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SMART LIVING AND QUALITY OF LIFE: DOMAINS AND INDICATORS

Melanie Kay Smith[a], **Songling Chang**[b], **Gábor Michalkó**[c, d]

[a]Budapest Business University, Budapest, Hungary,
[b]Corvinus University of Budapest, Budapest, Hungary,
[c]University of Pannonia, Veszprém, Hungary, Hungary,
[d]HUN-REN CSFK Geographical Institute, Budapest, Hungary

Abstract: Smart living appears as the most important domain of a smart city, and many studies propose that it is synonymous with resident quality of life. The main aims of this research were to understand better residents' perceptions of quality-of-life issues and priorities in smart cities. The study (re)defines smart living using domains and indicators that were carefully selected from a systematic literature review, a close analysis of previous studies and their methodologies, and a pilot test of a questionnaire in Budapest, Hungary. The research is considered timely because of Budapest's relatively low performance in quality-of-life rankings in Europe and the lack of data on the needs of citizens. The main domains of smart living and their relevant indicators include housing, health, safety, education, environment, social cohesion, leisure, culture and tourism. Overall, the research aims to assist urban researchers and city agencies in the development of indicators of smart living when measuring resident quality of life. The results could be applicable to other post-socialist cities which have followed similar trajectories to Budapest, but the results are useful for almost any city that hopes to enhance quality of life by prioritising smart living.

Keywords:

smart cities;
smart living;
quality of life;
residents;
Budapest

Email: smith.melanie@uni-bge.hu

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> *Until today, creating liveable cities is an art. Cities are not just giant optimization problems, nor are they giant entertainment parks, where pre-manufactured experiences are consumed. Cities are places where people meet, communicate, make friends, and fall in love. In other words, cities are first and foremost about people.*
>
> *(Helbing et al. 2021: 4)*

Introduction

The transformation of a city system into a smart system is meant to improve the quality of life (QoL) for its people and their way of living, its environment, economy, transport and governance (Muvuna et al. 2020). However, previous studies have not always focused specifically on QoL and citizen-centric issues. One systematic review of smart cities (SC) showed that research on humans was the least important (8.1%), but it has been suggested that the focus of SC is switching from infrastructure supply-oriented approaches to improving citizens' QoL and sustainability (Myeong et al. 2022).

Smart cities should put people first and use technology as a tool predominantly in the service of citizens (Trencher 2019). Some studies have even noted the negative impact of technology anxiety on peoples' quality of life in smart cities (Dash 2022). Earlier studies had also implied that smart city visions can be a way of imposing discipline on cities that reduces political resistance and resurgence (Vanolo 2014). Szarek-Iwaniuk and Senetra (2020) refer to three generations of SC, where in Smart City 3.0, citizens play a key role in urban development. It has been argued that innovation for the sake of innovation is not smart, but rather that a SC should be intertwined with and responsive to its community (Del-Real et al. 2023). Cities can only achieve an effective transformation to a SC and promote the improvement of people's QoL if they invest in ICT and human capital simultaneously (Wang and Zhou 2023). This includes addressing urban inequalities and focusing on excluded communities (Dragan et al. 2024). Rachmawati et al. (2024) suggest that 'liveability' should be one of the main purposes of the urban future and he use of ICT in sustainable smart cities can enhance wellbeing as well as ensure collaboration among stakeholders and to battle climate change.

This paper explores the meaning of smart living, including the domains that can be used to define it and the indicators that can be developed to measure it. In addition to a detailed review of recent literature using the terms 'smart cities' and 'quality of life' (2020-2023), a questionnaire was designed for the local residents, and it incorporates the most important domains and indicators of smart living. The questionnaire was tested on a representative sample of residents in the Hungarian capital city of Budapest, and care was taken to adapt the study to the specific context of a post-socialist city in CEE.

The main aims of this research were to understand better residents' perceptions on QoL issues in SC, to supplement 'top-down' approaches to smart city development with a 'bottom-up' understanding of resident priorities, and to complement research that has

focused on the development of objective or 'hard' indicators with more subjective or 'soft' ones. The ultimate aim is to inform SC strategies to encourage a more citizen-centric approach, as well as to assist researchers (both academics and practitioners) in developing reliable indicators to measure QoL in SC or so-called 'smart living'. The study also reflects on urban policy and planning in CEE cities like Budapest during their post-socialist transition and the implications for QoL and smart developments.

Methodology

This research included a detailed review of 40 articles (published between 2020-2023) using the keywords 'smart city' and 'quality of life'. The PRISMA model was used, which meant an initial screening of 265 articles for eligibility (articles were excluded if they were not full papers and not written in English). Out of the remaining 133 articles, exclusion criteria included: studies that focused on smart processes or tools rather than people; articles from outside the disciplinary scope (social science); and articles where quality of life was not a central focus. The aim was to identify definitions, domains, indicators and research methods used in the smart city domain of 'smart living', which is often considered to be synonymous with quality of life (Giffinger and Gudrun 2010, Braga et al. 2021, Valencia-Arias et al. 2021, Shami et al. 2022). It has been suggested that smart living is the most important domain of a smart and sustainable city and that QoL should be a significant goal of smart living (Ozkaya and Erdin 2020).

The second part of the research involved using the identified indicators to create a questionnaire for the local residents based on the smart living domain of smart cities. This questionnaire was designed with the residents of the Hungarian capital city of Budapest in mind, and it was piloted with a representative sample.

The limitations include the relatively limited time frame for the systematic review, which could have excluded seminal works from previous years (some of these are therefore cited in this article to provide background information and critical comment). Also, the identification of indicators requires decisions to be made about inclusion and exclusion of certain domains and elements, which could result in bias and value judgement. Thirdly, it will be challenging to design a sampling strategy that is representative of the population of the whole city, including those who are more marginal, less wealthy and educated or elderly.

Results

Systematic review

In the previous literature, six dimensions of SC were identified as smart economy, smart mobility, smart environment, smart people, smart governance and smart living (Giffinger and Gudrun 2010). Several authors have used these same domains in

subsequent studies (Ortega-Fernández et al. 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Braga 2021), sometimes with additions or variations. For example, Cantuarias-Villessuzanne et al. (2021) added 'smart architecture and technologies' and Valencia-Arias et al. (2021) use 'sustainability' instead of 'environment' and add the term 'quality of life'. Alongside smart environment, people and living, Ji et al. (2021) include 'smart safety', 'smart health', 'smart energy' and 'smart transport'. Chen and Chan (2023) focus on only five domains, but many of the elements above are incorporated under a different heading:

- Smart environment (including sustainability issues);
- Smart people (including social welfare and personal development);
- Smart livelihood (including an individual's way of life and community feelings, image and pride);
- Smart economy and economic policy (including government support);
- Smart mobility (including public transportation, infrastructure and safety.

Smart living (and its variations) has been defined as synonymous with or closely connected to QoL (Shami et al. 2022). Several definitions of SC directly mention QoL:

- "Improving the quality of life of citizens is a central concept, and we assume it to be an ultimate goal of SC developments" (Csukás and Szabó 2021: 3).
- "SC development should be people-centric, serving the needs of local citizens with the wider aim of improving their well-being and quality of life" (Ji et al. 2021: 2).
- "Urban smartization will ultimately improve quality of citizens' lives (smart living)" (Shami et al. 2022: 2).
- "Smart living examines the use of ICT for achieving quality of life in a liveable and safe environment" (Cantuarias-Villessuzanne et al. 2021: 4).

Braga et al. (2021) refer to smart ways of life associated with the locals' lifestyle choices and quality of life, and Valencia-Arias et al. (2021) describe the domain of smart life as a dimension that can be measured using social indicators that reflect the QoL of citizens. QoL of an individual may be determined by their physical health, psychological state, level of independence and social relationships (Chen and Chan 2023). Oh (2020) evaluates QoL according to subjective satisfaction with housing, facilities, overall urban environment, physical and mental health, and safety of the surrounding area. It has been argued that regardless of definitions and dimensions of SC, they should promote the quality of life of people (Keshavarzi et al. 2021). On the other hand, it would be a mistake to imply that urban development policies should be based on a model that is applicable everywhere (Vanolo 2014, Kitchin 2015).

QoL is defined as smart-city services that enhance the standards of living (Lytras et al. 2021) using advanced integrated services based on information and communication

technologies and the intelligent use of urban infrastructures for improving the QoL of its citizens (Barletta et al. 2020, D'Aniello et al. 2020). This can include a number of factors (economic, environmental, transport and governance, Muvuna et al. 2020) aiming to increase the efficiency and effectiveness of municipal services while facilitating private investment (Edge et al. 2020). In the context of safety, it should be noted that smart solutions can be used to reduce the risk of disasters like earthquakes (Kodag and Kodag 2023). Other authors added social cohesion and participation, consumption of resources and preservation of the environment as well as spatial development and building (Shami et al. 2022). Helbing et al. (2021) advocate a "value-sensitive smart city", which is inclusive, collaborative, ethical, citizen-centric and society-driven. In addition to previously mentioned values like health, security, sustainability, wellbeing (or QoL), the study refers to peace, justice, equity, dignity, solidarity and privacy (among others). Zhu et al. (2022) differentiate between 'livability' and 'life-ability', with 'livability of environment' referring to good living conditions, including the natural environment, built environment and social environment, and 'life-ability of person' referring to the opportunities for managing and improving life, including self-development, acquiring new knowledge and skills and enjoying life.

One systematic review of smart cities and quality of life identified the following topics as being the most frequently occurring in past studies (Chang and Smith 2023):

- Smart urban governance;
- Citizens' lived experience;
- Citizen participation and social inclusion;
- Sustainability;
- Indicators and measurement of QoL in smart cities.

It is important to analyse gaps between policies and practice (Nunes et al. 2021), as there is still a mismatch between the citizens' needs and the service design (Chen and Chan 2023). Although smart governance is not always visible to citizens and therefore not always ranked as highly in SC and QoL studies as other domains (Ozkaya and Erdin 2020, Braga et al. 2021), it underpins urban development, planning and management and it is often responsible for decisions about design and the implementation of smart systems. It is suggested that efficient public governance can help to reach a higher level of QoL by providing a transparent, collaborative, participatory, communicable and accountable government (Chen and Chan 2023). Some studies focus specifically on governance and decision-making (de Guimarães et al. 2020, Mills et al. 2022). On the one hand, the tools and mechanisms used by governments or municipalities for information provision, data collection and feedback can help to increase participation and social inclusion. On the other hand, many of the critiques of smart city developments highlight the inherent power relations (Vanolo 2014), weak collaborative engagement with stakeholders (Kitchin 2015), and

hegemonic approaches to urban governance and planning, which reproduce social inequalities (Krivý 2018). For this reason, Cheniki et al. (2020) suggest a so-called 'smart synthetic model' for e-governance that helps to integrate citizens into the political system, and to create equity between stakeholder decision-making and priorities.

Discussion on sustainability should be aligned with the SDG11 goals to make cities sustainable, safe and resilient (United Nations 2015). Some SC studies focus specifically on resilience (Bruzzone et al. 2021) and several definitions of SC that focus on QoL include sustainability as an important objective (Edge et al. 2020, Ortega-Fernández et al. 2020, Szarek-Iwaniuk and Senetra 2020, Ligarski and Wolny 2021). Cantuarias-Villessuzanne et al. (2021) categorise European cities into three clusters, arguing that the quality of life-orientated cluster should include sustainable goals. Indeed, Kubina et al. (2021) advocate the use of the 'superior' term "smart sustainable city".

Numerous indicators have been used in past studies to define the domains of smart cities, including smart living (Annex 1 offers a summary of selected recent literature on this topic). But it is important to consider that indicators can become a "subtle disciplining technique" if they are used to set specific political or financial agendas (Vanolo 2014: 890). It should also be noted that it is difficult to differentiate clearly between domains, as several areas of life impact on smart living. For example, Zhu et al. (2022) define a 'Happiness-driven SC' according to the following elements, which combine the economic, environmental and social domains:

- A city with efficient and green physical infrastructure
- A city with labour-friendly and innovative economy
- A city with inclusive and attractive society
- A city with sustainable and eco-friendly natural environment

SCs are inevitably affected by the economic situation and governance (e.g in the domains of health, education and housing). Environmental issues are a global concern (e.g. climate change), but local measures can help to mitigate pollution levels and to increase the number of green spaces, for example. Mobility issues may affect the residents' quality of life in terms of their commuting to work or the access to leisure and cultural experiences. Smart people and smart living are inextricably connected in terms of social cohesion, community development and inclusion.

Smart living

It has been suggested that smart living is the most important domain of a smart and sustainable city followed by a smart economy (Ozkaya and Erdin 2020, Toli and Murtagh 2020). Smart living includes the creation of liveable and safe cities (Cantuarias-Villessuzanne et al. 2021), which enhance lives and tackle social challenges (Chen and Chan 2023). Cities that score highly in smart living tend to be perceived as

safe with good healthcare and education systems (Toli and Murtagh 2020). Ozkaya and Erdin (2020) emphasise healthcare conditions, education facilities, individual safety, housing quality and affordability, cultural interaction opportunities in cultural facilities (e.g. events, heritage sites, museums, shopping), tourist attractivity, and social cohesion (e.g., homelessness, volunteering). Other authors include religion and tourism in smart living, as well as culture (art, cinema, theatre), sport, entertainment for children, religious and spiritual edifices, and restaurants. They also highlight the cost of living (Cantuarias-Villessuzanne et al. 2021).

Some authors have referred to 'smart livelihood', which includes a way of life, opportunities to use smart technology, personal life quality, a feeling of belonging in the city, community pride, and citizens' participation in government decision making (Chen and Chan 2023). The themes of surveillance and privacy emerge from several studies as being important issues that affect the residents' security (Ortega-Fernández et al. 2020, Vidiasova and Cronemberger 2020, Braga et al. 2021, Cantuarias-Villessuzanne et al. 2021). This includes also the risks associated with data privacy and protection (Sharif and Pokharel 2022) as in the domain of healthcare it is considered especially essential to ensure information security and strict privacy protection (Zhu et al. 2022).

Ji et al. (2021) found that the top-rated SC service belongs to the soft domain: the smart-living dimension. This was the welfare and social inclusion service, indicating that the respondents showed much concern about the delivery of SC services for serving the needs of minority groups. Social inclusion is characterised by equality, a balanced city development, and shrinking gaps between various groups with respect to economic conditions, education level, and so forth. Taking an inclusive approach to SC development puts the welfare, needs, and priorities of citizens first, helping to cultivate social and ethical plurality as well as fostering flexibility, creativity, and open-mindedness (Wang et al. 2021). It can involve delivering assistance to vulnerable people including the elderly or the disabled, as well as effective settlement policies for the immigrants (Shami et al. 2022). It is important to identify whose voices are missing, whether they are youth, refugees, or the homeless.

Several studies have attempted to capture the relative importance of different domains of smart living. For example, the results in three Korean cities indicate that citizens perceive smart cities as a means of improving their safety, convenience, and their local environments (Oh 2020). In a comparison of Taiwanese cities, researchers showed that citizens expressed the most concern for smart safety, smart transportation, a smart environment, and smart healthcare (Ji et al. 2021). Municipalities in Poland listed the following as the most important quality of life factors: living conditions in the city, public safety, education, housing, future perspectives, leisure opportunities, transport and communication and working conditions in the city (Ligarsky and Wolny 2021). A

study in Tehran, Iran (Shami et al. 2022), referred to several factors of smart-living quality, including housing and building, culture, the environment and natural resources. It was also thought that using modern and innovative methods in developing society's health and hygiene will have the greatest impact on improving the quality of smart living. These studies indicate that the relative importance of the domains largely depends on context and geographical scale (Keshavarzi et al. 2021), but wider research can lead to more definitive conclusions, for example, in their study of 44 cities, Ozkaya and Erdin (2020) found that individual safety, access to health services and the educational infrastructure are more important than other factors, whereas tourist attraction is the least important. Also, several authors have suggested the most important domains of smart living revolve mainly around housing, social cohesion, security, housing, culture, and education (Table 1).

Table 1. Suggested domains of smart living

Authors	**Suggested domains of smart living**
Bielińska-Dusza et al. (2021)	Housing quality Health condition Individual security Education facilities Economic welfare/social cohesion Cultural facilities Tourism attractiveness
Oh (2020) (for "subjective quality of life")	Housing (including facilities and environment) Health and wellbeing (including physical and mental health) Safety and convenience Urban environment
Ortega and Malcolm (2020)	Housing quality Citizen security Social cohesion Cultural facilities Tourism
Ozkaya and Erdin (2020)	Housing quality Health conditions Individual safety Education facilities Social cohesion Cultural facilities Tourist attractivity
Cantuarias-Villessuzanne et al. (2021)	Healthcare Security Education Tourism
Csukás and Szabó (2021)	Housing Health Social cohesion Culture

Authors	Suggested domains of smart living
Ji et al. (2021)	Welfare and social inclusion service, e.g. to reduce barriers for minority groups in social learning and participation Public spaces management service, e.g. maintenance E-democracy service, e.g. electronic voting service Online city-tourism information service
Pira (2021)	Health (including life expectancy) Safety (e.g. crime levels) Education Culture and wellbeing (living conditions, inequality, quality of life ranking)
Shami et al. (2022)	Housing and building Health and hygiene Security Public education Social cohesion and participation The environment and natural resources Culture
Zhu et al. (2022)	Reliable and efficient physical infrastructures Accessible and secured ICT infrastructures
Chen and Chan (2023) (for "smart livelihood SCQOL-LIVE")	Way of life Personal life quality A feeling of belonging in my city The image of my city to others Community pride Opportunities to use smart technologies Citizens' participation in government decision-making process

Research methods for smart city and quality of life research

According to the detailed literature review (2020-2023) of 40 academic articles focusing on SC and QoL, the most common research methods are quantitative (Figure 1), including questionnaires with the local residents. QoL research often employs questionnaires that focus on subjective wellbeing and the citizens' perceptions on the domains of SC (de Guimarães et al. 2020, Oh 2020, Vidiasova and Cronemberger 2020, Bielińska-Dusza et al. 2021, Ji et al. 2021, Simonofski et al. 2021, Shami et al. 2022, Chen and Chan 2023).

ome authors collect and analyse indicators and sub-indicators relating to smart buildings, resources management, energy consumption, transport systems, healthcare and smart infrastructure (Ivaldi et al. 2020, Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Pira 2021). Others analyse policy and strategy documents and reports which connect their research to smart governance, urban planning and management (Vidiasova and Cronemberger 2020, Csukás and Szabó 2021, Treude 2021). These methods can also help to provide a framework for a case study context (e.g. political, economic and environmental issues). Sometimes the document analysis is quite

specific, e.g. documents referring to resilient cities (Bruzzone et al. 2021) or inclusive smart cities (Wang et al. 2021). In addition to in-depth interviews, focus groups, workshops and Delphi studies, other ways of eliciting data from professionals include cognitive mapping research, which involve panel discussions with groups of experts (Braga et al. 2021, Nunes et al. 2021).

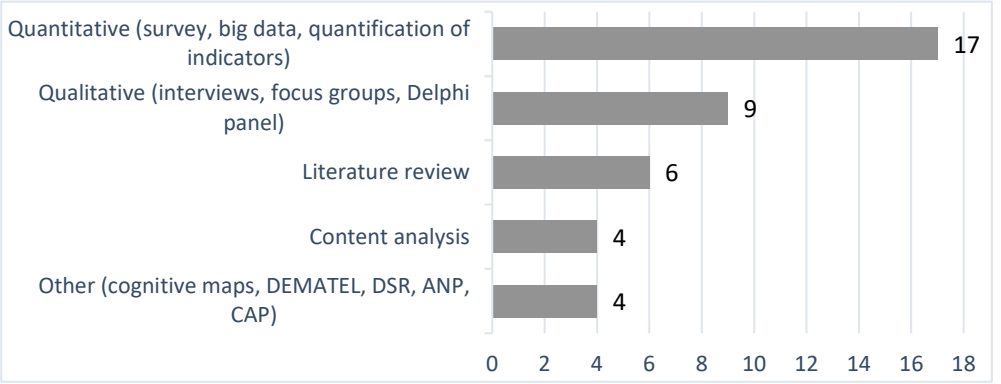

Figure 1. Summary of research methods used in past studies of QoL in SC

Several studies used mixed research methods (e.g. those listed under the 'Other' category in Figure 1). These appear to be the most informative for collecting objective indicators, subjective perceptions of both professionals and residents, as well as content-analysing policy documents. Several authors include comprehensive lists of indicators and sub-indicators across the domains of SC discussed earlier (Ortega-Fernández et al. 2020, Pira 2021), some having a specific focus on QoL (Ligarski and Wolny 2021, Chen and Chan 2023). Research across several cities and comparative work is invaluable, but it is important to note that one model may not work for all cities and that adaptation to the local context is essential. Nevertheless, applying the global principles of sustainability or good practice in citizen participation can work well in many different territorial contexts.

Context for Research

This section will demonstrate how the above information could be used in the context of a specific city. The identification of domains and indicators can be applied to various research methods but lend themselves especially well to questionnaire design which can reach a wider range of citizens than other methods (e.g. interviews or focus groups). The chosen context for the potential application of smart living research is the city of Budapest, the capital of Hungary. It is firstly necessary to consider the background of Budapest's urban development as a post-socialist city in transition.

The economic and social processes affecting urban transformation in all post-socialist cities include political change, transition to capitalism, gentrification, urban sprawl,

and segregation (Vesalon and Creţan 2019). Urban policy and planning have been somewhat laissez-faire with inadequate or inconsistent regulatory and legal frameworks, and inherent corruption (Tsenkova 2014). This has led to greater social inequalities and often a decrease in local resident quality of life (Smith and Klicek 2020). This was partly due to increasing economic polarisation, income inequalities and the spatial differentiation of the society (Marcińczak et al. 2013). In Romania, it was noted that the unequal exploitation of opportunities arising after the fall of the communist regime has greatly influenced urban development (Stoian et al. 2024). It is also important to mention the disappointments with post-socialist living, which offered relatively little security and state support in the absence of paternalistic authority (Shlapentokh and Shiraev 2002). Impoverishment, population decrease, and outmigration are common issues (Sýkora 2009, Marcińczak et al. 2013, Popescu 2014), which have not been ameliorated in many post-socialist cities like Budapest, even in recent years. It has been noted that marginal communities living in peripheral areas like the Roma people might be especially vulnerable to exclusion in this region because of uneven spatial development and displacement (Dragan et al. 2024). It is also important to consider ethnic minorities living in border regions (Berceanu et al. 2023).

