore patterns of visits to points of interest (POIs) related to health care during 2020, analysing associated socio-demographic and spatial characteristics. Areas with higher percentages of older people, minorities, those with low incomes and those without private vehicle access were also the areas that had limited use of healthcare before and during the pandemic and experienced a slower recovery after the lockdown (Wang et al. 2021). While this does not specifically state that older people reduced travel activity, it suggests that many older people lived in areas of low private vehicle ownership and high public transport reliance. Thus, when public transport was restricted, their access to transport and movement was reduced, and this is demonstrated in access to healthcare visits.

4.5 Limitations of articles

There are some limitations within the literature presented in this systematic review. Eleven (52%) of the studies included older people's views on their transport and mobility opportunities. However, within this there are some limitations to the representation of older peoples' experiences of transport and mobility. Seven of the eleven studies offered interviews or opportunities to self-report experiences which provides great depth of understanding contextual circumstances of the data. Four articles used semi structured interviews, questionnaire, or survey

formats, which allows for more generalisable findings due to the larger sample size but does limit the ability of respondents to actually express their unique experiences resulting in wider breadth but less depth of situational context in the data. Both are valuable, but it is worth noting the difference. Sample representativeness is a limitation in some of the studies allowing older persons to express their opinions. In Iran, for example, Shaer and Haghshenas (2021a, 2021b) research of travel mode choice recruited participants in public places at a time when public transport was suspended or restricted. Older adults unable to walk or cycle were therefore unlikely to be recruited, meaning the research does not examine older adults who rely on public transport or other people to mobilise them. In a study of walking steps recorded on pedometers in Japan, only those who recorded steps diligently were included in the study. Diligent participants are not representative of the population, especially as the authors conclude changes to be relevant to the built environment which may not impact decision to be physically active in people who are committed to an active lifestyle.

5 Discussion and conclusion

Literature within this review demonstrates a wide-ranging array of articles investigating transport, COVID-19, and older people. Despite this, from the thousands of articles published about coronavirus, only 21 met the criteria of this review, discussing older peoples out of home mobility. The scarcity of literature regarding older people's mobility and transport during the COVID-19 pandemic indicates a need for much more research in this area. It has been established that out of home mobility is important for physical and mental health and well-being (Mackett, 2018; Rogers & Musselwhite, 2023; Schwanen & Ziegler, 2011). As older people were advised to remain at home at key times during coronavirus, understanding the consequences of removing older peoples' access to day-to-day routines via transport and mobility opportunities is necessary. In this section we discuss the consequences of reduced transport, travel, and mobility options for older people during the pandemic lockdown situation globally.

Synthesis of the selected articles highlights general decline in use of transport, trip making and mobility amongst older adults, although there is evidence that physical activity increased for those with an ability to be active (section 4.4.1.1.). Geographical disparities in travel policies and infrastructure, built environment and social context are wide reaching in the articles included

herein. In addition, the methodologies are very varied, with wide ranging participant numbers, data collection methods, and analysis processes. However, as demonstrated in the results, the overwhelming findings are that older people's transport and mobility options and behaviours were impacted. Comparing restrictions on travel and mobility geographically, consequences of reduced mobility varied between low- middle- and high-income countries, however reduction in access to goods and services, and reduced social engagement were apparent and detrimental to well-being in all economic development settings.

5.1 Accessing basic needs

The impact of COVID-19 restrictions in low-income countries led to concerns for access to basic necessities such as income and therefore basic sustenance, exacerbating pre-existing inequalities and causing additional health crises in Uganda and Mozambique (Giebel et al., 2020; Krauss et al., 2022). Older peoples' inability to maintain nutritional standards is a factor in reduced wellbeing (Howe-Burris, 2022) indicating that this already vulnerable population became more vulnerable due to coronavirus containment measures. In China, (upper-middle-income) older people reported that they were unable to shop in markets where they would usually buy reasonably priced goods, instead sourcing items from local stores at inflated prices (Liu et al., 2021). Inability to access basic needs or paying inflated prices for necessities was echoed in Iran (Abootalebi et al. 2021).

5.2 Social activity

Transport is more than moving from one location to another, it holds social, personal, and emotional value for older people, with relationships, social activity and community connections being important for well-being (Musselwhite, 2015; Musselwhite et al., 2015; Rogers & Musselwhite, 2023; Schwanen & Ziegler, 2011). An important facet of well-being emanating from these studies, then, is diminishing access to social activity. In China, for example, researchers state the social impact of mobility constraints voiced by participants in their study was unexpected. "Older people considered outdoor activity to be the only way to achieve functional well-being, an important factor of Chinese culture (Liu et al., 2021). Other studies mention the importance of transport and mobility to enabling socialisation and reducing social isolation (Abootalebi et al., 2021; Leppä et al., 2021; Martinez et al., 2020; Saunders et al., 2023). Particularly striking are the findings in Uganda, where older adults feared dying of hunger, yet concern was still raised about missing social contact, and the ability to attend religious