Hungary experienced a more 'benign' form of state socialism than some countries in the Eastern Bloc (Bockman 2011) and the return to 'capitalism' was therefore swiffer (Marcińczak et al. 2015). Nevertheless, Budapest, like many post-socialist cities, is now suffering from issues that are also common to many Western European cities, such as gentrification, inflation, a housing crisis and overtourism, all of which impact on the local resident quality of life. It has been suggested that, like in other CEE cities, this is partly a result of following the Western pattern of prioritising economic growth over social cohesion and environmental protection (Vesalon and Creţan 2019).

In their comparison of nine cities, Csukás and Szabó (2021) state that smart developments have been ongoing in Budapest for the last decade (Figure 2), however, it has been suggested that the city ranks lower than its region's average (Csécsei 2020). Although it seems on the surface that Budapest shows some similarities with Vienna (Austria) based on the distribution of value proposition components (e.g. citizen inclusion, engagement and equality), alongside Moscow, Budapest is the lowest performing city in terms of QoL (Csukás and Szabó 2021). However, Vanolo's (2014) critique of smart city rankings should be mentioned here, where he argues that such standardising 'performance technology' may not take into consideration the diversity of factors that affect urban development in different cities, including power relations.

QoL in Budapest was defined based on numerous past studies as: "Activities, directly providing better conditions for the citizens to pursue happiness in their daily life, considering their needs and experience in mind, resulting in well-being" (Csukás and Szabó 2021: 7). The European Commission (2023) QoL report shows that satisfaction

with living in Budapest remained relatively low between 2019 and 2023, including healthcare, housing, air pollution and lack of trust in other people. It has been suggested that the issue of "disrupted wellbeing" in Budapest should be addressed, including gentrification, clash of interests over land use and overtourism (Namaz and Tvergyák 2023: 7).

Figure 2. The winners of smart city projects organised by the City Hall in Budapest (2021). Source: Kaiser (2024)

Csukás and Szabó (2018) previously cited lack of correct understanding of smart city concepts as one of the barriers to development in Budapest and other Hungarian cities and they emphasised the importance of understanding the specific local needs of a city, namely the needs of the citizens. Csukás and Szabó (2022) provide a focused analysis of Budapest's smart strategy, suggesting that the process is not entirely transparent, including legislation and regulations, while the roles and responsibilities of stakeholders are not clearly articulated, and activities related to gathering the opinions of the wider population are missing. Taking into consideration these authors' identified barriers to smart city development in Hungary, this work will make recommendations for improving the current 'smartness' of Budapest by researching the needs of the citizens. Research will identify the most important QoL issues for Budapest by collecting focused data from a sample of residents, which can help to assess the importance of several domains of smart living and to make recommendations for enhancing QoL based on the results. The sample will take into consideration the concerns expressed by Dragan et al. (2024) that less educated, older and poorer citizens are not as likely to have easy access to the digital world.

Discussion

Research Design

The research will build on and complement one previous study that focused on Budapest as a smart city from an environmental perspective. In addition to pollution and the heat island effect, the lack of green spaces, affordable housing and problems with the maintenance of the infrastructure were identified as key challenges by more than half of the respondents. Public cleanliness and safety were also identified as important (Fekete 2023).

In the design of the research, it was firstly important to examine the dimensions of smart city development that were included in the Smart City Vision of Budapest (Municipality of Budapest 2017):

- An integrated and holistic approach to development for the whole city;
- The extent to which digital tools and technology can improve quality of life;
- A strong connection to sustainability;
- The need to enhance social responsibility;
- And to create a dynamic, creative and liveable city.

The proposed smart living questionnaire would focus in particular on the improvement of QoL and liveability, including the role of digital tools and technology in this process. The Smart City Vision of Budapest strategy includes the economy (incorporating creativity, knowledge and innovation); mobility and the environment (accessible, sustainable transport and energy); leisure (including green spaces, heritage and tourism); as well as social regeneration (reference is made to equal opportunities, active society, inclusion of disadvantaged groups and preserving diverse residential communities). Among the most important intentions of the Smart City Vision for Budapest (Figure 3), the emphasis on improving liveability and quality of life through sustainability and technology is notable.

Of course, health and education are also fundamental aspects of QoL, but health and education systems are affected by national government policies, and they are often beyond the remit of city governance. It must be mentioned that urban governance in Budapest currently faces some barriers and restrictions due to the lack of political cooperation, economic and funding issues. However, the aim of this research will not be to explore the process of and barriers to implementation of smart city initiatives, instead it will examine the resident perceptions of existing and ongoing urban developments.

Using the domains that occur most frequently in the previous research on smart living, the questionnaire design will focus on the following: housing, health, education, safety,

Figure 3. Smart city vision for Budapest

environment (public and green spaces), social cohesion, leisure, culture and tourism. The following indicators from past studies of smart living were used as inspiration for the design of the statements:

- **Housing:** technology facilitates purchase, sale and rent; efficiency in water and energy (Shami et al. 2022);
- **Health:** adequate healthcare options within their budget; e-options (Ji et al. 2021); caring for and monitoring patients' health status (Shami et al. 2022);
- **Safety:** feeling safe within the city, including at night; monitoring and controlling public space (Shami et al. 2022);
- **Education:** digital education using modern and interactive ICT tools (Ji et al. 2021); innovation in educational methods (Shami et al. 2022);
- **Public spaces:** attractive and well-maintained public spaces (Ji et al. 2021);
- **Green spaces:** citizens have access to green spaces close to their homes (Liu et al. 2020);
- **Social cohesion:** a sense of belonging in the city (Chen and Chan 2023);
- **Social inclusion:** help and support for all citizens, including disadvantaged groups (Ji et al. 2021);

- **Leisure:** enough leisure and sports activities close to home (Oh 2020); e-library service; e-fitness service (Ji et al. 2021);
- **Culture:** interesting and affordable museums and galleries; enough information about cultural events (Shami et al. 2022);
- **Tourism:** new experiences of cultural heritage for residents and tourists using ICT, e.g. augmented reality (Ji et al. 2021); becoming familiar with tourist sites (Shami et al. 2022).

Pilot Study

The questionnaire was designed in English (because of the much wider availability of SC and QoL literature in English), but it was translated into Hungarian with the assistance of two native speakers. The questionnaire was also translated into Mandarin by a native speaker and checked by two further native Mandarin speakers, as there is a sizable Chinese minority in Budapest. However, it should be noted that foreigners (who would undertake the questionnaire in English) represent only 5.8% of the population of Budapest and it is estimated that there are 30,000 Chinese people in Budapest (approximately 1.8% of the total population) (HCSO 2023). The questionnaire will therefore be mainly distributed to Hungarian residents.

In addition to consulting the recent literature and previous studies, the proposed questionnaire statements (Table 2) were piloted on a representative sample of respondents in accordance with the planned distribution and using recent Census data. The ideal number of respondents for our study would be of 385 citizens, with a confidence level of 95% and a margin of error of 5% (Qualtrics 2023). This was calculated based on the total population of Budapest being of 1,685,342 people with an estimated 1,400,000 citizens aged 18+ (HCSO 2023). A minimum of 300 questionnaires was deemed acceptable. Previous SC and QoL studies include samples ranging from 235 citizens up to 848 people (de Guimarães et al. 2020, Oh 2020, Bielińska-Dusza et al. 2021, Ji et al. 2021, Simonofski et al. 2021, Vidiasova and Cronemberger 2020, Shami et al. 2022, Chen and Chan 2023). One of the aims of conducting a pilot study is to check the correctness of the developed questionnaire (Kaur et al. 2017, Menon et al. 2021), to include only relevant information (Morris and Rosenbloom 2017), and to modify the questions that do not elicit appropriate responses (Malmqvist et al. 2019). Some researchers recommend a pilot sample of around 10% of the total sample (Connelly 2008, Menon et al. 2021), while Perneger et al. (2015) suggest that thirty participants are a reasonable starting point for a pre-test of a questionnaire. As the minimum sample size would be 300 residents, the pilot sample was 30 respondents. In addition to fine-tuning language and translation, identifying repetition, omissions or redundant questions, some of the changes to statements suggested by the respondents can be seen in the Notes column in Table 2.

Table 2. Questionnaire statements for Smart Living Questionnaire

Domain	Suggested statements	Notes
Housing (Oh 2020, Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Csukás and Szabó 2021, Shami et al. 2022)	- It is easy to find good quality housing in Budapest at a reasonable price to rent - It is easy to find good quality housing in Budapest at a reasonable price to buy	*In the pilot study, respondents emphasised the need to differentiate between buying and renting accommodation.*
Health (Oh 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Cantuarias-Villessuzanne et al. 2021, Csukás and Szabó 2021, Pira 2021, Shami et al. 2022)	- I am satisfied with healthcare services, doctors and hospitals in Budapest	*Inspired by "the healthcare system is adequate for my needs" (Ji et al. 2021).*
Safety (Oh 2020, Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Cantuarias-Villessuzanne et al. 2021, Pira 2021, Shami et al. 2022)	- Budapest feels safe including at night	*Inspired by "The city feels safe and secure, including at night" (Shami et al. 2022).*

Education
(Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Cantuarias-Villessuzanne et al. 2021, Pira 2021, Shami et al. 2022)
	- I am satisfied with the education provision in Budapest:
	  - At primary level
	  - At secondary level
	  - At higher level
		In the pilot study, respondents suggested specifying which level of education (e.g. primary, secondary, higher).

Environment (public and green spaces) (Oh 2020, Liu et al. 2020, Ji et al. 2021, Shami et al. 2022)	- There are enough attractive green spaces in Budapest (e.g. parks and gardens) - Budapest is a clean city - Budapest seems to be a sustainable city	*Inspired by the maintenance of public spaces (Ji et al. 2021); the importance of green spaces (Liu et al. 2020).*
Social cohesion (Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Csukás and Szabó 2021, Ji et al. 2021, Shami et al. 2022, Chen and Chan 2022)	- The people in Budapest seem open and friendly - I feel a sense of community in Budapest	*Inspired by but simplified from: "I feel a sense of belonging in the city" (Chen and Chan 2021).*
Leisure (Oh 2020, Ji et al. 2021, Ligarski and Wolny 2021)	- Budapest has a good range of sports and fitness facilities	*Inspired by "There are enough sports and fitness facilities close to where I live" (Oh 2020).*

Domain	Suggested statements	Notes
		Budapest has excellent new sports facilities in the centrally located city park, so we did not want to limit answers to local areas.
Culture (Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Cantuarias-Villessuzanne et al. 2021, Csukás and Szabó 2021, Pira 2021, Shami et al. 2022)	- Budapest has a good range of affordable cultural facilities (e.g. museums, galleries, heritage sites, theatres)	*Inspired by "interesting and affordable museums and galleries" (Shami et al. 2022).*
Tourism (Bielińska-Dusza et al. 2021, Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Cantuarias-Villessuzanne et al. 2021, Ji et al. 2021, Shami et al. 2022)	- Budapest has many interesting tourist attractions - Tourism has many positive impacts on Budapest - Tourism has many negative impacts on Budapest	*Budapest suffered from 'overtourism' in the pre-COVID era and the residents were unhappy about the overcrowding and night noise. However, we wanted to balance the negative impact question with a positive one.*

Questionnaire distribution

Taking inspiration and methodological good practice from previous studies of SC and QoL (de Guimarães et al. 2020, Oh 2020, Bielińska-Dusza et al. 2021, Ji et al. 2021, Simonofski et al. 2021, Vidiasova and Cronemberger 2020, Shami et al. 2022, Chen and Chan 2023), the questionnaire will have the following characteristics:

- It will be designed using closed questions and a Likert scale
- It will be designed in both online (weblink and QR code) and paper format in order to capture all age groups as representative as possible
- It will be posted on social media (e.g. online District Forums, Expat networks) but also distributed in public places (e.g. the City Park in the centre of Budapest)

One more question will be included to capture the respondents' attitudes to SC development with the questions inspired by, but adapted from, Chen and Chan (2023):

- The development of Budapest as a smart city is important to me
- I would like to use more smart services in Budapest

In the study of Budapest by Fekete (2023) only around 40% of the residents were familiar with the term 'smart city' and even fewer could name some smart solutions. Of these, the best known are related to transport, including tickets and vehicle-sharing schemes, as well as smart benches, parking apps and a few references to lighting and

energy sources. For this reason, it was deemed important to include 'prompts' for respondents in subsequent research. A separate question will therefore be included that gathers information about the smart services that the residents are familiar with or most likely to use. In addition to the literature review, artificial intelligence (ChatGPT) made suggestions when tasked to: "list specific or tangible smart city initiatives that citizens can use". Some of the suggestions have been adapted to form the following list:

- A transport system with e-ticket options (e.g. via apps or online booking)
- Electronic information boards to show when the next bus/train is coming
- E-parking options
- Electricity charging stations for cars
- Car-pooling or sharing apps
- Bike-sharing schemes
- Rubbish collection based on smart technology which indicates when bins are full
- E-health options where people can access doctors online
- Online learning options offered by educational institutions
- Wi-Fi available everywhere in the city
- E-ticket options for theatres, museums and other cultural facilities
- Digital experiences in cultural facilities like museums, heritage sites and galleries (e.g. virtual reality, augmented reality, interactive technology)
- Smart lighting systems
- Cameras linked to security services in public spaces
- Touchscreen kiosks in public areas providing information about local services, events and points of interest
- Online complaint platforms where people can say what they find good or bad about the city

Many of these are related to Smart Mobility, especially public transport and car travel, as well as Smart Environment. Also, most of the current smart city initiatives in Budapest relate to mobility or environmental sustainability. However, several points are also relevant to Smart Living, and these will form part of a smart solutions question for the residents in the Budapest study:

- Housing: rubbish collection based on smart technology
- Health: E-health options where people can access Budapest doctors online
- Safety: cameras linked to security services in public spaces
- Education: online learning options offered by Budapest educational institutions
- Social inclusion: online complaint platforms where people can say what they find good or bad about the city

- Public spaces: Wi-Fi available everywhere in the city; touchscreen kiosks in public areas providing information about local services, events and points of interest
- Leisure: bike-sharing schemes
- Culture: E-ticket options for theatres, museums and other cultural facilities; digital experiences in cultural facilities like museums, heritage sites and galleries (e.g. virtual reality, augmented reality, interactive technology)
- Tourism: touchscreen kiosks in public areas providing information about local services, events and points of interest

Conclusions

This paper has centralised the residents' QoL in the context of smart cities using the domain of smart living. It has been suggested that this domain is actually the most important of the six commonly cited domains of SC, yet it is relatively under-researched. One of the main aims was to identify the appropriate indicators for measuring smart living, including connections to smart solutions. Unlike the wider measures of QoL, which also include economic and environmental dimensions, smart living focuses more on social indicators. These can include physical living conditions (e.g. housing, public space, safety), social services (e.g. health and education), but also those factors that contribute to psychological wellbeing, such as leisure, culture and social inclusion. Smart living should be underpinned by good governance and sustainability, but these processes are often unseen by the residents.

A wide range of research methods have been used in SC and QoL studies, with the most common being quantitative. Although mixed methods are arguably the most effective, questionnaires allow researchers to reach a representative sample of residents. This study therefore paves the way for quantitative research to be undertaken in a real city context (Budapest in Hungary) making recommendations for refining the domain of smart living, as well as for identifying indicators for measuring the residents' QoL within this domain. Future research will include distributing the questionnaire to a representative sample of the population of Budapest and using the results to identify the most important domains of quality of life for different segments of residents. This can help to inform policy and planning, as well as to determine the allocation of resources to future smart developments.

The research is considered timely because of Budapest's relatively low performance in QoL indicators in Europe, the lack of data on the needs of the citizens, and to complement previous studies that focused more on economic or environmental rather than social indicators. Overall, this article contributes to the development of theoretical and methodological approaches to SC and QoL studies, as well as assisting potential city governments in the development of measures and indicators. The results could be applicable to other post-socialist CEE cities which have followed similar trajectories to

Budapest. Indeed, although every context and community are different, the domains and indicators are applicable to almost any city that hopes to enhance quality of life by prioritising smart living.

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Annex 1

Smart Cities and Quality of Life domains and indicators

Authors	Indicators	Notes
Ivan et al. (2020)	**There are eight domains of an age-friendly city, namely:** • Social participation • Communication and information • Civic participation and employment • Housing • Transportation • Community support and health services • Outdoor spaces and buildings • Respect and social inclusion	
Oh (2020)	**Several studies on citizen-centric urban planning suggested that "Subjective Quality of Life" can be classified into four categories:** • ***Subjective health issues*** • ***Subjective safety evaluation*** • ***Urban environment*** • ***Residential environment (e.g. housing)***	**Quality of life variables were:** • ***Housing (including facilities and environment)*** • ***Urban environment*** • ***Health and wellbeing (including physical and mental health)*** • ***Safety and convenience***
Ortega-Fernandez et al. (2020)	**Dimensions of a smart city:** • Governance (including public services, taxation, transparency of data) • People (including creativity, social cohesion, qualifications) • Economy (including investment, competitiveness, entrepreneurship) • ***Living (including housing quality, tourism, cultural facilities, citizen security, social cohesion)*** • Environment (including pollution, energy efficiency, green buildings) • Mobility (including sustainable transport, traffic control, ICT infrastructure)	
Ozkaya and Erdin (2020)	The smart and sustainable city concept consists of six characteristics. ***While 'Smart Living' is the most important characteristic***, 'Smart Governance' is the last and 'Smart Economy' is ranked second.	***In their Keyword ranking, 'quality of life' is the first.*** ***Cities which have good scores in the smart economy and smart living also get good scores in the general ranking.*** ***The concept of 'Smart living (quality of life)' was assessed by seven factors. While individual safety is the most important factor, tourist attraction is the last one.***

Authors	Indicators	Notes
Szarek-Iwaniuk and Senetra (2020)	**A smart city is characterised by**: • sustainable economic development, and • ***a high quality of life*** **which are driven by:** • investments in human and social capital • traditional (transport) • modern (ICT) infrastructure • responsible resource management • social participation	
Braga et al. (2021)	**Smart city development depends on six critical pillars:** • Smart economy • Smart governance • Smart mobility (including transport) • Smart environment • Smart people • ***Smart ways of life (associated with locals' lifestyle choices and quality of life)***	**The most important four pillars are:** ● People's involvement in constructing an intelligent, informed, educated society ● Preserving the environment, managing energy, sustainability ● Mobility and transport ● Sustainable economic development
Cantuarias-Villessuzanne et al. (2021)	**Seven dimensions of the smart city (described by the academic literature):** • Smart architecture and technologies • Smart citizens • Smart economy • Smart environment • Smart government • Smart living • Smart mobility	***Smart living examines the use of ICT for achieving quality of life in a liveable and safe environment. This smart city dimension is mainly divided into four characteristics:*** • ***Security*** • ***Education*** • ***Healthcare*** • ***Tourism*** • ***Religion***
Ji et al. (2021)	**Respondents' preferences about seven dimensions of SC services, including:** • smart energy (four questions) • smart environment (six questions) • smart people (six questions) • ***smart living (seven questions)*** • smart transport (four questions) • smart safety (four questions) • smart health (four questions) ***Among these dimensions, smart people and smart living represent the soft domain***, and the others, the hard domain.	Although smart living was ranked highly, Taiwanese citizens expressed relatively higher preferences for SC services from the hard domain over those from the soft domain. Eight of the 10 most-preferred specific SC services were drawn from four hard-domain dimensions, i.e., smart safety, smart transport, smart environment, and smart health.
Kim et al. (2021)	**Main topics of citizens' complaints in Seoul:** • Health: public health, hygiene, etc. • Economy industry: payments for charges, prices, etc. • Traffic: public transportation, pedestrians, etc.	From 2006 to 2017, the three most important topics were traffic, the environment, and culture.

Authors	Indicators	Notes
	• Culture: sightseeing, cultural experiences, cyber subculture, etc. • Welfare: positive discrimination, labour welfare • Taxes: default, tax collection, etc. • Safety: firefighting, disaster prevention, declaration of emergency, etc. • Female: infant care, multi-children families, etc. • Housing: rentals, housing development, real estate policy, etc.	
Ligarski and Wolny (2021)	**The identification of eight areas which, according to the respondents (in 76 cities), have the greatest impact on the quality of life:** • ***Living conditions in the city*** • Public safety • Education • Housing • Future perspectives • Leisure opportunities • Transport and communication • Working conditions in the city	
Pira (2021)	**Indicators for smart sustainable cities:** • Socio-cultural (including health, education, culture, safety) • Economic (including housing, jobs, entrepreneurship) • Environmental (including green spaces, pollution, energy use) • Governance (including transport, data monitoring, internet and WiFi)	***The smart city 'Living' indicators are useful (adapted from Cohen 2014):*** • ***Culture and wellbeing (living conditions, inequality, quality of life ranking)*** • ***Health (including life expectancy)*** • ***Safety (e.g. crime levels)***
Sharif and Pokharel (2022)	**The primary goals considered for a smart city project were**: • ***the enhancements in quality of life*** • economy • transport and traffic • clean and sustainable environment • access to interaction with the government's relevant authorities	
Valencia-Arias et al. (2021)	**Smart cities integrate six concepts:** (1) smart economy, with high levels of innovation; (2) smart mobility, based on the adoption of sustainable and eco-friendly transportation systems; (3) smart environment, measured as the adequate management of natural resources; (4) smart communities, based on community training and the development of key skills for innovative ecosystems;	**The evaluation (for transformation of cities into smart cities) is focused on six dimensions:** (1) government (2) mobility (3) sustainability (4) people (5) economy ***(6) quality of life***

Authors	Indicators	Notes
	(5) smart life, a dimension that can be measured using social indicators that reflect the quality of life of citizens; (6) smart governance, from the standpoint of the supply of goods and services by government agencies and transparency in public administration.	
Shami et al. (2022)	***Dimensions and indicators to measure the quality of smart living:*** • ***Health and hygiene*** • ***Security*** • ***Public education*** • ***Social cohesion and participation***	***Smart living shall encompass innovations concerned with improvement of healthcare, education, and social services as well as the enhancement of citizens' participation (electronic-government projects) which is to have positive effect on the environment, to reduce vulnerability, and to improve safety (Appio et al. 2019).***
Zhu et al. (2022)	**Main features of a Smart City blueprint:** • A city with accessible and secured ICT infrastructures • A city with reliable and efficient physical infrastructures • A city with productive and innovative economy • A city with equal and inclusive society • A city with sustainable and resilient environment • A city with participatory and transparent governance	**Happiness Driven Smart City (HDSC) is supposed to have the following characteristics:** • A city with *efficient and green physical infrastructure* • A city with *labour-friendly and innovative economy* • A city with *inclusive and attractive society* • A city with *sustainable and eco-friendly natural environment*
Chen and Chan (2023)	**The five domains identified were the following:** (1) smart environment (SCQOL-ENV), which includes seven items related to environmental and sustainability issues; (2) smart people (SCQOL-PPL), which includes six items related to social welfare and personal development; ***(3) smart livelihood (SCQOL-LIVE), which includes seven items measuring an individual's way of life and community feelings, image and pride;*** (4) smart economy and economic policy (SCQOL-ECON), which includes five items related to the economic impact and government support of SCD; (5) smart mobility (SCQOL-MOB), which includes four items measuring the city's public transportation, infrastructure and safety.	

**The references to smart living and quality of life are highlighted and presented in Italic.*

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ON MIGRATION ASPIRATIONS IN SOUTHEASTERN EUROPE

Daniel Göler, Christoph Tausch
University of Bamberg, Bamberg, Germany

Abstract: Southeast Europe is considered a traditional emigration region in the past and present. Our study looks to the future, and it focuses on migration intentions there. The representative database of the OeNB Euro Survey offers the opportunity to analyse both large- and small-scale as well as group-specific differentiations beyond the question of the potential for future mobility in Southeast Europe. It became evident that migration intentions are still high. It can be seen that pure intentions are often accompanied by concrete plans. The age and level of education as well as a lack of trust in the government policy are important determining factors. The preference for Germany as a destination country in the post-Yugoslav region indicates the persistence of networks from the Gastarbeiter era. From a spatial perspective, it is also clear that it is mainly the deprived regions of Southeastern Europe where migration intentions are strong. However, the affected sub-regions are not necessarily those in which the plans are very concrete, i.e. there is often a considerable gap between aspirations and capabilities. The long-term and sustainable effects of the migration that is expected to continue, with the corresponding consequences for demographics, education, labour force and social infrastructures, remain problematic.

Keywords:

migration intentions;
(im)mobility;
migration potential;
brain drain;
Southeast Europe

Email: daniel.goeler@uni-bamberg.de

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Introduction

The Gallup World Poll reported for the period 2013 to 2016 that the "number of potential migrants worldwide tops 700 million" (Esipova et al. 2017). According to this, nearly 9% of the world's population had migration intentions; in terms of adults alone, the figure was as high as 14%. In 2021, the total was already 900 million or 16% (Pugliese and Ray 2023). However, the potential for current and future mobility appears to be high, even if it should be borne in mind that the aspiration to migrate often does not go hand in hand with carrying out a migration immediately. Behind sub-Saharan Africa, the highest figures are found in the group of European non-EU countries (27%; Esipova et al. 2017). The increases compared to the period 2010 to 2012 are well above average in some cases.

As expected, Eastern and Southeastern European countries occupy the top places in the ranking in this group of countries. First and foremost are Albania (in third place worldwide with 56% of respondents, on a par with Haiti), Bosnia and Herzegovina (36%) and Kosovo and North Macedonia (34% each). The fact that massive increases were recorded in most countries at the same time – in the case of Albania by 20 percentage points [!] – must give food for thought and it is also motivation to take a closer look at migration intentions in Southeastern Europe. This is all the truer as this group of countries has already experienced considerable population losses through emigration in the past: there were 4.6 million emigrants from the Western Balkans between 1990 and 2019, half of whom moved to Western EU countries, with Germany as their main destination (Ströhm 2023). It is not without reason that the same author recently referred to "emigration as tradition in the Western Balkans" and, like a number of other studies (Oruč 2022, Petrović and Adeljević 2024), he problematised it with reference to the potentially noticeable brain drain and the demographic consequences. Earlier studies emphasised, among others, how EU enlargement contributed to a substantial change of the European migration system that created not least a "new face of East-West migration" (Favell 2008) there. In their quantitative study, Knezović and Grošinić (2017) point to political, cultural and economic impacts of migration in Croatia (for a similar study on Bulgaria: Mintchev et al. 2016; and on Romania: Şoşea et al. 2018), while Bălţătescu (2007) focused on the qualitative aspect of life satisfaction of migrants from a receiving countries' perspective mainly. Finally, Șuiu (2015) analysed the coping strategies of Romanian stayers in Spain in the face of the 2008 crisis.

Our analysis then looks to the future. We follow the approach of de Haas (2021), which conceptualises migration as a function of aspirations and capabilities within given sets of perceived geographical opportunity structures, and then we ask these further questions: (1) how strong is the potential for future mobility in Southeastern Europe; (2) how concrete are the intentions expressed by individuals; (3) what group-specific differences stand out; and (4) what country-specific differentiations need to be

considered? Such topics, among others, are part of the Euro Survey of the Austrian National Bank (OeNB 2023) and the opportunity arose for the authors to conduct a secondary statistical analysis in 2023[1]. From a geographical perspective, this task is fascinating, as the survey (a) enables a cross-country comparison inside SEE, which (b) can be continued at the small-scale level of the NUTS 3 regions, and (c) it offers the reference to two Eastern European countries.

Methodology

The OeNB Euro Survey (OeNB 2023) has been conducted annually in ten Central and South-East European countries since 2007; the data from the 2019 survey was used for our analysis as, since 2020, the pandemic has led to a significant decline in migration volumes and massive upheavals in the global migration regime. The selection criterion was the means of payment used in each country: the sample only included countries that have not introduced the Euro as official currency. With regard to the Western Balkans, this results in a gap, as Montenegro and Kosovo unilaterally use the Euro as their national currency.

The OeNB's Euro Survey (OeNB 2023) focuses on issues related to the use of foreign currency. In particular, it aims to determine the extent to which the Euro is used for payment and savings purposes in the surveyed countries. Determinants of the demand for foreign currency are also examined. These include, for example, questions on critical risks such as a financial crisis or the pandemic and on expectations of currency developments, but also on private income and remittances from other countries. A second part of the survey covers socio-demographic and socio-economic questions, such as age, number of household members or income. A third part covers additional topics of policy relevance and of current research interest. In the 2019 survey, on which this study was based, this additional topic was migration and migration intentions.

The sample elements in the Euro Survey are individuals. For the survey, approx. 1,000 adult citizens are selected in each of the ten countries, i.e. the entire sample (n) comprises 10,102 people, 8,086 of whom live in the sample's Southeast European countries. The selection is based on a multi-stage stratified random sample with random route selection. Bulgaria and Bosnia-Herzegovina are exceptions as quota sampling is used there. The interviews are conducted face-to-face in the homes of the interviewees.

The underlying questionnaire is initially formulated in English, and it is translated into the respective national languages in order to avoid communication problems during

[1] The OeNB has had no capacity for a detailed analysis of the data set, and it contacted the working group on 'Geographic Migration and Transition Studies' at the University of Bamberg (Germany). There, a candidate was found (C. Tausch) and he took on the analysis in the form of a supervised thesis (by D. Göler).

the interviews (OeNB 2023). More detailed information on the survey, including the limitations of the data, can be found in Raggl (2017).

Results

The regions of emigration

The wish to migrate

In the survey, 15.4% of all respondents stated that, if they had the opportunity, they would move permanently to another country. Almost as many (14.8%) would emigrate temporarily. Just under a third therefore expressed a 'permanent' or 'temporary' desire to migrate. In terms of the next 12 months, however, only 6.6% stated that they were planning to do so. When asked about concrete steps, such as organising the emigration trip, only 2.9% confirmed. This means that around one tenth of people with migration intentions actually underpinned these with corresponding measures.

Migration potential and the 'EU paradox'

The desire to live permanently at another place is particularly high in the non-EU states of Albania, North Macedonia and Serbia. This is also where concrete plans are the most advanced. The lowest values are found in the Czech Republic and Hungary, followed by the Southeast European EU countries (Figure 1).

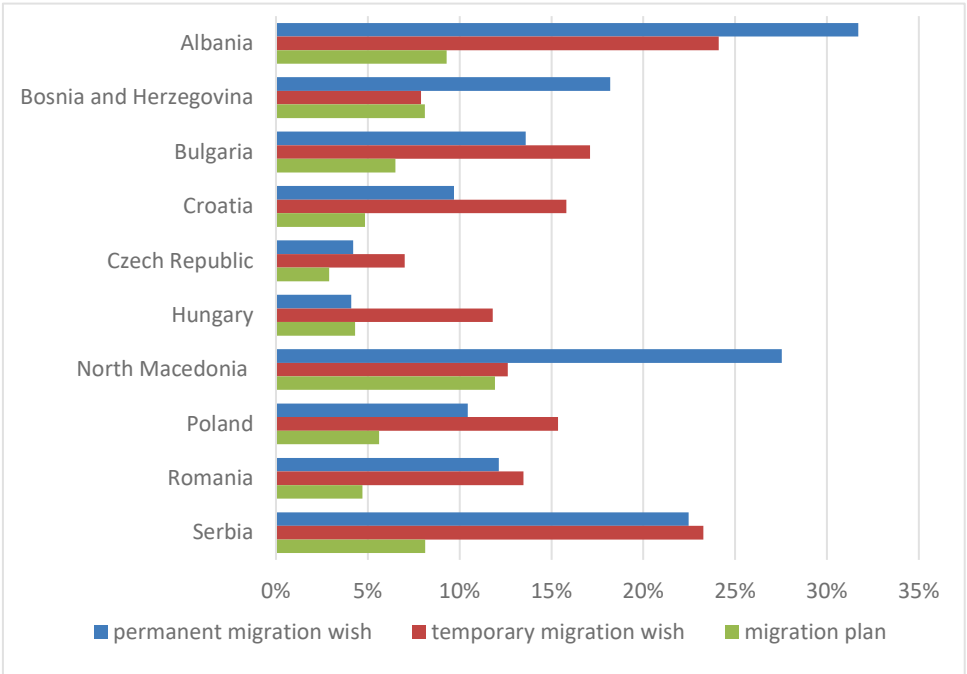

Figure 1. Countries of origin for migration intentions and plans. Source: OeNB Euro Survey 2019; n=10,102

In contrast, the desire to migrate temporarily is more pronounced among the citizens from the EU countries in the sample; this is particularly clear in the case of Hungary and Croatia. The question of EU membership (or a more advanced EU perspective, as in the case of Serbia) therefore seems to play a decisive role in that way that free and thus possibly repeatable access to the EU labour market after return is more likely to stimulate circular movements instead of permanent ones, as it could be expected at a first glance. This kind of a paradox would be an excellent argument for an accelerated EU enlargement in the Balkans, as our findings suggest that such a step would primarily promote circularity and return rather than further accelerating the (already high) permanent emigration and brain drain. In any case, there is no empirical evidence from the previous rounds of enlargement to support the frequently expressed concerns about overburdening the EU labour market or the social systems there (Pries 2023).

Three facts stand out and should be emphasised. Firstly, there is the permanent and extreme tendency to emigrate for the population in Albania (Göler and Doka 2015), where the OeNB sample confirms quite precisely the Gallup findings mentioned above. Secondly, the situation is similar in North Macedonia, particularly because the permanent desire there is already massively accompanied by concrete plans. Third, in the case of Serbia, the tendency towards permanent and temporary emigration is at a similarly high level with a slight predominance of the temporary, which in our opinion would again reflect the argument of the comparatively advanced EU perspective.

In order to be able to assess how realistic the migration wishes are, the Euro Survey asked those who had expressed migration plans for the next 12 months (n'=669) to take concrete preparatory steps such as obtaining a visa, work permit or contract and arranging travel and accommodation. In the case of Albania, nearly 60% of the respondents had already taken such steps and in the case of Serbia more than 50% (Figure 2). The lower rates for Poland and Romania (34.1% and 28.6% respectively) indicate a certain routine in preparing for (then circular) migration.

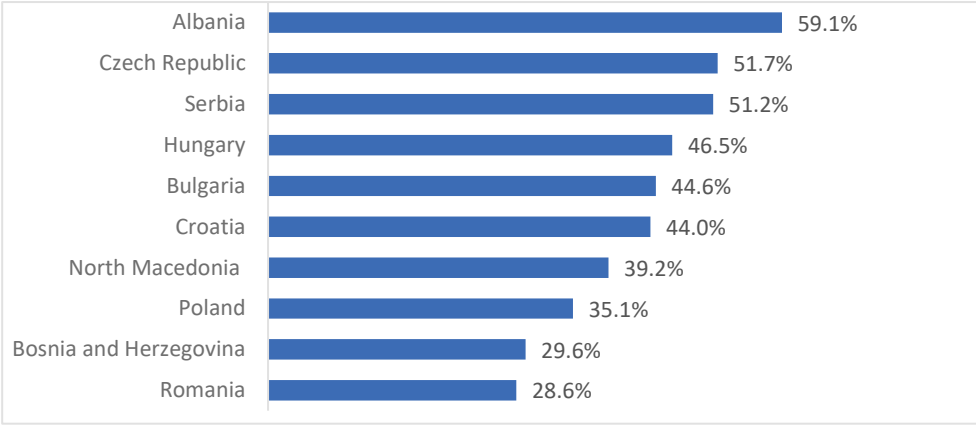

Figure 2. Preparations for migration by country of origin. Source: OeNB Euro Survey 2019; n'=669

A small-scale analysis of regions of emigration

The small-scale analysis of permanent migration intentions on the basis of the NUTS 3 regions only provides clear findings insofar as no particular 'clusters' can be identified in the maps on Hungary, Romania and Bulgaria (Tausch 2023). The migration intentions in particular tend to show a spatial uniformity of intentions (Figure 3). With regard to the potential for temporary or circular migration, the picture is somewhat more differentiated, although there is no need to go into this in detail here.

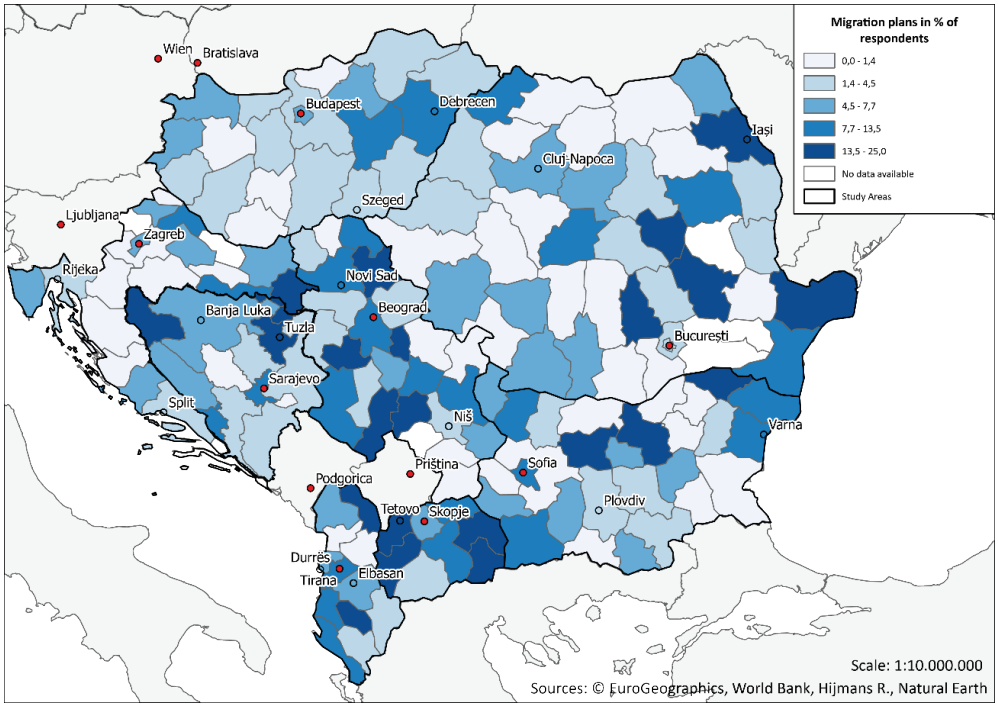

Figure 3. Migration plans. Source: OeNB Euro Survey 2019; only Southeast European countries; n'=8,086

In Serbia (eastern parts of the country) and Albania (especially in the north) in particular, there are clusters with stronger migration intentions, which, as in North Macedonia and Bosnia and Herzegovina, are evidently widespread. However, the regions with pronounced migration aspirations are not necessarily those with the most developed migration plans. In the case of the latter, the picture is quite fragmented, i.e. there is no single potential region of emigration. Rather, in the mentioned countries, and similarly in Bulgaria and Romania, there are almost erratically distributed individual NUTS 3 regions with strikingly high values for migration plans. This is the case in detail, for example, around Tuzla or in Una-Sana (BH), in eastern Vojvodina (Srednjobanatska oblast) and around Kruševac and Kraljewo (RS), in the district of Kukës (AL), in western and eastern peripheral districts of North Macedonia, around Buzău or Iaşi (RO) and in Lovech and Veliko Tarnovo (BG).

The gap between expressed migration wishes on the one hand, and the plans to migrate on the other, which is particularly evident in the small-scale differentiation, is clearly linked to local migrant network structures. Family members, friends or acquaintances living abroad define important, local support structures for further migration. The survey shows that half of the respondents in Southeast European countries with migration plans and preparations have family member(s) living abroad. Among those with migration plans, the proportion is one third (Table 1).

Table 1. Share of respondents with family members living abroad

Family abroad	Permanent migration wish	Temporary migration wish	Migration plan	Migration preparation
Yes	33.4%	34.1%	47.5%	52.2%
No	66.2%	64.8%	52.1%	47.4%
Don't know	0.1%	0.2%	0.2%	0.0%
No answer	0.3%	0.9%	0.2%	0.4%
Total	100.0%	100.0%	100.0%	100.0%

Source: OeNB Euro Survey 2019; only Southeast European countries; n'=8,086

If such "facilitators" in the form of social networks (Kley 2017) are not present to a similar extent in a neighbouring region, then this would explain the spatially fragmented pattern, even if no further empirical evidence can be found in detail in the used data set.

Embedded in the migration theory, this gap reflects exactly the contrast between migration aspirations and capabilities (de Haas 2021), whereby a certain proximity or desire to migrate may be offset by individually limited resources. This can lead to a failure to migrate, and it leaves those affected with the feeling of forced immobility, i.e. ultimately being trapped, figuratively speaking. Nevertheless, if the desire to migrate exists, it can be reactivated at any time as a means of social resilience (Göler and Krišjāne 2024) if resources change.

Destination countries

In the survey, 45 countries were specified as the destinations for migration planning. Table A1 shows the 17 countries that were named most frequently. Overall, there is a clear dominance of Germany, which at 33.9% has also a large lead over all other migration destinations, followed by the United Kingdom and Switzerland with more than 7% each and Austria with 6%. After that, EU countries that were already members before the 2004 enlargement round, such as Greece, Italy, France and Belgium, are the main destinations. Non-European destinations are the USA, Canada and Australia.

However, if the respective country of origin is considered individually, a more differentiated picture emerges with regard to the main destination. In percentage terms,

the respondents in Bosnia and Herzegovina (at 58% [!]), North Macedonia and Croatia mention Germany more often than the average, whereas Romanians mention the United Kingdom, and Hungarians opt for neighbouring Austria the most frequently.

The second place in this order shows an even wider spread: in the ten countries in the survey, seven different countries were mentioned in this regard. In addition to the nations already mentioned, such as Great Britain (by 16.9% of Bulgarians), Switzerland (by 18.3% of North Macedonians; by 15.9% of Serbs) and the USA, other destinations stand out: in Croatia, for example, Ireland (14.0%) and, in Albania, Greece (10.8%) were named in the second place. And in the case of Bulgaria, it is surprising that 12.3% are still undecided about their migration plans.

With regard to the destination countries for migration wishes, there are hardly any changes in the respective preferences. However, the frequency with which they are mentioned differs. For example, non-European countries are less prominent as migration destinations. The USA was named as a destination country by 6.6% of the respondents with migration wishes, but only by 4.5% of those with migration plans. The reasons for this are probably to be found in the geographical barriers (distance; costs) and the restrictive immigration policy there.

All in all, the countries of Southeastern Europe differ significantly in terms of the variety of planned destination countries. Migrants from Albania and Serbia are expected to continue to move in very diverse directions in the future. In contrast, North Macedonia and Bosnia-Herzegovina show an almost monopolistic position of the destination country Germany. In both countries, the guest worker era plays a role as a historical component; after all, networks from that time, which are known to generally favour migration (Haug 2008), are still in place today. Other factors are Germany's robust labour market and the shortage of (skilled) workers, for example in the medical and nursing sector, which is covered by migrants from Western Balkan countries, among others, via the German "Beschäftigungsverordnung" (the so-called "Western Balkans regulation", Brücker et al. 2020).

King and Gëdeshi (2020) come to similar conclusions in their study on migration intentions in Albania. Here, too, Germany is the main destination country, followed by the USA, Italy and Greece. In addition to economic factors such as access to the labour market and wage levels, the study identifies factors such as social networks and education as reasons for the choice of a certain destination country. It also shows that social networks are the main reasons for the long-established destination countries Greece, Italy and the UK; however, the migration movement here has shifted towards the more prosperous countries in Europe over the last 10 years due to the temporarily poor economic situation in the neighbouring countries. Recently, there has indeed been an increase in the choice of Germany as a destination country for qualified specialists and academics. These migrants attach greater importance to issues of job opportunities

and income, a trend that intensifies the brain drain (King and Gëdeshi 2020). Fassmann (2015) also cites issues of social security, solidarity, democracy and respect for human rights as factors that influence the choice of destination country, leading us to a more diversified analysis of the reasons.

In general, events such as the accession of Romania and Bulgaria to the EU and the associated regulations on the free movement of labour force, as well as the current accession to the Schengen area, have pushed destination countries such as Italy, Spain and Germany to the forefront of migrants' considerations (Mintchev 2016, OECD 2019). In contrast, Brexit has had the opposite effect in that the UK has become less attractive to migrant workers from East and Southeast Europe (Pries 2023). For example, while around 55,000 people from Bulgaria and Romania migrated to England and Wales in 2020, the number fell to around 8,500 in 2021 (ONS 2023). For the United Kingdom as a whole, the net migration with these countries fell by 40% (Cuibus 2023).

Discussion

Explaining migration intentions: findings and evidence

Migrants generally want to achieve an improvement in their previous living situation and conditions by relocating. Corresponding opportunities and possibilities can be generated through their own initiative (Oltmer 2017), but they can also be predetermined by external factors. Based on Williams et al. (2018), migration motives will therefore be explained and classified in this section on a macro and micro level.