gatherings (Giebel et al., 2020). Social isolation was the result of driving cessation, exacerbated by coronavirus and associated difficulties and fears accessing public transport according to research in Shiraz, Iran (Abootalebi et al., 2021). In Finland older people felt less able to participate in out of home activities, and those with mobility difficulties found participation more difficult than those with intact mobility (Leppä et al., 2021). While some governments and authorities in higher income countries provided food resources for some (Sebastian et al., 2021) the impact of unmet social needs was not considered. As reduced mobility is linked to social isolation, loneliness, and negative health and well-being consequences this may be an oversight, especially when European social policy is focused on reducing social exclusion as a key theme (Burns et al., 2012; Chung et al., 2021).

5.3 Article Policy recommendations

Transport and out of home mobility are inextricably linked (WHO, 2018, 2023) and enable continuing independence and social participation, engagement, and inclusion for older people (Aguilar & Macário, 2017; Banister & Bowling, 2004; Davey, 2007; Gagliardi, 2007; Musselwhite et al., 2015; Schwanen & Ziegler, 2011). Literature herein made recommendations regarding public transport and planning and the built environment that authors concluded would improve the transport and mobility opportunities of older adults, either during future health emergency situations, or at any time.

5.3.1 Public Transport

Five articles make recommendations for public transport reflecting the aims and objectives of the research (Carney et al., 2022; Dinhobl et al., 2022; Gramsch et al., 2022; Saunders et al., 2023; Shaer & Haghshenas, 2021a). Two articles highlighted the importance of ensuring transport is regular and consistent in less advantaged areas, and for people who are vulnerable (Carney et al., 2022; Saunders et al., 2023). Both of these studies were conducted in high income countries, one in the UK (Carney et al., 2022) and one in the United States (Saunders et al., 2023). Dinhobl et al. (2022) suggest public transport, provided by Rural Transit Districts (RTD) in the United States should be included in disaster planning policies. Examining the effects of COVID-19 on travel mode choice, research in Iran recommends a number of solutions to assist older people during lockdown situations, one of which is to provide free personal protective equipment on public transport. The same authors also recommend improving walking routes and accessibility

to public transport for older people to improve public transport options (Shaer & Haghshenas, 2021a). Investigating public transport in Chile, Gramsch et al. (2022) make recommendations for the effectiveness of future lockdown policies. Overall, there is a sense that public transport did not meet the needs of older people during the pandemic. Either through government and local authority restrictions or a failure to ensure public transport is seen as the essential resource it is for many older people within planning and policy arenas. More accessible transport is required to ensure older people globally have access to goods and services, but also the means to access social inclusion to enable physical and psychological wellbeing (Aguiar & Macário, 2017; Banister & Bowling, 2004; Davey, 2007; Gagliardi, 2007; Musselwhite et al., 2015; Schwanen & Ziegler, 2011).

5.3.2 Planning and the built environment

Planning and the built environment are the subject of recommendations in five articles (Carney et al., 2022; Dinhl et al., 2022; Fischer et al., 2022; Hino & Asami, 2021; Liu et al., 2021). As indicated above, Dinhl et al (2021) propose public transport should be included in disaster and pandemic planning policies, which would have improved transport opportunities for those reliant on this form of transport. In a similar vein, Carney et al., (2021) propose prioritising and planning public transport services in areas identified as having high numbers of transport access deprived people, at times of pandemic and beyond. A study of cycling in Vancouver, Canada (Fischer et al., 2022) recommends utilising street reallocations inspired by COVID to create healthier streets for all through planning policy decisions. Policy recommendations emanating from research in China state that urban renewal plans should include planning for older people to access food and also highlight the need for walkable neighbourhoods so that older people are able to mobilise even during times of pandemic, as this study found that older people often seek mobility for its own sake (Liu et al., 2021). Similarly, Hino and Asami (2021) make recommendations for built environment planning policies in Japan to promote social participation of older people by reducing population density and including open spaces in cities, again to appease infection fears and promote activity during times of pandemic or other emergency. In addition, there is a need to consider older adults who cannot access so called active ageing solutions such as walking or cycling as highlighted by Shaer & Haghshenas (2021a) and the disproportionate decline in autonomy experienced by people with walking difficulties (Leppä et al., 2021). Social connections and confidence of older people were

impacted detrimentally by COVID-19 restrictions, exacerbated by inadequate planning, and built environments, which needs to be considered should any future similar situations arise.

5.4 Strengths and Limitations of this review

One of the major strengths of this review is that it is a collaboration by authors from a variety of disciplines including ageing research, the built environment and technology. Screening and analysis of articles was therefore stringent and thorough in terms of being analysed from different perspectives and approaches.