The macro level

Explanations for patterns of emigration from a macro perspective (i.e. on the societal level) quickly move into the realm of gravitational concepts. Socio-economic disparities are among the main drivers of migration worldwide; the greater the difference between national and regional GDP, the greater the openness to migration (Williams et al. 2018). This is also the case in Southeastern Europe. The small-scale 'clusters' of emigration mentioned above, such as northern Albania, southern Serbia and parts of North Macedonia, are among the most deprived regions on the Balkans; push-pull mechanisms may serve to explain the intensive emigration from exactly these areas. In the Bulgarian case, the above-average unemployment in individual regions – in Vidin, Montana and Silistra, for example, between 13.3% and 20.4% each, with 4.1% nationwide in 2019 (NSI 2023) – finds its expression in strong international migration wishes and plans.

High unemployment rates and low GDP are also usually associated with poor career opportunities in the country of origin, which reinforces the intention to migrate (Fassmann and Hintermann 1997, Vidovic and Mara 2015, Zulfiu Alili et al. 2024).

Kupiszewski (2009) also points to shortcomings of infrastructure, such as recurring blackouts of electricity or critical water supplies, as further push factors at this scale.

The micro level

Approaches at the micro level address demographic, socio-economic and psychosocial characteristics of individuals. International labour migration is generally very strongly influenced by age. In our sample, too, the affinity for migration is less prevalent with increasing age. It is noticeable, however, that although there is only a moderate difference between the age groups under 50, young adults (18–29-year-olds) in particular have a disproportionate number of plans and preparations already in place, meaning that they are often already at a very concrete stage (Table 2). Young people are therefore more likely to be willing and able to realise their desire to migrate.

Table 2. Age-specific differentiation of migration intentions

Age	Permanent migration wish	Temporary migration wish	Migration plan	Migration preparation
18 to 24 years	19.5%	15.4%	20.8%	20.2%
25 to 29 years	12.8%	12.6%	20.6%	20.6%
30 to 34 years	12.0%	11.2%	11.1%	11.1%
35 to 39 years	13.9%	13.8%	13.2%	15.4%
40 to 44 years	11.2%	12.8%	11.1%	10.7%
45 to 49 years	10.1%	11.4%	8.4%	7.9%
50 to 54 years	7.5%	9.3%	7.0%	8.3%
55 to 59 years	6.5%	7.2%	4.5%	4.3%
60 to 64 years	3.8%	3.8%	1.7%	1.2%
65 to 69 years	1.5%	2.1%	1.2%	0.4%
70+ years	1.1%	0.2%	0.3%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Source: OeNB Euro Survey 2019; only Southeast European countries; n'=8,086

The level of education of potential migrants also plays a major role (Table 3). The propensity to migrate is by far the most significant among those with a medium level of education. By contrast, the reluctance of people with a high level of education seems surprising. This confirms the finding for Albania, for example, that emigration among academics was quite common very early on after the beginning of the transition period (Gjonca 2002, Schmidt 2003); a similar effect is reported for Bosnia and Herzegovina and other ex-Yugoslavian countries for the 1990s (Uvalic 2005). This suggests the reverse conclusion, namely that those with higher qualifications who wanted to emigrate have long since done so or, if still in the country, have found an adequate position that makes staying more attractive. Otherwise, there is only a limited difference in intensity within

the respective categories; only among the highly educated is the desire to migrate already more strongly underpinned by concrete measures.

Table 3. Migration intentions and education level

Education level	Permanent migration wish	Temporary migration wish	Migration plan	Migration preparation
Low education	12.5%	9.4%	11.1%	9.9%
Medium education	62.7%	67.2%	64.5%	59.3%
High education	24.8%	23.4%	24.4%	30.8%
Total	100.0%	100.0%	100.0%	100.0%

Source: OeNB Euro Survey 2019; only SouthEast European countries; n'=8,086

The social-psychological aspect, which has long been underestimated and it has recently received increasing attention in migration studies (Vathi and King 2017), is only slightly reflected in the OeNB Euro Survey (OeNB 2023). Only the question about trust in political actors generally shows a massive mistrust in this regard, which is strongly correlated with the advanced concretisation of migration intentions (Table 4).

Table 4. Trust in politics and migration intentions

Level of trust	Permanent migration wish	Temporary migration wish	Migration plan	Migration preparation
I trust completely	5.3%	5.6%	5.7%	5.5%
I trust somewhat	19.4%	25.7%	20.1%	26.5%
I neither trust nor distrust	17.4%	23.5%	17.8%	17.0%
I distrust somewhat	13.7%	17.7%	13.4%	13.8%
I do not trust at all	42.7%	26.5%	41.7%	37.2%
Don't know	1.1%	0.8%	1.0%	0.0%
No answer	0.3%	0.2%	0.3%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Source: OeNB Euro Survey 2019; only Southeast European countries; n'=8,086

Taken together, these findings confirm the ongoing brain drain, especially among the young and well-educated people. In addition to structural deficits on labour markets, in education system etc., the skilled emigration from Southeast Europe has a lot to do with the government policies there and the resulting general lack of future prospects (Efendić 2016).

Conclusions

All in all, it can be said that the potential for future mobility all over Southeastern Europe remains high. Our findings from the Euro Survey show that this will remain

the case in the future, even if it must be taken into account that not every individual aspiration to migrate leads or can lead to the realisation of migration, especially if relevant and supportive capabilities are lacking. The findings also clearly show that social networks significantly increase the likelihood of migration and that it is particularly the young population with a medium level of education who will be able to realise their desire to migrate to Western EU countries. At the centre of this desire is Germany, which is by far the most frequently mentioned destination. However, the United Kingdom and Switzerland are also mentioned as destinations in many countries. In contrast, regions with strong migration intentions are spatially fragmented. In most of the analysed countries, there are individual NUTS3 regions with high values regarding the migration plans. However, no specific spatial pattern of emigration can be identified.

In a similar context to our study on migration intentions in Southeastern Europe, Pries (2023: 16) recently called for greater consideration of the "multidirectionality of migration impacts", and he suggested broadening the mainly economic focus to include remittances. So, "societal transmittances" (Pries 2023), as a dimension of analysis, offer a viable perspective for evaluating the dynamics of migration with regard to Southeastern Europe. The mobilisation and dynamization of relevant capitals concern not only monetary values, brains and skills, but also social dimensions. We argue that discussions in this regard should not be one-sided and deficit-orientated from the outset, as the corresponding effects are bi-directionally constituted in the context of origin and destination. The economic, political, cultural and social impact of migration unfolds in both countries of origin and destination.

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Appendix

Table A1. Migration plans and destination countries

Country	Albania	Bosnia-Herzegovina	North Macedonia	Bulgaria	Croatia	Poland	Romania	Serbia	Czech Republic	Hungary	Mean
Germany	32.3%	58.0%	44.2%	24.6%	34.0%	26.3%	20.4%	30.5%	17.2%	20.9%	33.9%
UK	5.4%	1.2%	1.7%	16.9%	2.0%	7.0%	26.5%	1.2%	10.3%	18.6%	7.3%
Switzer-land	0.0%	4.9%	18.3%	0.0%	6.0%	1.8%	4.1%	15.9%	6.9%	2.3%	7.2%
Austria	2.2%	9.9%	5.0%	1.5%	10.0%	1.8%	2.0%	3.7%	6.9%	25.6%	6.0%
USA	6.5%	1.2%	4.2%	1.5%	4.0%	8.8%	0.0%	6.1%	17.2%	0.0%	4.5%
Greece	10.8%	0.0%	0.0%	7.7%	0.0%	0.0%	2.0%	1.2%	3.4%	2.3%	2.8%
Italy	4.3%	1.2%	2.5%	3.1%	4.0%	1.8%	10.2%	1.2%	0.0%	0.0%	2.8%
France	5.4%	1.2%	0.8%	6.2%	0.0%	1.8%	4.1%	1.2%	0.0%	2.3%	2.4%
Belgium	6.5%	1.2%	0.0%	3.1%	6.0%	0.0%	4.1%	1.2%	0.0%	2.3%	2.4%
Nether-lands	4.3%	0.0%	0.8%	3.1%	4.0%	5.3%	2.0%	1.2%	6.9%	0.0%	2.4%
Spain	1.1%	0.0%	0.8%	9.2%	0.0%	3.5%	8.2%	1.2%	0.0%	0.0%	2.2%
Denmark	4.3%	0.0%	0.8%	1.5%	2.0%	1.8%	0.0%	4.9%	3.4%	2.3%	2.1%

Canada	4.3%	0.0%	3.3%	1.5%	0.0%	1.8%	0.0%	2.4%	6.9%	0.0%	2.1%
Ireland	0.0%	0.0%	0.0%	1.5%	14.0%	3.5%	2.0%	3.7%	0.0%	0.0%	2.1%
Norway	1.1%	1.2%	4.2%	0.0%	2.0%	3.5%	0.0%	3.7%	0.0%	0.0%	1.9%
Slovenia	0.0%	7.4%	1.7%	0.0%	0.0%	0.0%	0.0%	4.9%	0.0%	0.0%	1.8%
Australia	1.1%	0.0%	2.5%	1.5%	4.0%	0.0%	0.0%	2.4%	6.9%	0.0%	1.6%
Sweden	4.3%	1.2%	2.5%	0.0%	0.0%	0.0%	0.0%	1.2%	0.0%	2.3%	1.5%
Finland	0.0%	0.0%	1.7%	0.0%	0.0%	0.0%	4.1%	0.0%	3.4%	9.3%	1.3%
Other	6.5%	8.6%	4.2%	4.6%	8.0%	26.3%	6.1%	9.8%	10.3%	11.6%	8.8%
Don't know	0.0%	2.5%	0.8%	12.3%	0.0%	5.3%	4.1%	2.4%	0.0%	0.0%	2.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: OeNB Euro Survey 2019; n=10,102

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REEXAMINING ENVIRONMENTAL HEALTH RISK ASSESSMENT IN URBAN SETTLEMENTS

Agus Sarwo Edy Sudrajat, Imam Buchori, Sunarti Sunarti
Universitas Diponegoro, Semarang, Indonesia

Abstract: Environmental health studies and practices tend to prioritise health and hygiene, with environmental sanitation, which encompasses behaviour and sanitation facilities, representing a significant concern in environmental health risks. Nevertheless, numerous studies have demonstrated that the physical components of buildings exert an impact on environmental health status. The purpose of this article is to demonstrate that the physical components of buildings influence environmental health risks and they can be incorporated as additional variables in the development of a more precise, valid, and comprehensive environmental health risk assessment model. In this study, a multistage random sampling technique was employed to obtain a total sample of 400 households. This study is a second-order construct that was measured formatively using an embedded two-stage approach. The findings of this study indicate that the physical component of the building has a significant effect on environmental health risks. This is indicated by the path coefficient value of 0.249. The most influential components are bedroom windows, floor type, ceiling, wall type, roof type, living room windows, occupancy density, temperature, humidity, and temperature. By identifying these neglected health risk factors, governments, health institutions, and communities can develop more effective and efficient strategies for mitigating environmental health risks.

Keywords:
environmental sanitation;
household behaviour;
sanitation facilities;
physical components of buildings

Email: agus.sarwo16@gmail.com

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Introduction

As urbanisation advances globally, the issue of "urban diseases" has become increasingly prominent (Chen et al. 2023). By 2050, 68% of the world's population will likely live in urban centres, representing more than six billion urban dwellers (United Nations 2019); nearly 1.1 billion new urban residents will be absorbed by cities from 2015 to 2030 (Gu 2019). Simultaneously, urbanisation and urban activities are a major cause of simplification of ecological processes, loss of biodiversity, and declining ecosystem health (Alberti 2005). Rapid and unplanned urbanisation also contributes directly to the expansion of slums, and this is seen as a symptom of "exclusive urbanisation", where urban growth is not accompanied by adequate efforts to integrate all its inhabitants into a viable and sustainable urban ecosystem (Ghosh et al. 2021). Urbanisation also leads to increased unemployment, traffic congestion, and other classic urban problems. This is as a result of migrants being attracted to job opportunities, despite the often low to moderate wages on offer (Giyarsih and Marfai 2017). As a result, this increases the burden on the capacity of the urban environment (Chen et al. 2023).

In recent years, the issue of urban sanitation and health has attracted significant attention on a global scale due to its impact on human health. The challenge of providing adequate and equitable sanitation services is one of the world's most pressing challenges (Kwarteng et al. 2015, Han et al. 2021). By 2050, the UN estimates that the world's urban population will increase from 55% to 68%. About 90% of this growth is concentrated in Asia and Africa, and an additional 2.5 million people are expected to live in cities over the next 30 years. About 62-93% of urban dwellers in Vietnam, Sri Lanka, the Philippines and Indonesia rely on septic tanks, where wastewater treatment is rare. Globally, more than 80% of wastewater is discharged into the environment without adequate treatment. About 11% of all irrigated agricultural land is irrigated with untreated or poorly treated wastewater. In addition to acute and chronic health effects, this also results in significant pollution of often limited surface and groundwater resources in Africa and Sub-Saharan Asia (Kookana et al. 2020).

The deterioration of the slum areas of the city will have a detrimental impact on the quality of environmental health, with sanitation and environmental health being particularly affected. The health problems associated with urbanisation include poor sanitation and housing conditions, as well as malnutrition, pollution and infectious diseases. This has a direct impact on the quality of life of individuals and the allocation of public health resources (Kuddus et al. 2020). Accordingly, it is essential to assess and enhance the quality of the settlements, with particular attention to their impact on public health (Zhang and Wang 2023).

An introduction to the living conditions of settlements makes it possible to uncover specific problems in urban planning, making it easier to facilitate improvements in the

urban settlements (Chen et al. 2023). One thing that is included in this is the assessment of environmental health risks both at the household scale and the scale of the larger environment (settlements). In the context of public health, risk is a potential hazard to human health or the environment. This means that the protection of human health and the environment is based on the fundamental principle of not endangering health and of not increasing the risk of disease (Robson et al. 2023).

Over the last 30 years, public health scientists and policy makers have developed and applied systematic approaches to understand and evaluate the level of exposure to environmental agents, the nature of potential hazards to health, the variations in susceptibility to those adverse effects, and the likelihood and magnitude of those effects on the population. It is further explained that the objectives of risk assessment are: to balance risks and benefits; to set target risk levels; to establish priorities for program activities; to estimate the residual risk and degree of risk reduction after the measures to reduce risk are taken (Omenn and Eaton 2023); to measure the level of potential hazard based on a set of defined conditions (Wu and Rodricks 2023); and to examine the combined adverse human health effects of exposure to a combination of environmental stressors (Sexton 2012).

This approach is important as it considers encounters with multiple environmental hazards through various media and time, thus providing a more comprehensive understanding of the overall risk (Huang and London 2012), and it combines individual environmental hazards using multiplicative or additive models to assess the overall impact on different population groups (Su et al. 2009). Environmental health risk assessment models recommended by organisations such as the US EPA are widely used to evaluate the impact of pollutants on human health (Changhong et al. 2019). There are many risk assessment models that fit the context in which the risk assessment is conducted. Even limited risk level measurements can be useful for identifying complex cause-and-effect processes and the most efficient ways to address risks (Commonwealth of Australia 2012).

In Indonesia, the concept of environmental health risk is better known as Environmental Health Risk Assessment (EHRA). EHRA is a participatory study to understand the condition of sanitation and hygiene facilities and community behaviours at the household scale (Kemenkes 2021). The concept of environmental health risk is adopted from Bright-Davies et al. (2015), and it consists of two main aspects: behaviour and sanitation facilities. This concept has since been expanded by recent studies to include wastewater management, clean water management, waste management, and drainage management (Haris and Basir 2018, Syamsuar et al. 2018, Maliga and Darmin 2020, Lestari et al. 2021, Wahyudi and Zaman 2021). However, the developed concept only focuses on behavioural aspects and sanitation facilities. Where the behavioural aspects include: open defecation, hand washing with soap, waste management and household

wastewater management (environmental drainage); while the coverage of sanitation facilities includes: drinking water sources, waste disposal services, latrines, household sewerage and drainage (Commonwealth of Australia 2012, Kemenkes 2021).

Indeed, the concept of environmental health risks focuses on environmental sanitation. Factors affecting environmental health include: toilet or latrine management, water supply, sewerage and solid waste facilities, poorly maintained sanitation facilities and infrastructure, defecation management and waste disposal practices, lack of inadequate drainage facilities, non-functioning toilets, absence of sufficient drinking water and unhygienic conditions (Sarkar 2013, Campos et al. 2015, Danbaba et al. 2016, Mosler et al. 2018, Mensah 2020). In addition, environmental health includes drinking water quality, emptying of sanitation facilities, and hygiene behaviour at the household scale, domestic waste disposal (solid and liquid), defecation behaviour and lack of or access to domestic water supply (Bwala et al. 2017, Khan et al. 2017, Susilawaty et al. 2018, Indriyani et al. 2019, Riyanto et al. 2020, Santosa et al. 2020a, Santosa et al. 2020b, Yasya and Juwana 2020). Therefore, behavioural aspects and the condition of sanitation facilities are closely related in determining environmental health risks.

Many studies have shown that good sanitation can improve social, health and economic aspects, especially in developing countries (Mara et al. 2010). Public health has been associated with housing issues for a long time. Poor housing conditions, poor sanitation, overcrowding, and inadequate ventilation are associated with a range of health conditions, including respiratory infections, asthma, lead poisoning, injuries, infectious diseases and mental health issues (Krieger and Higgins 2002). The construction and environment of a house that does not meet the requirements of a healthy home is one of the factors that cause sources of disease and make the residents uncomfortable (Diandra et al. 2020). Environmental health is not only determined by the occupant behaviour, but by the sanitation facilities such as latrines, clean water, wastewater and garbage disposal, as well as by the physical components of the building related to ceilings, walls, windows, floors, ventilation, kitchen smoke holes, lighting and occupant density (Basri et al. 2022).

The above description indicates that the concept of environmental health risk is limited to environmental sanitation. This encompasses aspects of behaviour and sanitation facilities. Meanwhile, other studies have shown that the physical components of buildings also contribute to health problems, but have not considered the concept of environmental health risks. As a result, there is a research gap where the physical components of the building have not been considered in the concept of environmental health risk or the development of the model. Therefore, the study intends to prove that the physical components of the building affect environmental health risks and they can be combined as additional variables in the development of a more precise, valid and comprehensive environmental health risk assessment model. According to the

explanation mentioned above, the research question in this study is to which extent does the physical component of the building affect the environmental health risk?

Methodology

The determination of the selected study locations uses a multistage random sampling technique. This technique is a sample determination based on the division of an area in stages, then taken randomly for each area. The goal is that each sample in an area has the same opportunity to be used as a study location. This technique consists of several stages (Priyono 2016). In the first stage, all study locations are divided into several strata groups (stratum 1, stratum 2, and stratum 3) be based on the criteria of population density, poverty rate, areas prone to inundation or flooding, and areas drained by rivers. Second, study locations that have been divided into strata are grouped according to regional categories, namely study locations in the urban centre category and the non-urban centre category based on the Spatial Planning Regulation Number 4/2021. After grouping, a simple random sampling technique is carried out.

Study area

This study was conducted in Surakarta City, Central Java Province, Indonesia. Surakarta City was chosen because it was one of the first pilot locations to conduct an environmental health risk assessment (World Bank 2011). In addition, Surakarta was internationally recognised as an example of 'best practice' in urban policy (Obermayr 2017). Surakarta was also one of the major cities in Indonesia experiencing a faster growth than other cities (Buchori et al. 2017). From the 54 urban villages that make up the city, the selected locations were: a) Kelurahan Purwosari (urban centre as a sub-service centre), and Kelurahan Sriwedari (not an urban centre) in STRATA 1; b) Kelurahan Kampung Baru (urban centre as a service centre), and Kelurahan Gandekan (not an urban centre) in STRATA 2; c) Kelurahan Sudiroprajan in STRATA 3, chosen because locations fall here into the category of not an urban centre (Figure 1).

The total population in this study is 193,177 households as they represent the smallest environmental unit contributing to environmental health risks. This is in accordance with the opinion that the household or living environment has an important role as a major determinant of health (Basri et al. 2022). The household as a basic unit in the planning of the built environment then plays a role in the formation and development of human settlements (Doxiadis 1970); it is more than just a physical unit of residence but it includes complex social, economic and cultural entities (Rapoport 1969). Based on the population, a sample was taken using the Slovin formula (1).

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

where, n is the number of samples, N is the number of households, and e is the error with error tolerance of 5% or 0.05.

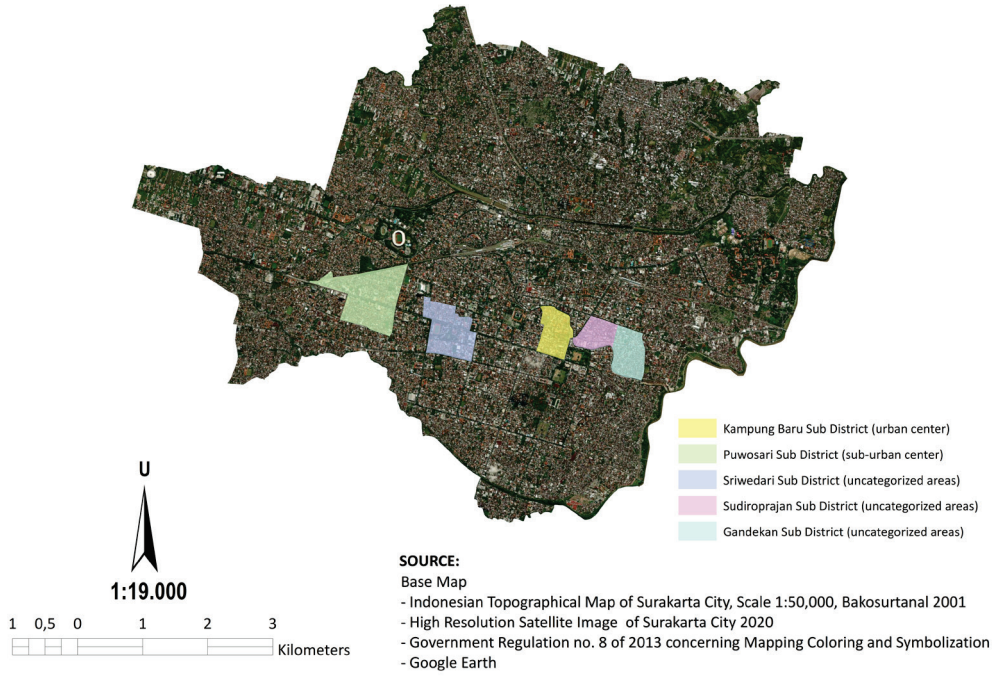

Figure 1. Study areas and sample distribution

Based on the results of the sample calculation using the Slovin formula, a sample of 400 households was obtained. This sample was taken in Surakarta City which is spread in the selected study locations, namely: Kampung Baru Village, Puwosari Village, Sriwedari Village, Sudiroprajan and Gandekan. The sample was analysed using a questionnaire and a direct measurement with 72 indicators in the selected households.

Data

The determination of variables and indicators in this study is based on the concept of urban environmental sanitation (Bright-Davies et al. 2015) and it is supported by various existing studies. The concept of environmental health risks related to environmental sanitation focuses more on sanitation facilities which include sanitation management, clean water, waste, drainage, and behaviour (Syamsuar et al. 2018, Maliga and Darmin 2020, Lestari et al. 2021, Wahyudi and Zaman 2021). Meanwhile, physical building component variables such as roof type, ceiling, walls, floors, bedroom windows, living room windows, occupancy density, ventilation area, lighting, kitchen smoke holes, humidity, temperature also influence the environmental health risks (Romadhan et al. 2019, Zuraidah and Ali 2020, Akbar et al. 2021, Aryani et al. 2022).

The process begins with identifying the latent variables that will be analysed, in accordance with the research objectives. Given that the specified variable is still unobserved, it needs to be translated into indicators based on empirical measurements with a rating scale of 1-5. The determination of indicators to translate the latent variables can be done through the research literature, relevant theories and the researchers' experience and knowledge (Chin 1998, Hair et al. 2021).

Based on the detailed illustration of the Partial Least Square-Structural Equation Modeling (PLS-SEM) diagram (Figure 2), several things can be explained as follows:

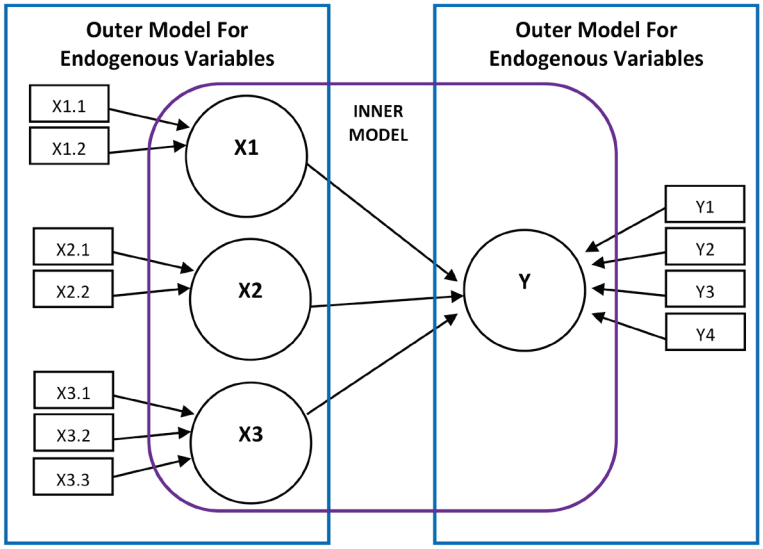

Figure 2. Illustration of PLS-SEM Path Diagram

a. Latent Variables are variables that are not directly measured, sometimes called unobserved variables, factors, constructs, or abstract phenomenon variables. The latent variables in the diagram include X1, X2, X3 and Y. This is because the value of the latent variable is influenced or determined by its constituent indicators such as X1.1, X1.2, which compose or form X1.

b. Endogenous variables and Exogenous variables: (1) endogenous variables are latent variables that are influenced by exogenous variables; (2) exogenous variables are causal variables or variables without being preceded by other variables with arrows pointing to other variables (endogenous variables). Based on the pattern of causal relationships in the PLS-SEM model (Figure 2), it can be seen that latent variables X1, X2 and X3 affect the latent variable Y. In this case, X1, X2 and X3 are referred to as exogenous variables, because these three variables have no other exogenous variables affecting them and those who affect the latent variable Y are endogenous variables. Thus, these

exogenous and endogenous variables only apply at the Inner Model level. Whereas at the Outer model level, what applies is no longer exogenous and endogenous variables anymore, but the form of reflective and formative relationships. The outer model is the relationship between the manifest variables/indicators and the latent variables. Indicators are for example X1.1, X1.2, X2.1, etc. The reflective measurement describes the latent variable, for example X1, which reflects the indicators in it, namely X1.1 and X1.2. Conversely, the formative measurement describes how the indicators X1.1 and X1.2 will form a component called X1.

c. Manifest Variables: the latent variable formers are indicators, namely X1.1, X1.2, as indicators of X1. Because these indicators are measured directly, they are also called observed variables or manifest variables, indicators or references. The endogenous variable used in this study is environmental health risk (Y), while the exogenous variables include sanitation facilities (X1), behaviour (X2), and the physical components of the building (X3). These variables (Table 1) are then translated into indicators/question items based on empirical conditions.

Table 1. Research Variables and Indicators

Variable	Indicators	Code	Rating Scale
	Sanitary facilities (x1) – FSN		
Latrine condition (x1.1) KJB	Latrine ownership	KJB1	1 s/d 5
	Presence of disease vectors	KJB2	1 s/d 5
	Septic tank final disposal	KJB3	1 s/d 5
	Availability of clean water for watering	KJB4	1 s/d 5
	Availability of soap for hand washing	KJB5	1 s/d 5
	Wall and top condition of the restroom	KJB6	1 s/d 5
	Latrine floor condition	KJB7	1 s/d 5
	Pit floor material	KJB8	1 s/d 2
	Number of people using restrooms	KJB9	1 s/d 5
Solid waste condition (x1.2) KPS	Garbage bin ownership	KPS1	1 s/d 5
	Closed garbage condition	KPS2	1 s/d 5
	Safety from disease vectors	KPS3	1 s/d 5
	State of the garbage	KPS4	1 s/d 5
	Presence or not of a foul odour	KPS5	1 s/d 2
Drainage condition (x1.3) KDR	Sewage disposal conditions	KDR1	1 s/d 5
	Drainage conditions	KDR2	1 s/d 5
	Propensity for flooding	KDR3	1 s/d 2
	Flood events	KDR4	1 s/d 5
Drinking water condition (x1.4) KAM	Type of primary source of water	KAM1	1 s/d 5
	Water taste quality	KAM2	1 s/d 2
	Water colour quality	KAM3	1 s/d 2
	Odour quality of water	KAM4	1 s/d 2
	Shelter c1ondition	KAM5	1 s/d 5
	Distance between drinking water and faeces discharge	KAM6	1 s/d 5
	Distance between drinking water and neighbour's faeces discharge	KAM7	1 s/d 5

Variable	Indicators	Code	Rating Scale
	Behaviour (x2) – PHBS		
Wastewater management (x2.1) PAL	Latrine cleaning routine	PAL1	1 s/d 5
	Family defecation location	PAL2	1 s/d 5
	Age of septic tank	PAL3	1 s/d 5
	Long-time septic drain	PAL4	1 s/d 5
	Handling of infant or toddler faeces and diapers	PAL5	1 s/d 5
Waste water disposal management (drainage) (x2.2) PDR	Faecal sludge disposal process	PDR1	1 s/d 5
	Used wastewater disposal process	PDR2	1 s/d 5
		PDR3	1 s/d 5
	Presence of garbage in the drainage		
Solid waste management (x2.3) PPS	Garbage disposal	PPS1	1 s/d 5
	Waste processing	PPS2	1 s/d 5
	Waste segregation	PPS3	1 s/d 2
	Garbage collection	PPS4	1 s/d 5
	Timeliness of waste transportation	PPS5	1 s/d 5
Clean water management (x2.4) MISSING CODE	Drinking water treatment	PAB1	1 s/d 5
	Use of soap for hand washing	PAB2	1 s/d 5
	Use of running water for hand washing	PAB3	1 s/d 5
	Hand washing location	PAB4	1 s/d 5
	Hand washing after using the toilet	PAB5	1 s/d 2
	Hand washing after diaper changes for infants	PAB6	1 s/d 2
	Hand washing after defecation	PAB7	1 s/d 2
	Hand washing before and after preparing food	PAB8	1 s/d 2
	Hand washing before and after eating or feeding	PAB9	1 s/d 2
Clean house habits (x2.5)	State of windows—open or closed	BR1	1 s/d 5
	Yard cleanliness	BR1	1 s/d 5
	Ceiling cleaning routine	BR3	1 s/d 5
	Water reservoir cleaning routine	BR4	1 s/d 5
	Room cleaning routine	BR5	1 s/d 5
	Number of people per bedroom	BR6	1 s/d 5
	Cooking fuel usage	BR7	1 s/d 5
	Physical components of the building (x3) – FFR		
Physical building (x3.1) FR	Roof type	FR1	1 s/d 5
	Ceiling type	FR2	1 s/d 5
	Wall type	FR3	1 s/d 5
	Floor type	FR4	1 s/d 5
	Bedroom window	FR5	1 s/d 5
	Living room window	FR6	1 s/d 5
	Residential density	FR7	1 s/d 5
Sick building syndrome (x3.2) SBS	Ventilation area (lv/ ll) * 100 units (%)	FR8	1 s/d 2
	Kitchen smoke hole	FR9	1 s/d 2
	Lighting (lux)	FR10	1 s/d 2
	Humidity (%)	FR11	1 s/d 2
	Temperature degree (C)	FR12	1 s/d 2
	Environmental health risks (y1) – RKL		
(Y1.1)	Disease occurrence	RKL1	1 s/d 5
(Y1.2)	Garbage burning	RKL2	1 s/d 5
(Y1.3)	Environmental pollution	RKL3	1 s/d 5

Variable	Indicators	Code	Rating Scale
(Y1.4)	Emergence of a disease	RKL4	1 s/d 5
(Y1.5)	Use of drinking water sources	RKL5	1 s/d 5
(Y1.6)	Sanitation service	RKL6	1 s/d 5

PLS-SEM data uses interval or ratio data or it can use qualitative data, which is then notated or coded first into numeric form according to the scale used in the study. Data does not have to use normally distributed data. With bootstrapping testing, for example resampling 5,000 times, it will make our design results consistent and reliable. The used sample size does not have to be large, as some studies have proven that to be able to use PLS-SEM correctly, it is sufficient to use only twenty observations.

The first step in PLS-SEM is to construct a path diagram (specification model) which is used as a basic reference in the next process. The path diagram construction describes the relationship between exogenous and endogenous variables (structural model/inner model) and the relationship between exogenous and endogenous variables to their respective indicators (measurement model/outer model). In this study, the construction of the path diagram (model specification) was formed based on theory, namely the causal relationship between behaviour, sanitation facilities, and the physical components of buildings on environmental health risks (Figure 3).

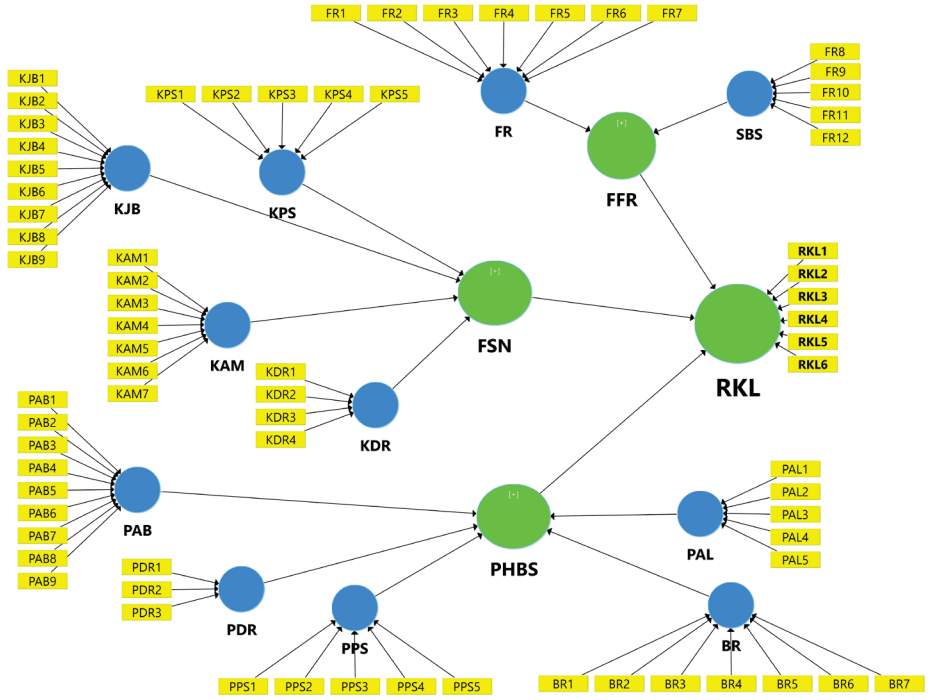

Figure 3. Path Diagram (Model Specification)

Methods

This research is quantitative research conducted with deductive reasoning. The method used is a survey method with primary data obtained from questionnaires distributed to respondents, namely selected households, through direct face-to-face meetings. The questionnaire was made with a Likert measurement scale, and its content concerns behavioural variables, sanitation facilities, and the physical components of buildings that affect environmental health risks. The variables are then translated into certain indicators to look for interrelationships, both influences and relationships between variables. The results of the questionnaire became the basis for data processing using PLS-SEM software.

PLS-SEM is a multivariate analysis that is useful for estimation between research variables simultaneously, and for estimation between variables and their measurement items with the aim of testing the theory of models that emphasise prediction studies and structural model development (Hair et al. 2019, Sarstedt et al. 2021). PLS-SEM estimation in this study is measured formatively – formative and second order construct, so it can be done with the embedded two stage approach method, namely the two-step estimation (Sarstedt and Cheah 2019).

There are two approaches to estimating the relationship between variables in SEM, namely Covariance Based-Structural Equation Modeling (CB-SEM) and PLS-SEM (Wong 2013, Astrachan et al. 2014, Wong 2019, Hair et al. 2020). Covariance Based-Structural Equation Modeling (CB-SEM) is an approach to SEM that is used when the purpose of the research is to test a theory, to confirm a theory and to compare several alternative theories, large sample sizes and normal distribution data, while PLS-SEM is for theory development that aims to make predictions (Hair et al. 2021, Sarstedt et al. 2021, Klesel et al. 2022). In general, PLS-SEM has a higher level of statistical power and it shows a higher convergence than CB-SEM (Hair et al. 2021).

The choice of PLS-SEM software in this study, because this analysis does not require certain distribution assumptions (normal distribution), can work with models that are complex in structure and include many constructs, indicators and/or model relationships simultaneously, are able to analyse variables that cannot be measured directly (unobserved variables), and take into account their measurement errors, do not require a minimum number of samples, but are able to work very well with large sample sizes; and the purpose of the study is model theory testing which focuses on prediction studies, exploration or development of structural model theory (Hair 2021, Hair et al. 2021). It is further explained that PLS-SEM is not limited only to the relationship between the indicators and latent variables that are reflexive but also used for formative relationships. In addition, PLS-SEM is not only for model design, but for the confirmation and expansion of theory.

The causality of the measurement model in this study is measured in a formative-formative manner, which means that indicators will form or cause constructs or latent variables, where the direction of the causality relationship is from indicators to constructs. This research is a second order construct, where there are two levels of construct, namely the sub-variables measured by the indicators (second order), and the variables measured by the sub-variables (first order). While the use of embedded two-stage approach or two-step estimation includes two stages, namely the first estimate at the level of sub-variables measured by indicators (second order), and the second estimate at the level of variables measured by sub-variables (first order). PLS-SEM itself in the process includes evaluating the measurement model with PLS Algorithm, which is a standard algorithm for calculating correlations between the components; evaluating the structural model with Bootstrapping analysis, which assesses the level of significance or the probability and hypothesis; evaluating the goodness and fit of the model with Blindfolding analysis, which assesses the level of predictive relevance of a construct model (Sarstedt 2019, Sarstedt and Cheah 2019).

Evaluation of Measurement Model with PLS Algorithm

This analysis includes two processes – the first process is the evaluation of the measurement model at the sub-variable level which is carried out by estimating the causality of indicators that measure sub-variables (second order). If all indicators are significant, then the process can continue at the stage of interpreting the results (measurement path diagram). However, if there are indicators that are not significant, then these indicators need to be reduced or reconsidered for use in the path diagram. At this stage, the measurement path diagram will be reconstructed and form a new path diagram which is often called the measurement path diagram – respecification. At the next stage, the measurement model will be re-evaluated to determine whether there are still significant indicators or not. This process will repeat until all indicators are significant. If the measurement model evaluation of the measurement path diagram indicator – respecification is significant, the process can be stopped and continued with the interpretation of the results that have been finalised at the PLS Algorithm stage.

After the first process is fulfilled, then proceed with the second process, namely evaluating the variable-level measurement model, namely by estimating the causality of sub-variables that measure variables (first order). Evaluation of the variable-level measurement model is formative-formative. Therefore, the evaluation of the measurement model is also the same as the first process, namely the significance of the outer weight and the absence of multicollinearity between items with outer VIF (variance inflation factor) (Hair and Sarstedt 2021, Sarstedt et al. 2021). The sub-variable score is obtained from the measurement process of the measurement – respecification path diagram called the latent variable score. The result of the estimation in the second process (first order) is the Path Diagram – PLS Model. This

path diagram is the final path diagram (specification model), where the model will show a simpler appearance because the significant indicators on the measurement – respecification path diagram – have merged to form sub-variables that measure variables.

Structural Model Evaluation with Bootstrapping

The next process is the bootstrapping analysis which is used to test the hypothesis of influence between previously determined research variables. In this process, the estimation is carried out to measure the path diagram – PLS model, so that it will be known which hypotheses are accepted or not.

Evaluation of Goodness and Fit of the Model with Blindfolding

Furthermore, the blindfolding analysis process is used to measure the goodness and suitability of the path diagram – PLS model that has been formed. This process focuses on prediction studies with the aim of testing the model theory, it is linear and it proves that the influence between variables developed in the construction of path diagrams (model specifications) can be explained through empirical data. The result of this process is a Path Diagram – Prediction Model that can be used for prediction and it can apply in general. This path diagram – prediction model is the final model for the development of modifications to the environmental health risk model including the development of mathematical formulas (Figure 4).

Results

The results in this study were obtained from several testing processes, namely: first, the Measurement Model Evaluation (PLS algorithm); second, the Structural Model Evaluation (Bootstrapping); and third, the Evaluation of Goodness and Model Fit (Blindfolding).

Evaluation of Measurement Model

After the construction of the path diagram (specification model) is formed, the next stage is the evaluation of the measurement model. Estimation or the estimation of model parameters is done using the PLS Algorithm. The PLS Algorithm is carried out using a partial regression model which is carried out iteratively in two stages. The first stage is the assessment of the construct score. The second stage is the assessment of the outer weight value and the outer loadings value. The outer weight measurement is the result of the multiple regression of a construct on its set of indicators, while the outer loading measurement is estimated through the simple regression of each indicator on each construct. The PLS algorithm is stopped when convergence is achieved or the maximum number of iterations is reached.

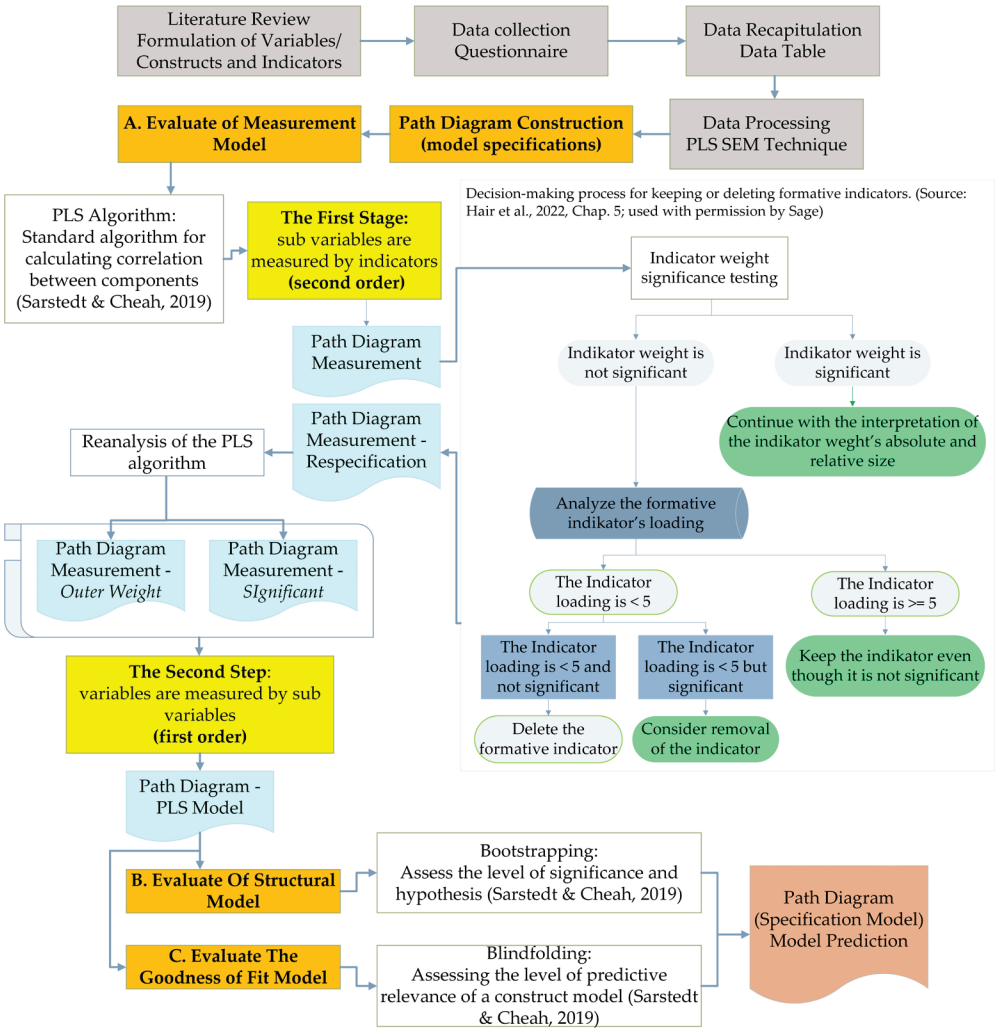

Figure 4. The research framework

The evaluation of the measurement model in this study is formative where the evaluation of the specifications of the model that has been formed can be seen from the significance of the outer weight and the outer loading, and the absence of multicollinearity between items with outer VIF (variance inflation factor) (Hair et al. 2021). If the outer weight is not significant, then the measurement item is not directly eliminated but it still considers the existing outer loading value. If the outer loading value is above 0.50, it is still included in the model; if the outer loading is below 0.50 and significant, the item is considered to be included in the model; and if the outer loading is below 0.50 and insignificant, the item is removed (Hair et al. 2021). The tolerated value of collinearity is a maximum of 5. If there are highly correlated measurement items as seen from the outer VIF value, then one of the measurement

items is gradually removed (Hair et al. 2021). There are two processes in evaluating the measurement model, namely the first evaluation is the second order measurement, which assesses the causality between indicators and sub-variables; and the second evaluation is the first order measurement, which assesses the causality between sub-variables and variables.