The search strategy and inclusion of literature which did not specify a mode of transport or mobility could be considered a limitation. The decision was made in order to reflect the definition of mobility as movement from one place to another, and thus any examination of routine human movement was deemed relevant. While it disallows the ability to compare the specific ways in which people moved from place to place, it does provide the ability to analyse the differences in movements across age groups. As is the case for many reviews, the differing aims, objectives, methodologies, and sampling strategies used by authors presents some limitations in comparing data across economic and geographical contexts. Cultures, routines and expectations of transport, mobility and daily life are not universal, but there is no way of accounting for these differences in this review. The wide array of contexts and methodologies provides a comprehensive picture of the ways in which older people's transport and mobility has been impacted by coronavirus, but not necessarily representative of each nation's older people's needs, practices, patterns of movement or expectations. The wide range of methodologies and global contexts provide both trends of movement and older people's experiences of transport and mobility during the initial COVID-19 lockdown conditions, but from different, not necessarily comparable socioeconomic contexts. It is important that older people's views are reflected in transport literature when examining this previously unimagined situation, whilst also reflecting wider social, economic, and cultural situational contexts and expectations. More depth of individual experience and breadth of statistical patterns of transport use and mobility are needed to provide a comprehensive understanding of older people's transport and mobility during pandemic or other emergency situations to inform practice and policy.

5.5 Implications for transportation planning and policymaking

Seven years before the coronavirus outbreak, Lucas (2012) pointed out that the study of transport-related exclusion revealed interactions between the causal factors within the individual such as ageing, structures of the local area such as inadequate public transport services, and legislative frameworks. While it may seem that transport and planning services could not respond quickly enough to pandemic conditions, there have been many warnings that social planning and transport services were not inclusive for older people (Dumbaugh, 2008; Lucas, 2011; Martens, 2018; Ormerod et al., 2015). Many of the articles in this review make recommendations in that vein for planning and policymaking, in particular the links between transport and social participation and social isolation (see section 5.2). Planning and policy of public transportation and built environment are important in facilitating access to physical and psychological needs as well as to social engagement (Carney et al., 2022; Hino & Asami, 2021; Liu et al., 2021; Schwanen et al., 2015). Active ageing and age-friendly discourses are included in some of the articles discussed here (Martinez et al., 2020; Shaer & Haghshenas, 2021a, 2021b; Zingmark et al., 2022) but these did not improve accessibility during the pandemic, even for the purpose of exercise either because older people were unable to exercise for health limitations, or for fear of encountering too many other people that might compromise safety. Active ageing has been criticised for lack of engagement with disease and disability, with Timonen (2016) stating that “where dependency begins, policy ends”(p.15).

The articles in this review overwhelmingly demonstrate a reduction in transport and mobility for older people during COVID-19 lockdown conditions, and many highlight negative consequences of this reduction. While there was little time for transport and planning to respond to the emergency situation there had been many warnings from transport research, gerontology, social science, and human geography that older people, and especially vulnerable older people, were not finding their needs met by the transport options offered in all levels of economic development across the world. There is obviously a greater difficulty for this to be achieved in lower income countries where perhaps more innovative solutions may be sought through research and possibly third sector intervention. Pandemic conditions should serve as a warning that transport and planning play a key role in the well-being of older people. As such these arenas must make accommodation of older people’s needs, with the intervention of local or

national government to ensure any future emergency situation does not result in detriment to their well-being in the way the COVID-19 pandemic has been shown to in this review. perhaps

5.6 Avenues for future research

As indicated throughout this review, while there are a variety of methodologies, regions, types of travel and participants in the literature included here, there is a scarcity of literature focusing on the transport of older people during the COVID-19 pandemic. Literature links social isolation to negative well-being outcomes (Leppä et al., 2021; Schwanen & Ziegler, 2011), so the impact of enforced immobility needs to be researched in greater breadth and depth. More quantitative research to understand the numbers of people affected by reduced mobility during the COVID-19 pandemic across and within nations is necessary to provide information for health and well-being statistics, and planning for any future well-being issues that may arise from coronavirus lockdowns. In addition, more research in different regions globally is needed to understand why older people chose the options of mobility (or immobility) that they did, including that they may not have had any choices. The impacts of transport choices (or lack thereof), the built environment and ageing policies are factors in enabling or disabling activity and social engagement which need to be documented, analysed, and acted upon to ensure planners, policymakers, practitioners, and older people themselves can be prepared for such difficult conditions should they arise in the future. In addition, the conditions of lockdown and social distancing provided opportunities to explore and underline further need for research into the links between social engagement and transportation and transport inequality. Future research needs to examine the importance of active ageing, age-friendly and transportation policies in creating resilient transportation options to support older adults' mobility needs and access in the post COVID-19 era across the globe.

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