First Process – Evaluation of Measurement Model (Second Order)

In this measurement, the level of significance of the indicators in measuring the sub-variables (Second Order) of each construct will be known.

Based on the evaluation of the measurement model at the sub-variable level (Figure 5), it can be explained as follows:

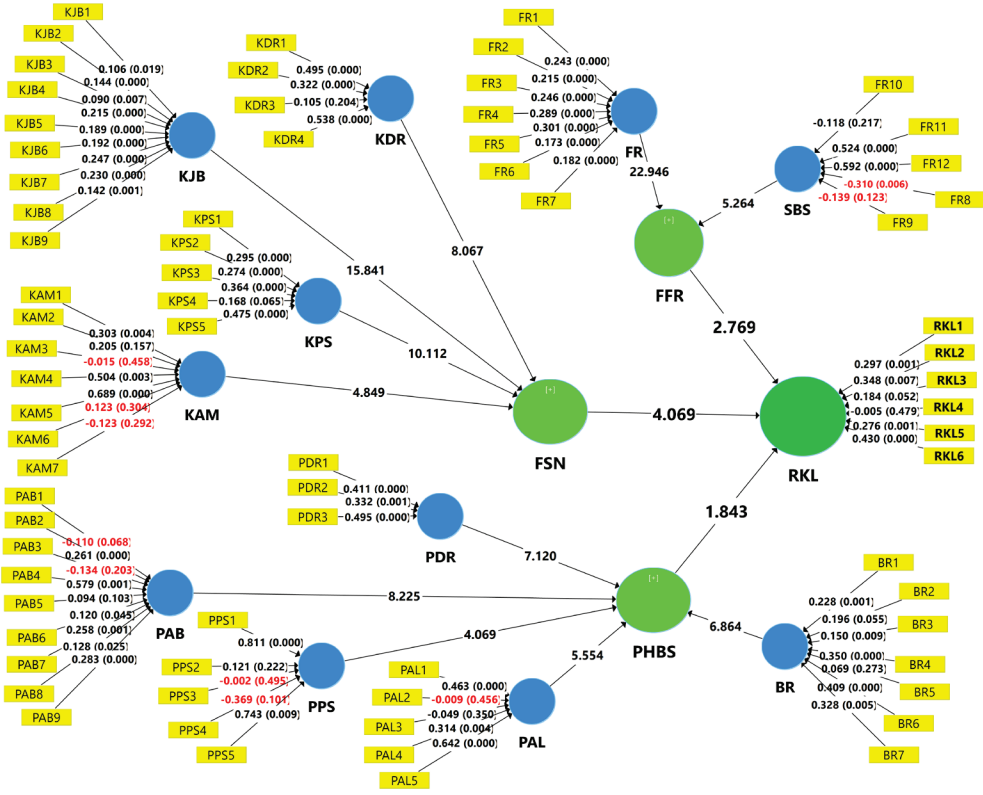

Figure 5. Measurement Path Diagram

Measurement of indicators that form PHBS sub-variables

In the first estimation of sub-variable level evaluation, the BR sub-variable shows that indicators BR1, BR2, BR3, BR4, BR6 and BR7 have significant outer weights (p-value

<0.05) but indicator BR5 is not significant with a p-value of 0.273> 0.05. However, this BR5 indicator has an outer loading of 0.625 and a p-value of 0.000 <0.05 so that BR5 is not removed from the model (it remains in the model).

The PAB1 indicator has an outer weight (-0.110) with a p-value of (0.068> 0.05) and the outer loading value of this indicator is (-0.037) and a p-value of 0.345> 0.05 (insignificant), so the PAB1 indicator is omitted from the model. Indicators PAB3 and PAB4 have high multicollinearity with outer VIF 12.688 and 12.996 which means they have a VIP>5 value. Therefore, one of the indicators is eliminated, namely PAB3 with a negative outer weight coefficient (-0.134), while the PAB 4 indicator remains in the model because the outer weight is positive (0.578). The PAB5 indicator, although not significant (p-value 0.103> 0.05), has an outer loading of 0.550 and a p-value of 0.000 < 0.05, so it remains in the model.

The PAL2 indicator is removed from the model with an outer weight (-0.009) and it is not significant (p-value 0.456> 0.05), and it has an outer loading of -0.025 and a p-value of 0.410> 0.05 (not significant). While PAL1, PAL3, PAL4, and PAL5 indicators remain in the model (p-value <0.05). The three PDR indicators are significant in influencing PDR and they remain in the model where the three indicators relatively have the same high outer weight. On the one hand, PPS1 and PPS2 indicators have significant outer loadings and they remain in the model. On the other hand, the PPS3 indicator is removed from the model because it has insignificant outer weight and outer loading. The PPS4 indicator is omitted from the model because it is multicollinear with PPS5. This is indicated by the high outer VIF of 7.888 > 5 (Table A1).

Measurement of indicators that make up the FSN sub-variable

In this estimation, indicators KAM3, KAM6 and KAM7 are removed from the model because the outer weight and the outer loading are not significant, while KAM1, KAM2, KAM4, and KAM5 remain in the model because they have a significant outer weight. KDR1, KDR2, and KDR4 indicators are significant to KDR, while KDR3 is not significant with a p-value of 0.186 > 0.05. However, the KDR3 indicator remains in the model because it has an outer loading of 0.598 and it is significant. The KJB sub-variable is measured by 9 indicators where all nine indicators are significant (p value <0.05). KPS1, KPS2, KPS3, KPS4 and KPS5 have significant outer weights (p-value <0.05). So that the five indicators remain in the model with an outer VIF < 5 (low multi-collinearity) (Table A2).

Measurement of indicators that make up the FFR sub-variable

In the FFR sub-variable, the outer weight values of all indicators produced are significant, so the seven indicators remain in the model. On the other hand, indicators FR8 and FR9 in the SBS sub-variable are omitted from the model, although the outer

weight is significant, the direction of the outer loading is negative (-0.595) and (-0.287). FR10 remains in the model even though the outer weight is not significant, but has a significant outer loading (p-value 0.029 <0.05). FR11 and FR12 remain in the model with significant outer weights (Table A3).

From the description above (called iteration 1), it can be explained that there are still indicators that do not meet the outer weight value or outer loading value and p-value> 0.05; then the indicator must be removed. Therefore, it is necessary to re-measure (respecification) using indicators that meet.

Evaluation of the measurement model in respecification is a re-measurement of the improved measurement path diagram, by reducing indicators with insignificant outer weight on sub-variables. The construction of the new measurement path diagram is called the measurement path diagram (Figure 6) – respecification which will then be re-estimated (called iteration 2).

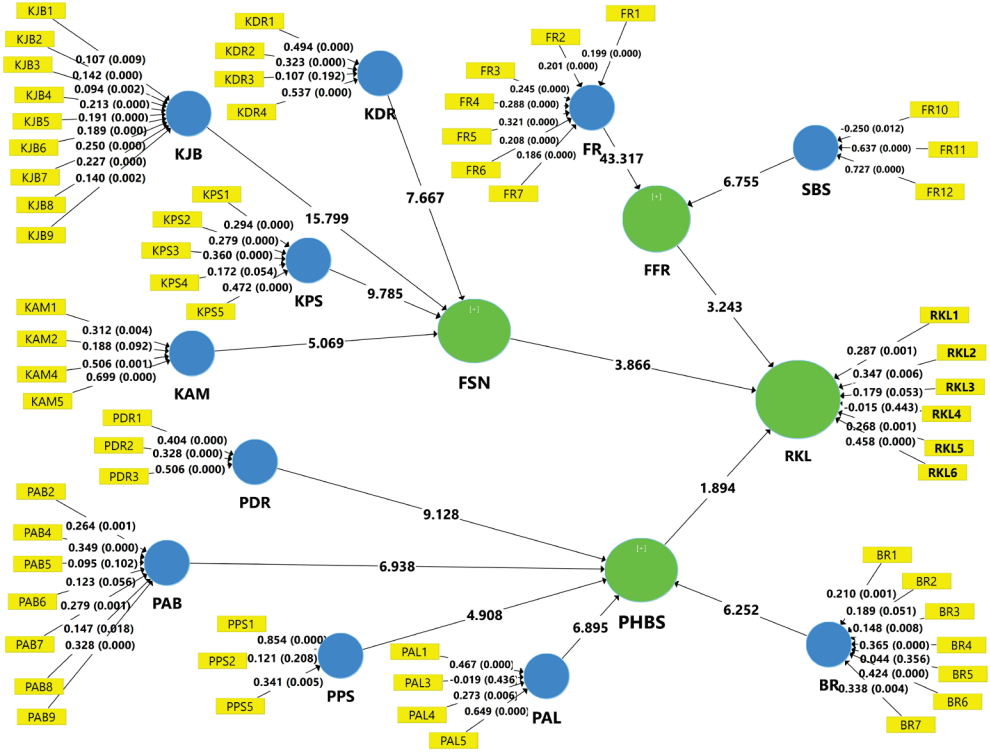

Figure 6. Path Diagram of Measurement – Respecification

Based on the evaluation of the measurement model at the respecification stage (iteration 2), it can be concluded that the estimation results show that all indicators have met the p-value <0.05. In detail, it can be explained as follows:

Measurement of Indicators Forming PHBS Sub-variables (Respecification)

Based on the measurement (figure 6), the BR sub-variable has 7 (seven) indicators with significant outer weights. The level of multicollinearity between the seven indicators is low with outer VIF < 5. So it can be concluded that all indicators have been fulfilled.

For the PAB sub-variable, it is measured by 7 (seven) indicators included in the model where there are 5 (five) indicators with significant outer weight with p-value <0.05, namely PAB2, PAB4, PAB7, PAB8 and PAB9. While 2 (two) indicators are not significant, namely PAB5 and PAB6 because the p-value> 0.05. However, PAB5 and PAB6 are not removed from the model because they have significant outer loading, namely outer loading 0.568 and 0.517 and significant with a p-value of 0.000 <0.05.

In the PAL sub-variable, it is measured by 4 (four) indicators where there are 3 (three) indicators that have significant outer weights, namely PAL1, PAL4, PAL5. Meanwhile, PAL3 is not significant with a p-value of 0.436> 0.05. However, PAL3 is not removed from the model because it has a significant outer loading. The PDR sub-variable is measured by 3 (three) indicators where all three indicators significantly and the three indicators' outer weights are relatively equal. The PPS sub-variable is measured by 2 (two) significant indicators, namely PPS1 and PPS5 while PPS2 is not significant (p value 0.208 > 0.05). The PPS2 indicator is not removed from the model because it has a significant outer loading (0.532) (p value <0.05). The level of multicollinearity between the three indicators is also low with outer VIF < 5 (Table A4).

Measurement of Indicators Forming FSN Sub-variables (Respecification)

The KAM sub-variable is measured by 4 (four) indicators and all are significant. The KDR sub-variable is measured by 5 (five) indicators where there are 4 (four) significant indicators, namely KDR1, KDR2, KDR3, KDR4 and there is 1 (one) insignificant indicator, namely KDR3. The KDR3 indicator is not removed from the model because it has an outer loading of 0.599 and is significant with a p-value of 0.000 <0.05.

The KJB sub-variable is measured by 9 (nine) indicators where all nine indicators are significant (p-value <0.05). The sub-variable of Waste Condition (KPS) is measured by 5 (five) indicators where there are 4 (four) indicators that are significant to waste conditions, namely KPS1, KPS2, KPS3, KPS5 while there is 1 indicator that is not significant, namely KPS4 because it has an outer weight of 0.172 and a p-value of 0.074 > 0.05. However, the KPS4 indicator is not removed from the model because it has an outer loading of 0.622 and is significant with a p-value of 0.000 <0.05 (Table A5).

Measurement of Indicators Forming FFR Sub-variables (Respecified)

The FR sub-variable is measured by 7 (seven) indicators where the PLS estimation results show that all seven indicators are significant with a p-value <0.05. Meanwhile,

the SBS sub-variable is measured by 3 (three) indicators where both indicators are significant, namely FR11 and FR12. FR10 has a low outer weight (-0.250), however, the outer loading value is positive 0.217 and significant (p value 0.032 <0.05) (Table A6).

Based on the explanation above, it can be concluded that the measurement model evaluation process in iteration 1 and iteration 2 has met the significance of the PLS Algorithm. There are several indicators that are significant in influencing environmental health risks, namely in the PHBS variable there are several significant indicators, namely BR1, BR2, BR3, BR4, BR5, BR6, BR7, PAB2, PAB4, PAB5, PAB6, PAB7, PAB8, PAB9, PAL1, PAL3, PAL4 PAL5, PDR1, PDR2, PDR3, PPS1, PPS2, PPS5. In the FSN variable, there are several significant indicators, namely KAM1, KAM2, KAM4, KAM5, KDR1, KDR2, KDR3, KDR4, KJB1, KJB2, KJB3, KJB4, KJB5, KJB6, KJB7, KJB8, KJB9, KPS1, KPS2, KPS3, KPS4, KPS5. Meanwhile, in the FFR variable, the significant indicators are FR1, FR2, FR3, FR4, FR5, FR6, FR7, FR10, FR11, FR12.

Second Process – Evaluation of Measurement Model (First Order)

After the evaluation of the sub-variable level measurement model is fulfilled, the second process of evaluating the variable level measurement model is continued. Evaluation of the variable-level measurement model is measured formatively, namely the causality between variables and the sub-variables that measure them. Therefore, the evaluation of the measurement model is also the same as the causality of the sub-variable measurement model with the measurement items, namely the significance of the outer weight and the absence of multicollinearity between the items with the outer VIF (variance inflation factor) (Hair and Sarstedt 2021, Sarstedt et al. 2021).

Based on the results of the measurement evaluation analysis, it is found that all sub-variables forming variables have a p-value <0.05 so that they are still considered in the path diagram. The results of this process are called the path diagram – PLS model. This estimate is obtained from measurements on the measurement path diagram – respecification. At the end of the process, all significant indicators "merge" to form sub-variables and measure variables, thus proving that the PHBS, FSN and FFR variables significantly affect environmental health risks. The process can be explained as follows:

Measurement of sub-variables that make up the FSN variable

The FSN variable is measured by 4 (four) sub-variables where the PLS Algorithm estimation results show that the KAM, KDR and KJB sub-variables have a significant effect. While the KPS sub-variable has an outer weight of 0.061 and a p-value of 0.264> 0.05. These results indicate that the KPS sub-variable has no significant effect. Even though KPS has an insignificant outer weight, the resulting outer loading value is 0.514 with a significant p-value of 0.00 <0.05. Therefore, KPS is still included in the model (Table 2).

Table 2. Outer Weight, Outer Loading and Outer VIF variable PHBS

Sub-variable	Outer Weight			Outer Loading			Outer VIF
	Outer Weight	T Statistics	P Values	Outer Loading	T Statistics	P Values	
BR -> PHBS	0.410	3.703	0.000	0.711	8.951	0.000	1.213
PAB -> PHBS	0.340	3.120	0.002	0.668	7.410	0.000	1.219
PAL -> PHBS	0.252	1.821	0.069	0.679	7.481	0.000	1.440
PDR -> PHBS	0.338	2.540	0.011	0.719	7.847	0.000	1.658
PPS -> PHBS	0.132	0.814	0.416	0.509	3.295	0.001	1.338

Measurement of sub-variables that make up the FFR variable

The FFR variable based on the PLS Algorithm estimation results, shows that the FR sub-variable has an outer weight of 0.797 and a p-value of 0.000 < 0.05; which means it has a significant effect. While the Sick Building Syndrome (SBS) sub-variable has an outer weight of 0.426 and a p-value of 0.000 < 0.05; which means it has a significant effect (Table 3).

Table 3. Outer Weight, Outer Loading and Outer VIF variable PHBS

Sub-variable	Outer Weight			Outer Loading			Outer VIF
	Outer Weight	T Statistics	P Values	Outer Loading	T Statistics	P Values	
FR -> FFR	0.797	11.853	0.000	0.912	20.075	0.000	1.078
SBS -> FFR	0.426	4.356	0.000	0.641	8.441	0.000	1.078

Measurement Indicators that make up the RKL variable

In the RKL variable, indicators RKL1, RKL2, RKL3, RKL5, RKL6 show a significant effect. Meanwhile, RKL4 has an outer weight of 0.026 and a p-value of 0.786 > 0.05 so it has no significant effect. However, RKL 4 remains in the model because it has an outer loading at a p-value of 0.000 (Table 4).

Table 4. Outer Weight, Outer Loading and Outer VIF Variable RKL

Indicator	Outer Weight			Outer Loading			Outer VIF
	Outer Weight	T Statistics	P Values	Outer Loading	T Statistics	P Values	
RKL1 -> RKL	0.237	2.454	0.014	0.572	6.793	0.000	1.231
RKL2 -> RKL	0.442	3.270	0.001	0.800	8.397	0.000	1.951
RKL3 -> RKL	0.195	2.003	0.045	0.661	7.796	0.000	2.685
RKL4 -> RKL	0.026	0.272	0.786	0.618	8.678	0.000	2.186
RKL5 -> RKL	0.185	2.081	0.038	0.496	5.322	0.000	1.149
RKL6 -> RKL	0.410	3.623	0.000	0.669	7.380	0.000	1.197

By evaluating the measurement model, both at the sub-variable level and variable level, it can be concluded that the physical component of the building is proven to have an effect on the environmental health risks. This can be seen from the outer weight value, the outer loading, and the p-value <0.05. Furthermore, the results of this process are called the path diagram – PLS model (Figure 7).

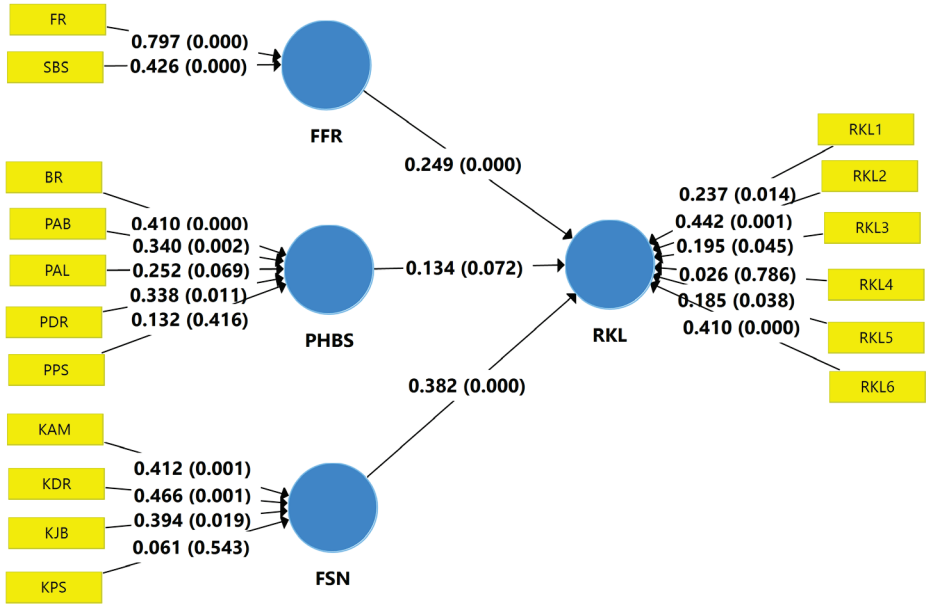

Figure 7. Path Diagram – PLS Model

Structural Model Evaluation (Bootstrapping)

Structural model evaluation relates to hypothesis testing of the influence between previously hypothesised research variables. The structural model evaluation consists of checking the collinearity between variables with the Inner VIF (Variance Inflation Factor) measure, testing the path coefficient hypothesis if the test p-value is less than 0.05 (significant), namely using a one-way hypothesis test, and evaluating the influence of variables at the structural level with f square. Based on the estimated inner VIF (Variance Inflation Factor) value of less than 5, the multicollinearity between FFR, FSN and PHBS variables is low (negligible). This result indicates that the estimated parameters are acceptable/unbiased. The correlation between FFR, FSN and PHBS in influencing RKL does not cause a high multicollinearity, the values being: 1.494, 1.466, and 1.785.

Furthermore, to find out if the three hypotheses contained in this study have a positive influence in shaping the environmental health risk component, it can be explained as follows (Table 5):

- The first hypothesis (H1): there is a significant positive effect of FSN on RKL with path coefficient (0.382) and t statistic 4.596 > 1.645 and p-value 0.000 < 0.05.
- The second hypothesis (H2): there is a positive influence of PHBS on RKL with path coefficient (0.134) and t statistic 1.914 > 1.645 and p-value 0.028 < 0.05.
- The third hypothesis (H3): there is a significant positive effect of FFR on CTR with path coefficient (0.249) and t-statistic 4.323 > 1.645 and p-value 0.000 < 0.05.

Table 5. Hypothesis analysis

Hypothesis	Hypothesis Statement	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
H1	FSN -> RKL	0.382	0.386	0.083	4.596	0.000
H2	PHBS -> RKL	0.134	0.162	0.070	1.914	0.028
H3	FFR -> RKL	0.249	0.236	0.058	4.323	0.000

Furthermore, to see the effect of variables at the structural level, the effect size f square or f square can be used where the f square value can be interpreted as low influence (f square = 0.02), moderate influence (f square = 0.15), and high influence (f square = 0.35) (Hair and Sarstedt 2021); at the structural level:

- The effect of FSN on RKL is f square 0.166, including a moderate effect.
- The effect of PHBS on RKL is f square 0.017 including low influence.
- The effect of FFR on RKL is f square 0.069 including low to moderate influence.

Based on the structural evaluation of the model, the path diagram – PLS model has significance and positive influence, and the estimated produced parameters are acceptable. This shows that the path diagram – PLS model that combines the three variables, namely PHBS, FSN and FFR, is acceptable. This also proves that not only behaviour and sanitation facilities, but the physical components of the building also affect.

Evaluation of Goodness and Model Fit (Blindfolding)

PLS is a variance-based SEM analysis with the aim of testing the theory of models that emphasise prediction studies. Therefore, several measures were developed to declare the proposed model as being acceptable, such as R square and SRMR and robustness checks, namely the linearity test (Sarstedt et al. 2019, Hair et al. 2021).

The R square statistical measure illustrates the amount of variation in endogenous variables that can be explained by other exogenous/endogenous variables in the model. According to Chin (1998), the qualitative interpretation values of R square are 0.19 (low influence), 0.33 (moderate influence), and 0.66 (high influence). Based on the results of data processing, it can be said that the magnitude of the influence of the FFR variable, the PHBS variable and the FSN variable on the RKL variable is 39.9%, including a

moderate influence (the R Square for the RKL variable is 0.399). This shows that the three variables are proven to have an effect on environmental health risks.

SRMR is a measure of model fit (PLS model goodness of fit), namely the difference between the data correlation matrix and the estimated model correlation matrix. Where the SRMR value is below 0.08, it indicates a model fit (Hair and Sarstedt 2021). The data processing results show that the SRMR value of the model is 0.069, which means that the model has a good fit. In addition, this also proves that empirical data can explain the influence between variables in the developed path diagram. So that the path diagram – the resulting PLS model has a good fit in the context of prediction and it is acceptable.

The value of robustness check in the PLS SEM analysis is to ensure that the relationship between variables is linear. Therefore, it is necessary to check linearity (Hair et al. 2019). This check can be done by looking at the significance of the squares of exogenous variables and their effect on endogenous variables (Hair et al. 2019, Sarstedt et al. 2019). If the test result is not significant, the relationship between the variables is linear.

According to the test results, the square effect (FSN x FSN) on RKL has a p-value of 0.311 > 0.05, so it is not significant, which means that there is a linear relationship between FSN and RKL. The p-value of the square effect (PHBS x PHBS) on RKL is 0.135 > 0.05, so it is not significant, which means that there is a linear relationship between PHBS and RKL. Meanwhile, the effect of the square (FFR x FFR) on RKL also produces a p-value of 0.340 > 0.05, which is not significant, which means that there is a linear relationship between FFR and RKL. Based on this, it can be concluded that the assumption of linearity of the relationship between variables is fulfilled. This shows that the developed path diagram has a good fit and an acceptable predictive power, so that it can be interpreted that the path diagram can generally apply to all locations. This also proves that the physical components of the building also have an influence on environmental health risks (Table 6).

Table 6. Linearity Test

Hypothesis	Path coefficient	T Statistics	P Values
FSN X FSN -> RKL	0.016	0.492	0.311
PHBS X PHBS -> RKL	0.049	1.102	0.135
FFR X FFR -> RKL	0.013	0.412	0.340

In addition, the modified path diagram – PLS model that combines the three variables is valid and reliable, it has a good fit for prediction and it is acceptable, and it fulfils the assumption of linearity/it has a linear relationship to environmental health risks. In addition, the modified path diagram – PLS model that combines the three variables is

valid and reliable, has a good fit in the context of prediction and it is acceptable, and it meets the assumption of linearity/it has a linear relationship to environmental health risks. Therefore, it is clear that not only the aspects of behaviour and sanitation facilities affect the environmental health risks, but also the physical components of the building. So, the variable of the physical component of the building can be considered in developing the concept of environmental health risk.

Discussion

The physical components of the building have a significant influence on the environmental health risks. The physical components of the building include components of roof type, ceiling, wall type, floor type, bedroom windows, living room windows, occupancy density, lighting, humidity, and temperature. This is in line with the perspective of Basri et al. (2022) which states that the household or living environment has an important role as a major determinant of health. As it is also confirmed by Perdana and Putra (2018), Pradita et al. (2018), Akbar et al. (2021), and Aryani et al. (2022), who stated that human health status is influenced by the physical factors of the house and the basic sanitation, where poor home sanitation is associated with high levels of various health problems. This is also supported by Krieger and Higgins (2002) who stated that poor housing conditions, inadequate sanitation, high occupancy density, and insufficient ventilation are associated with a variety of health conditions, including respiratory infections, asthma, lead poisoning, injuries, infectious diseases, and mental health problems.

Home construction that does not meet health standards can be a major source of various diseases and they create an uncomfortable environment for the residents. For example, roofs and ceilings made of hazardous materials such as asbestos can cause serious lung diseases, while poorly insulated walls and floors can lead to extreme temperatures and high humidity that trigger the growth of mould and bacteria, worsening the residents' respiratory conditions (Perdana and Putra 2018, Akbar et al. 2021, Aryani et al. 2022). In addition, adequate ventilation through windows and building designs that consider daylighting are essential for maintaining indoor air quality and psychological well-being. High occupancy density can increase stress and the risk of disease transmission, suggesting that the chosen building design and materials should support occupant health and comfort. Therefore, paying attention to the physical components of the building is crucial to creating a healthy and safe living environment, as outlined by Basri et al. (2022).

Improperly insulated walls and floors can lead to high humidity that favours the growth of mould and bacteria. Poor ventilation through inadequate windows can also lead to poor indoor air quality, increasing the risk of respiratory disorders and allergic diseases. In addition, inadequate lighting and temperature extremes due to inefficient building

design can lead to physical discomfort and mental health issues. Thus, ensuring good physical building components and proper sanitation are key to creating a healthy living environment and to preventing various health problems, in line with the previous study by Aryani et al. (2022). Furthermore, Diandra et al. (2020) emphasised that the construction and the environment of houses that do not meet the requirements of healthy homes is one of the main factors causing disease and discomfort for the residents. A healthy home is characterised by the use of safe building materials, good insulation, adequate ventilation, and sufficient lighting. A healthy environment also includes proper sanitation, such as hygienic latrines, access to clean water, and efficient waste water and garbage disposal systems. All these components play a role in preventing disease and in ensuring the physical and mental well-being of the residents.

Such studies as those conducted by Pradita et al. (2018) and Aryani et al. (2022) showed that factors such as lighting, humidity, and occupancy density had a significant correlation with the incidence of ARI and pulmonary tuberculosis in children under five. Likewise, Perdana and Putra (2018) found that occupancy density, ventilation, lighting, and humidity were associated with the incidence of pulmonary tuberculosis. This suggests that the physical components of a building have a substantial impact on the health of its occupants.

Furthermore, these physical factors of the home are also associated with the Sick Building Syndrome (SBS), which includes a wide range of symptoms related to indoor air quality. Poor ventilation, high humidity, inadequate lighting, as well as building materials containing hazardous substances can cause the Sick Building Syndrome (SBS). As explained by Burge et al. (1987), the possible impacts of SBS include poisoning, irritation, infection and allergy. In addition, common symptoms related to odour, humidity, temperature, too little air movement, static electricity, and ventilation-related noise influence the indoor air quality (Brauer et al. 2006). This is also supported by Ikmala et al. (2018), and Karlina et al. (2021) which state that the factors affecting the appearance of the Sick Building Syndrome (SBS) include humidity, air conditioning, ventilation, lighting, temperature, and humidity.

The environmental health risk assessment is an important approach in identifying, evaluating and managing the environmental hazards that may affect human health. In this context, it is important to consider the physical components of buildings as significant factors in determining environmental health risks. The integration of the physical components of buildings in environmental health risk assessment is a crucial step as it enables a more holistic and comprehensive understanding of the factors that can affect human health in their living environment.

This approach enables a more comprehensive assessment of overall environmental health risks by considering the encounters with multiple environmental hazards through various media and time, as described by Huang and London (2012). By

including the physical components of buildings in risk assessments, such as ventilation conditions, humidity, temperature, and building materials, we can better identify and evaluate the potential health risks arising from the physical environment in which individuals live. This also allows the incorporation of environmental hazards using multiplicative or additive models to assess the overall impact on different population groups (Su et al. 2009).

Environmental health risk assessment models, such as those recommended by organisations like the US Environmental Protection Agency, have become an important tool in evaluating the impact of pollutants on human health (Changhong et al. 2019). By including the physical components of buildings in these models, we can better identify how these physical environmental factors can affect human health risk levels. Even limited measurements of risk levels can be useful in identifying complex cause-and-effect processes and the most efficient ways to address risk (Commonwealth of Australia 2012). Accordingly, the addition of a physical building component to the environmental health risk assessment not only broadens the scope of risk evaluation, but it also enables more effective and targeted risk management strategies.

In another context, a deeper understanding of the concept of environmental health risk allows for a more holistic and comprehensive risk assessment, considering not only the behavioural aspects and sanitation facilities, but also the physical components of the building that affect them. This is also emphasised by Bright-Davies et al. (2015), who have provided an important foundation in understanding and managing environmental health risks by focusing on two main aspects: behaviour and sanitation facilities. The purpose of risk assessment, as described by Omenn and Eaton (2023), is to balance risks and benefits, to set a target risk level, to prioritise program activities, and to estimate the residual risk after taking the measures to reduce risks. This approach involves measuring the level of potential hazards based on specific conditions (Wu and Rodricks 2023), and the examination of the combined adverse human health effects of exposure to combinations of environmental stressors (Sexton 2012). As a result, adding the finding that the physical components of buildings also have a significant effect on environmental health risks, this approach becomes more holistic and comprehensive.

The integration of physical building components allows for more accurate risk assessment and the development of more effective environmental health risk mitigation strategies. By thoroughly considering the behavioural aspects, the sanitation facilities, and the physical components of buildings, this approach provides a strong foundation for creating a healthier and safer environment for the community as a whole. Therefore, this integration is an important step in improving quality of life and environmental health at various levels. It has also proven to be a generally applicable approach to environmental health risks.

Conclusions

This article aims to show that the physical features of buildings impact environmental health risks and they can be included as additional variables in creating a more accurate, valid, and comprehensive environmental health risk assessment model. The physical components of buildings have been shown to have a significant effect on environmental health risks, both for the residents and the surrounding environment. The influential components are bedroom windows, floor type, ceiling, wall type, roof type, living room windows, occupancy density, temperature, humidity and temperature. In this case, the physical components of the building in the selection of materials and the design of residential construction are important and they should not be ignored.

Overall, these components have an effect on environmental health with better measurement results, although some components only have a low-moderate level of influence. With this study, governments, health agencies and communities have better tools to identify health risk factors that may have previously been overlooked. This allows them to plan more effective and efficient strategies in risk mitigation. This study still needs other variables to be more accurate in health risk assessment in various cases. Therefore, it can be further developed by considering other supporting variables such as the accessibility of the study location to certain activity centres.

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Annex

Table A1. Outer Weight, Outer Loading and Outer VIF Variable PHBS

Indicators	Outer Weight			Outer Loading			Outer VIF
	Outer Weight	T Statistics	P Values	Outer Loading	T Statistics	P Values	
BR1 -> BR	0.228	3.178	0.001	0.370	4.365	0.000	1.064
BR2 -> BR	0.196	1.601	0.055	0.515	4.890	0.000	3.100
BR3 -> BR	0.150	2.358	0.009	0.444	5.833	0.000	1.204
BR4 -> BR	0.350	4.875	0.000	0.651	10.582	0.000	1.389
BR5 -> BR	0.069	0.605	0.273	0.625	7.343	0.000	3.599
BR6 -> BR	0.409	3.384	0.000	0.734	8.851	0.000	1.328
BR7 -> BR	0.328	2.598	0.005	0.541	4.861	0.000	1.310
PAB1 -> PAB	-0.110	1.493	0.068	-0.037	0.398	0.345	1.040
PAB2 -> PAB	0.261	3.618	0.000	0.653	9.722	0.000	1.383
PAB3 -> PAB	-0.134	0.830	0.203	0.608	7.532	0.000	12.688
PAB4 -> PAB	0.579	3.051	0.001	0.648	7.951	0.000	12.996
PAB5 -> PAB	0.094	1.268	0.103	0.550	5.783	0.000	1.388
PAB6 -> PAB	0.120	1.693	0.045	0.481	3.904	0.000	1.436
PAB7 -> PAB	0.258	3.019	0.001	0.623	5.391	0.000	1.638
PAB8 -> PAB	0.128	1.971	0.025	0.553	6.763	0.000	1.554
PAB9 -> PAB	0.283	3.619	0.000	0.674	10.155	0.000	1.568
PAL1 -> PAL	0.463	4.755	0.000	0.653	7.653	0.000	1.120
PAL2 -> PAL	-0.009	0.110	0.456	-0.025	0.242	0.404	1.138
PAL3 -> PAL	-0.049	0.386	0.350	0.489	4.664	0.000	3.592
PAL4 -> PAL	0.314	2.643	0.004	0.579	5.865	0.000	3.641
PAL5 -> PAL	0.642	7.734	0.000	0.840	13.982	0.000	1.255
PDR1 -> PDR	0.411	3.941	0.000	0.800	12.894	0.000	1.799
PDR2 -> PDR	0.332	3.149	0.001	0.841	15.953	0.000	2.059
PDR3 -> PDR	0.495	5.249	0.000	0.792	12.157	0.000	1.293
PPS1 -> PPS	0.811	6.220	0.000	0.898	11.168	0.000	1.235
PPS2 -> PPS	0.121	0.767	0.222	0.511	3.177	0.001	1.261
PPS3 -> PPS	-0.002	0.013	0.495	-0.102	0.653	0.257	1.143
PPS4 -> PPS	-0.369	1.276	0.101	0.380	2.190	0.014	7.888
PPS5 -> PPS	0.743	2.354	0.009	0.471	2.628	0.004	7.866

**Refer to Table 1 (Research Variables and Indicators) for the code/abbreviation*

Table A2. Outer Weight, Outer Loading and Outer VIF Variable FSN

Indicators	Outer Weight			Outer Loading			Outer VIF
	Outer Weight	T Statistics	P Values	Outer Loading	T Statistics	P Values	
KAM1 -> KAM	0.303	2.628	0.004	0.305	2.370	0.009	1.275
KAM2 -> KAM	0.205	1.006	0.157	0.242	1.704	0.044	2.087
KAM3 -> KAM	-0.015	0.107	0.458	0.114	0.949	0.171	1.912
KAM4 -> KAM	0.504	2.759	0.003	0.668	3.752	0.000	1.277
KAM5 -> KAM	0.689	5.324	0.000	0.743	7.310	0.000	1.386
KAM6 -> KAM	0.123	0.512	0.304	-0.020	0.114	0.455	4.651
KAM7 -> KAM	-0.123	0.548	0.292	-0.112	0.694	0.244	4.440
KDR1 -> KDR	0.495	5.347	0.000	0.717	7.240	0.000	1.661
KDR2 -> KDR	0.322	3.467	0.000	0.672	6.976	0.000	1.584
KDR3 -> KDR	0.105	0.828	0.204	0.598	4.883	0.000	2.287
KDR4 -> KDR	0.538	4.160	0.000	0.680	5.885	0.000	2.071
KJB1 -> KJB	0.106	2.088	0.019	0.577	9.539	0.000	1.599
KJB2 -> KJB	0.144	3.691	0.000	0.619	11.392	0.000	1.484
KJB3 -> KJB	0.090	2.446	0.007	0.457	6.576	0.000	1.331
KJB4 -> KJB	0.215	4.221	0.000	0.753	14.668	0.000	2.095
KJB5 -> KJB	0.189	4.261	0.000	0.618	13.720	0.000	1.469
KJB6 -> KJB	0.192	4.276	0.000	0.769	19.263	0.000	2.081
KJB7 -> KJB	0.247	5.766	0.000	0.704	19.400	0.000	1.573
KJB8 -> KJB	0.230	6.410	0.000	0.571	11.885	0.000	1.304
KJB9 -> KJB	0.142	3.033	0.001	0.550	9.203	0.000	1.506
KPS1 -> KPS	0.295	3.838	0.000	0.527	5.980	0.000	1.143
KPS2 -> KPS	0.274	3.806	0.000	0.564	7.921	0.000	1.212
KPS3 -> KPS	0.364	4.273	0.000	0.649	9.061	0.000	1.155
KPS4 -> KPS	0.168	1.518	0.065	0.619	6.635	0.000	1.367
KPS5 -> KPS	0.475	5.518	0.000	0.736	10.207	0.000	1.312

Table A3. Outer Weight, Outer Loading and Outer VIF Variable FSN

Indicators	Outer Weight			Outer Loading			Outer VIF
	Outer Weight	T Statistics	P Values	Outer Loading	T Statistics	P Values	
FR1 -> FR	0.243	6.176	0.000	0.568	9.863	0.000	1.268
FR2 -> FR	0.215	6.378	0.000	0.573	12.102	0.000	1.258
FR3 -> FR	0.246	7.420	0.000	0.638	12.177	0.000	1.376
FR4 -> FR	0.289	8.262	0.000	0.693	16.133	0.000	1.522
FR5 -> FR	0.301	8.202	0.000	0.643	13.411	0.000	1.506
FR6 -> FR	0.173	4.121	0.000	0.493	7.228	0.000	1.409
FR7 -> FR	0.182	5.288	0.000	0.564	10.506	0.000	1.281
FR8 -> SBS	-0.310	2.533	0.006	-0.595	4.516	0.000	1.444
FR9 -> SBS	-0.139	1.161	0.123	-0.287	1.712	0.044	1.350
FR10 -> SBS	-0.118	0.781	0.217	0.279	1.898	0.029	1.271
FR11 -> SBS	0.524	4.079	0.000	0.692	6.338	0.000	1.189
FR12 -> SBS	0.592	4.808	0.000	0.753	8.095	0.000	1.253

Table A4. Outer Weight, Outer Loading and Outer VIF Variable PHBS (Respecification)

Indicators	Outer Weight			Outer Loading			Outer VIF
	Outer Weight	T Statistics	P Values	Outer Loading	T Statistics	P Values	
BR1 -> BR	0.210	3.031	0.001	0.350	4.323	0.000	1.064
BR2 -> BR	0.189	1.641	0.051	0.493	4.771	0.000	3.100
BR3 -> BR	0.148	2.403	0.008	0.440	5.997	0.000	1.204
BR4 -> BR	0.365	5.200	0.000	0.657	11.445	0.000	1.389
BR5 -> BR	0.044	0.369	0.356	0.604	6.782	0.000	3.599
BR6 -> BR	0.424	3.578	0.000	0.748	9.851	0.000	1.328
BR7 -> BR	0.338	2.699	0.004	0.547	4.859	0.000	1.310
PAB2 -> PAB	0.264	3.290	0.001	0.666	10.085	0.000	1.357
PAB4 -> PAB	0.349	4.116	0.000	0.563	6.880	0.000	1.134
PAB5 -> PAB	0.095	1.271	0.102	0.568	6.751	0.000	1.377
PAB6 -> PAB	0.123	1.592	0.056	0.517	4.382	0.000	1.423
PAB7 -> PAB	0.279	3.154	0.001	0.663	6.297	0.000	1.629
PAB8 -> PAB	0.147	2.110	0.018	0.597	7.511	0.000	1.538
PAB9 -> PAB	0.328	4.186	0.000	0.722	12.625	0.000	1.562
PAL1 -> PAL	0.467	4.971	0.000	0.659	8.203	0.000	1.074
PAL3 -> PAL	-0.019	0.162	0.436	0.489	5.233	0.000	3.509
PAL4 -> PAL	0.273	2.516	0.006	0.567	6.168	0.000	3.633
PAL5 -> PAL	0.649	8.575	0.000	0.842	15.932	0.000	1.169
PDR1 -> PDR	0.404	4.167	0.000	0.794	13.277	0.000	1.799
PDR2 -> PDR	0.328	3.522	0.000	0.838	18.405	0.000	2.059
PDR3 -> PDR	0.506	5.694	0.000	0.798	12.306	0.000	1.293
PPS1 -> PPS	0.854	7.545	0.000	0.929	14.944	0.000	1.223
PPS2 -> PPS	0.121	0.815	0.208	0.532	3.370	0.000	1.241
PPS5 -> PPS	0.341	2.554	0.005	0.416	2.905	0.002	1.019

Table A5. Outer Weight, Outer Loading and Outer VIF Variable FSN (Respecification)

Indicators	Outer Weight			Outer Loading			Outer VIF
	Outer Weight	T Statistics	P Values	Outer Loading	T Statistics	P Values	
KAM1 -> KAM	0.312	2.670	0.004	0.313	2.564	0.005	1.014
KAM2 -> KAM	0.188	1.330	0.092	0.235	1.854	0.032	1.103
KAM4 -> KAM	0.506	3.093	0.001	0.666	4.211	0.000	1.098
KAM5 -> KAM	0.699	5.632	0.000	0.746	7.936	0.000	1.066
KDR1 -> KDR	0.494	5.149	0.000	0.716	7.060	0.000	1.433
KDR2 -> KDR	0.323	3.665	0.000	0.672	7.381	0.000	1.462
KDR3 -> KDR	0.107	0.872	0.192	0.599	4.927	0.000	2.109
KDR4 -> KDR	0.537	4.509	0.000	0.681	6.003	0.000	2.071

Indicators	Outer Weight			Outer Loading			Outer VIF
	Outer Weight	T Statistics	P Values	Outer Loading	T Statistics	P Values	
KJB1 -> KJB	0.107	2.391	0.009	0.578	9.810	0.000	1.599
KJB2 -> KJB	0.142	3.738	0.000	0.618	11.480	0.000	1.484
KJB3 -> KJB	0.094	2.869	0.002	0.459	7.129	0.000	1.331
KJB4 -> KJB	0.213	4.402	0.000	0.753	15.781	0.000	2.095
KJB5 -> KJB	0.191	4.769	0.000	0.620	13.976	0.000	1.469
KJB6 -> KJB	0.189	4.378	0.000	0.767	20.003	0.000	2.081
KJB7 -> KJB	0.250	6.224	0.000	0.706	19.808	0.000	1.573
KJB8 -> KJB	0.227	6.194	0.000	0.568	11.816	0.000	1.304
KJB9 -> KJB	0.140	2.952	0.002	0.549	9.265	0.000	1.506
KPS1 -> KPS	0.294	3.998	0.000	0.527	6.035	0.000	1.143
KPS2 -> KPS	0.279	4.147	0.000	0.568	8.070	0.000	1.212
KPS3 -> KPS	0.360	4.412	0.000	0.646	9.153	0.000	1.155
KPS4 -> KPS	0.172	1.608	0.054	0.622	6.771	0.000	1.367
KPS5 -> KPS	0.472	5.297	0.000	0.735	10.390	0.000	1.312

Table A6. Outer Weight, Outer Loading and Outer VIF Variable FFR (Respecification)

Indicators	Outer Weight			Outer Loading			Outer VIF
	Outer Weight	T Statistics	P Values	Outer Loading	T Statistics	P Values	
FR1 -> FR	0.199	6.942	0.000	0.524	9.767	0.000	1.268
FR2 -> FR	0.201	8.384	0.000	0.557	12.702	0.000	1.258
FR3 -> FR	0.245	8.556	0.000	0.631	12.876	0.000	1.376
FR4 -> FR	0.288	9.791	0.000	0.688	16.700	0.000	1.522
FR5 -> FR	0.321	11.380	0.000	0.668	18.078	0.000	1.506
FR6 -> FR	0.208	7.580	0.000	0.535	10.250	0.000	1.409
FR7 -> FR	0.186	6.501	0.000	0.564	10.914	0.000	1.281
FR10 -> SBS	-0.250	2.258	0.012	0.217	1.854	0.032	1.231
FR11 -> SBS	0.637	4.790	0.000	0.747	7.111	0.000	1.134
FR12 -> SBS	0.727	5.742	0.000	0.797	8.058	0.000	1.194

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UNDERSTANDING THE MULTI-DIMENSIONAL NATURE OF CULTURAL IDENTITY IN HISTORIC URBAN LANDSCAPES: A STUDY OF JIAXIULOU IN GUIYANG, CHINA

Shi Linfeng, Yang Wanyi, Norsidah Ujang
Universiti Putra Malaysia, Serdang, Malaysia

Abstract: The conservation and sustainable development of historic urban landscapes (HUL) are imperative in the face of rapid urbanisation. This study, based on Jiaxiulou in Guiyang City, China, examines the dimensions of cultural identity (CI) in HUL. Using a mixed qualitative and quantitative approach, a three-dimensional model of CI is validated, comprising cognitive, emotional, and behavioural aspects. Results show that while cognitive understanding of HUL is essential, it alone does not directly influence the residents' emotions and behaviours. Pride in cultural heritage emerges as a significant driver of CI, impacting the residents' perceptions and behaviours. Conversation behaviour is identified as a primary expression of CI. Recommendations are proposed to integrate local values into urban planning, to enhance public participation, and to provide diverse cultural activities for the residents, highlighting the importance of social engagement in shaping CI. This study contributes to understanding the complexity of CI and its role in HUL conservation and sustainable development

Keywords:

cultural identity;
historic urban landscape;
cognition;
emotion;
behaviour

Email: shilinfeng1020@163.com

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Introduction

Uncontrolled changes in urban density and growth pose a threat to the integrity of local identity, urban fabric, and cultural affiliation (UNESCO 2011). Particularly, historic urban landscapes (HUL) are at risk of losing their functions, traditional roles, and populations (UNESCO 2011). Scholars argue that these HULs play a crucial role in shaping the cultural identity (CI) of the local residents and in fostering a sense of connection with the past (Rodwell 2008). Strengthening the CI can, in turn, promote the conservation and sustainable development of these historic urban landscapes (WHITRAP Shanghai 2023). Despite the growing recognition of the importance of understanding CI for urban heritage preservation, research on its internal influence mechanism remains fragmented (Pan et al. 2020).

In the current research, CI is determined by race, cultural background, social class, religion and other factors (Urrieta and Noblit 2018, Boruah 2020), formed by combining various dimensions such as cognition, attitude, emotional attachment, and behaviour (Klerides 2009, Pan et al. 2020). Most studies hold that the dimensions of CI mainly include cognition, emotion and behaviour (Ibrahim and Heuer 2016, Pan et al. 2020, Fu and Luo 2023). Among the few relevant studies, the main object of concern is the factors that generate the CI of local tourists in urban heritage sites, among which there are relatively few studies on the HUL for the residents. In addition, although some scholars have measured and verified different dimensions of CI (Pan et al. 2020, Fu and Luo 2023), a more internal mechanism of research is still in its infancy (Pan et al. 2020). Therefore, it is necessary to continue to study the relational models for measuring and verifying the various dimensions of CI.

Based on UNESCO's definition of historical urban landscape (UNESCO 2011), this study selects the Jiaxiulou landscape in Guiyang City, China as a case study. The analysis employs a combination of quantitative and qualitative methods to validate the three-dimensional theoretical model of CI based on prior research (Pan et al. 2020, Fu and Luo 2023), and to elucidate the interplay between these dimensions. The primary focus of this paper is to examine the significance and interconnectedness of various dimensions in the CI of HUL, while also outlining the specifics and the underlying reasons behind the residents' CI.

The study makes three main contributions. Firstly, it presents a three-dimensional scale for measuring CI in HUL and it validates its reliability. This scale includes cognitive, emotional, and behavioural dimensions and it can assess the general CI perception. This provides a dimensional model and scale reference for future research in this area. Secondly, the study conducts a joint analysis of the functions and interactions of the three dimensions of CI using both a quantitative analysis and a qualitative interpretation. This integrated approach offers a more comprehensive and insightful understanding of the dimensions and nuances of CI. Thirdly, the study integrates the

field of urban heritage conservation to underscore the importance of understanding the residents' CI within the context of HUL. This discussion provides valuable insights for the future urban historic area renewal and planning efforts.

Literature review and hypothesis

Cultural identity of HUL

Cultural identity (CI) encompasses an individual's recognition and identification with the unique culture of a place (Clark 1990). According to Phinney (1990), belonging to a specific ethnic group constitutes a key aspect of CI. It is not only an individual's self-perception within a cultural setting (Padilla and Perez 2003, Schwartz et al. 2006) but also a collective identity within a shared cultural and historical heritage environment (Chattalas and Harper 2007, He and Wang 2015). Ethnic identity or national identity often influences CI (Pan et al. 2020). Thoughts, emotions, and behaviours rooted in the common customs and values of a particular ethnic group (Phinney and Ong 2007) and national society (Nakata and Sivakumar 2001) play a significant role in shaping CI.

McIlvenny et al. (2009) demonstrated that CI and place attachment play crucial roles in the individuals' social and psychological empowerment. They influence each other and together they shape social and behavioural decisions. Numerous studies have also confirmed that CI significantly impacts place attachment (Freeman et al. 2023, Chan et al. 2024). Even when different cultural backgrounds within the same place led to multiple CIs, they still contribute to fostering place attachment (Ujang and Zakariya 2015). Targeted urban renewal driven by place attachment and CI is sustainable (Hwang 2014, Chan et al. 2024). The CI of residents can impact the local cultural representation (Lu and Lu 2014), with cultural heritage typically serving as the primary medium through which CI is expressed (Zhang et al. 2018).

According to UNESCO (2011), the concept of HUL encompasses the intricate fusion of cultural and natural elements that have evolved within a city over time. Encompassing both historical and contemporary architectural and landscaped areas, alongside the topography and natural surroundings, HUL encapsulates the tangible and intangible facets of cultural heritage. This composite entity serves as a tangible manifestation of a city's distinctiveness and local culture, acting as a crucial conduit for the expression of behavioural experiences and cultural sentiments among its inhabitants (UNESCO 2011). Acknowledged as a public domain with unique cultural characteristics, HUL warrants thorough investigation to elucidate the perceptions and acknowledgments of its residents (Ziyaee 2018). Furthermore, spaces within HUL distinguished by their CIs play a crucial role in fostering the residents' sense of belonging and attachment to their surroundings (Ziyaee 2018). The residents enhance their CI through the community atmosphere and environmental quality created by the HUL (Jackson 2008, Wang 2023). Revitalising historic urban landscapes helps strengthen the locals' CI (Cittati et al. 2022)

and place attachment (Lee and Jeong 2021), while also better preserving the collective memory (Cittati et al. 2022) and the attachment to one's hometown (Chan et al. 2024). Consequently, research focusing on HUL can provide valuable insights to inform urban planning and design initiatives aimed at creating culturally rich and socially vibrant urban environments (UNESCO 2011, Ziyaee 2018).

Scholarly research commonly defines CI as comprising dimensions such as cognitive judgement, attitude, emotional attachment, and behavioural intention (Klerides 2009). Despite the construction of CI scales in some studies, there remains a notable lack of research investigating their application and validation within contexts like HUL (Pan et al. 2020). Studies focusing on subjects akin to HUL, such as cultural heritage and historical landscapes, advocate for the inclusion of (1)cognitive, (2) emotional, and (3) behavioural dimensions within the construct of CI (Pan et al. 2020, Fu and Luo 2023). Therefore, the present study is designed to formulate hypotheses and to conduct research specifically targeting these three dimensions.

Cognitive dimension in CI

The cognitive dimension of CI refers to the people's thoughts and beliefs about place (Pan et al. 2020). It encompasses the people's understanding and perception of places, which form the emotional bond between individuals and their surroundings (Altman and Low 1992). This cognitive aspect is influenced by the individuals' memory and knowledge of a place, contributing to their sense of place and CI (Scannell and Gifford 2010, Pan and Cobbinah 2023). The individuals' cognition of places and the significance that they attribute to them are also shaped by their emotions and experiences (Tuan 1977, Manzo and Perkins 2006), particularly the emotions and behaviours that are formed through memories and experiences (Markus 1977). The emotional connection that individuals feel toward places is related to the cognitive significance that they assign to those places (Casakin and Kreitler 2008). People's cognitions of local culture and its significance can motivate them to act (Manzo and Perkins 2006).

While the current perspective suggests a strong relationship between the cognitive dimension and the emotional and behavioural dimensions, it is not entirely clear whether the cognitive dimension directly influences the emotional and behavioural dimensions. Therefore, we propose the following hypotheses regarding the cognitive dimensions of CI: (H1) *The cognitive dimension of CI affects the emotional dimension*; (H2) *The cognitive dimension of CI affects the behavioural dimension*.

Emotional dimension in CI

The emotional dimension of CI refers to the positive and negative emotions evoked by the local culture (Pan et al. 2020). In the emotional bond between individuals and places, this dimension is reflected in the people's satisfaction and attachment to a place (Altman

and Low 1992). Various studies have used different emotional terms to describe the emotional connections between individuals and places, such as "love of place" (Tuan 1990), "pride of place" (Brown et al. 2003), and "sense of happiness" (Fullilove 1996, Giuliani 2003, Manzo 2005). These diverse feelings and emotions represent the individuals' attitudes and emotions toward places (Breckler 1984), serving as an important basis for their perception of these places (Jiang and Wang 2006).

Some studies assess the quality of places based on data regarding the individuals' emotional responses to them (Jiang and Wang 2006). People's emotions about places are affected by their interactions with the physical and social environment (Zhang 2023), as well as by behaviour and cognition (Bow and Buys 2003, Moulay and Ujang 2021). On the other hand, emotions can also influence individuals' perception, cognition, behaviour, and activities related to a place (Zhang 2023). Among these factors, positive emotional interactions are crucial in the formation of CI and local identity (Manzo 2003). Therefore, we propose the following hypotheses regarding the emotional dimension of CI: (H3) *The emotional dimension of CI affects the cognitive dimension*; (H4) *The emotional dimension of CI affects the behavioural dimension*.

Behavioural dimension in CI

The behavioural dimension of CI pertains to the actions and behaviours of individuals in a place that are influenced by culture (Pan et al. 2020). Within the emotional bond between individuals and places, these actions encompass the activities and functional relationships between individuals and places (Altman and Low 1992). Behavioural participation is related to relevant events and activities (Preusche and Göbel 2022). Behaviour is also associated with familiarity, as individuals maintain connections to a place by adopting habits and activities similar to those in the past (Michelson 1976). The physical environment impacts the individuals' behaviour, which in turn influences their emotional attachment to the place (Ujang and Zakariya 2015, Pan and Cobbinah 2023). Additionally, individuals' emotions (Hashemnezhad et al. 2013, Zhang 2023) and perceptions of a place are influenced by their behaviour in that place (Tuan 1977, Manzo and Perkins 2006). Emotional investment affects the individuals' active participation in behaviours (Preusche and Göbel 2022). Therefore, we propose the following hypotheses regarding the behavioural dimensions of CI: (H5) *The behavioural dimension of CI affects the cognitive dimension*; (H6) *The behavioural dimension of CI affects the emotional dimension*.

Methodology

Study area

This study focuses on the historic urban landscape area of Jiaxiulou (Figure 1), situated in the urban centre of Guiyang, Guizhou Province in southwest China. Guiyang is an

underdeveloped city with a rich history, where the urban landscape steeped in history and culture carry the memories and identity of its residents (Guiyang Municipal People's Government 2023). However, to achieve rapid economic growth, the city has seen rapid development and renewal focused on tourism and real estate around its historic urban landscapes (Yang and Peng 2024), posing a threat to the residents' place of identity and belonging. Exploring the city's historic urban landscapes and the residents' CI and responses to them is therefore of great importance.

Jiaxiulou comprises the landscape and plaza area surrounding Jiaxiu Tower, a structure constructed during the Ming Dynasty in 1598 (Guiyang Municipal People's Government 2023). Designated as a national key cultural relic protection unit in May 2006, Jiaxiu Tower serves as a prominent landmark, and it embodies the cultural history of Guiyang (Guiyang Municipal People's Government 2023). Adjacent to the Nanming River, Jiaxiu Plaza derives its name from its connection to the cultural landscape of Jiaxiulou (ECPH Editorial Board 2018). Constructed in October 2001, the plaza consists of two parts: a plaza characterised by national and historical features, and a greenway reflecting the Han cultural and historical characteristics. Renowned as a well-known leisure and historical landscape in the old city, Jiaxiu Plaza embodies both intangible historical and cultural significance, and tangible cultural appearance (ECPH Editorial Board 2018, Guiyang Municipal People's Government 2023).

Figure 1. Historic urban landscape area of Jiaxiulou. Source: Linfeng (December 2023)

Perception assessment

This research designed a questionnaire by modifying and drawing on previous research scales. Questions regarding the residents' CI were formulated to be quantifiable and easily understood. To ensure the reliability and validity of the research content, the CI scale primarily referenced the scale summarised by Fu and Luo (2023), with questions in the questionnaire also drawing from previous related research (Phinney 1992, Pan et al. 2019, Tian et al. 2020, Fu and Luo 2023). In order to make the scale more consistent with the topic of this research, we adjusted the three dimensions in the scale more appropriately. Among them, the cognitive dimension mainly refers to the residents' understanding of the culture of the research site. The emotional dimension mainly refers to the residents' feelings about the cultural aspects of the landscape. The behavioural dimension refers to the residents' cultural behaviours and activities.

The questionnaire content consists of three parts. The first part collects the personal information of the participants. The second part gathers measurement data on the cognitive, behavioural, and emotional aspects of the CI scale. The third part collects other factors influencing CI. A seven-point Likert scale was used for all questions in the second part to ensure the accuracy and reliability of results (Lietz 2010), with response options ranging from 1 (Strongly disagree) to 7 (Strongly agree).

To ensure the reliability and clarity of the questionnaire, experts in cultural landscape and CI, along with a group of local residents (not part of the formal survey population), were consulted to review the questions in the scale and questionnaire. Since the scale was originally designed for tourists, adjustments were made to some questions to make them more relevant for the residents (Table 1). The final questionnaire for this study was formed after these modifications were completed.

Table 1. Measurement scale of CI

Dimension	Question	Keyword
Cognitive dimension	CD 1. I understand the culture of this landscape	Cultural knowledge
	CD 2. I know the value of this cultural landscape	Cultural value
	CD 3. I know the history of this cultural landscape	History
	CD 4. I know the location of important culture	Cultural location
Emotional dimension	ED 1. I am proud of the culture landscape here	Cultural pride
	ED 2. I am deeply attracted by the cultural landscape here	Cultural attraction
	ED 3. I am interested in understanding culture within the landscape	Cultural interest
	ED 4. I expect this place to be protected and developed	Cultural expectation
Behavioural dimension	BD 1. I come here often	Intention to come
	BD 2. I will stay here for a while and enjoy here	Enjoyment
	BD 3. I will participate in cultural activities here	Activity
	BD 4. I will talk to others about the culture here	Conservation

A pilot test was conducted with 80 questionnaires distributed and 77 valid responses collected to ensure the questionnaire's reliability and validity. The results showed a Cronbach's α coefficient exceeding 0.8, indicating good internal consistency. In addition, all factor loading coefficients were greater than 0.8, and the common factor variances exceeded 0.6, demonstrating a good construct validity. Overall, the scale demonstrated satisfactory reliability and validity.

Data collection

This study employed a mixed qualitative and quantitative approach to data collection, recognising its value in accurately elucidating the relationship between people and places (Lewicka 2011). Initially, on-site random sampling was used to distribute the questionnaires to the local residents on December 20 and 22, 2023, in the historic urban landscape of Jiaxiulou. This location was chosen due to the residents' likely cultural identification with the area. A total of 300 questionnaires were distributed, with 275 valid responses received. The participants, predominantly from Guiyang, included 48.8% male and 51.2% female population, with the majority aged between 21-40 (29.45%) and 41-60 years old (29.09%).

To further explore the dimensions of CI, semi-structured interviews were conducted with 12 local residents, including 5 males and 7 females, selected randomly from the questionnaire respondents. The interviews, conducted online from December 24, 2023, to January 2, 2024, aimed to gather data on the relationship between the different dimensions of CI. Each interview lasted between 30 to 60 minutes, and data saturation determined the interview endpoint. Recordings of the interviews were transcribed and analysed alongside the quantitative data to comprehensively examine the relationship among dimensions and the reasons for their formation.

Results

The data collected from the questionnaire was initially processed using SPSS ver. 27. Subsequently, the confirmatory factor analysis was employed to assess the reliability and validity of the three-dimensional model of CI. The relationship and strength between dimensions were then examined through the collinearity analysis, correlation analysis, and path analysis to validate the hypothesis. Finally, the findings regarding the relationship between dimensions were elucidated based on the interview data.

Confirmatory factor analysis

The confirmatory factor analysis (CFA) of the CI model using AMOS 24.0 showed strong correlations between the first order and the second-order factors of the model, as indicated by the standardised loading values exceeding 0.6 (Table 2). The model's fit indices were within acceptable ranges, with a $\chi 2/df$ value of 1.323, NFI of 0.976, AGFI

of 0.941, GFI of 0.961, RMSEA of 0.034, and CFI of 0.994, meeting the model fitting criteria (Hair et al. 2013). The second-order factor composite reliability (CR) for CI in HUL was good, with values all above 0.7, indicating a good reliability (Hoyle 1995). Additionally, the average variances (AVE) were all above 0.5, suggesting a reasonable structure of the second-order model. The reliability of the questionnaire was further confirmed by the Cronbach's α values ranging from 0.898 to 0.905, and the CR values ranging from 0.900 to 0.909, both exceeding the benchmark of 0.70 (Fornell and Larcker 1981), indicating the high reliability of the model dimensions.

Table 2. Measurement of model evaluation results

First-ordered Factor (latent variable)	Measurement items (manifest variables)	Std. Estimate	VIF	Cronbach's α	CR	AVE
Cognitive dimension	CD 1 (Cultural knowledge)	0.860	3.157	0.909	0.909	0.714
	CD 2 (Cultural value)	0.839	2.836			
	CD 3 (History)	0.847	2.986			
	CD 4 (Cultural location)	0.834	2.857			
Emotional dimension	ED 1 (Cultural pride)	0.858	3.364	0.905	0.907	0.709
	ED 2 (Cultural attraction)	0.818	2.790			
	ED 3 (Cultural interest)	0.857	3.398			
	ED 4 (Cultural expectation)	0.834	3.127			
Behavioural dimension	BD 1 (Intention to come)	0.845	3.152	0.898	0.900	0.692
	BD 2 (Enjoyment)	0.797	2.556			
	BD 3 (Activity)	0.828	3.033			
	BD 4 (Conservation)	0.856	3.408			

VIF = variance inflation factor, CR = composite reliability, AVE = average variance extracted

The CI model demonstrated a good convergent validity, with standard estimates and AVE values exceeding the threshold of 0.60. Additionally, all AVE values were above 0.5, indicating a good scale convergent validity (Fornell and Larcker 1981). Discriminant validity was confirmed by comparing the square root of AVE with the correlation coefficients (Table 3), where all square root values of diagonal AVE exceeded the coefficients between other constructs, indicating a good discriminant validity (Fornell and Larcker 1981).

Table 3. Discriminant validity results

	Cognitive	Emotional	Behavioural
Cognitive	0.845		
Emotional	0.662	0.842	
Behavioural	0.674	0.710	0.832

To assess the potential collinearity interference, we conducted the collinearity analysis on the model. A VIF value of 5 or greater typically indicates the presence of collinearity (Bricker and Kerstetter 2000). In our analysis of the model, the VIF values ranged from 2.556 to 3.408, indicating no significant collinearity in the model.

Analysis of CI dimensions

After confirming the structural validity of the CI model, we proceeded to test the relationships between its three dimensions through the correlation analysis and the path coefficient analysis to verify the hypotheses. First, the Pearson correlation coefficients were calculated for the cognitive dimension with the affective dimension, the cognitive dimension with the behavioural dimension, and the affective dimension with the behavioural dimension. The results revealed significant positive correlations among all the three dimensions. The further detailed correlation analysis among the 12 test subjects across the three dimensions also indicated significant positive correlations, reinforcing the strong interrelation between the dimensions of the CI model. Additionally, to elucidate the influence relationships between the dimensions and to validate the research hypotheses, we conducted the path analysis for each dimension. The fit indices demonstrated a well-fitting model, with values of $\chi 2/df < 5$, TLI > 0.9, CFI > 0.9, GFI > 0.9, IFI > 0.9, and NFI > 0.9, meeting the criteria (Hu and Bentler 1999).

The path analysis results (Table 4) indicate that the cognitive dimensions did not significantly influence the emotional dimensions ($z = -0.946$, $p = 0.344 > 0.05$) or behavioural dimensions ($z = -1.937$, $p = 0.053 > 0.05$). In contrast, emotional dimensions significantly influenced cognitive dimensions ($\beta = 0.324$, $p = 0.009 < 0.01$), and behavioural dimensions ($\beta = 0.842$, $p = 0.000 < 0.01$). Similarly, behavioural dimensions significantly influenced cognitive dimensions ($\beta = 0.549$, $p = 0.000 < 0.01$), and emotional dimensions ($\beta = 0.513$, $p = 0.000 < 0.01$). These findings (Figure 2) suggest a strong interplay between emotional and behavioural dimensions, with both significantly influencing cognitive dimensions.

Table 4. Model regression coefficients and hypothesis verification

Hypothesis	X	→	Y	Path Coefficients	SE	z (CR)	p	Decisions
H1	*Cognitive*	→	Emotional	-0.138	0.142	-0.946	0.344	Not valid
H2	*Cognitive*	→	Behavioural	-0.129	0.048	-1.937	0.053	Not valid
H3	*Emotional*	→	Cognitive	0.324**	0.128	2.599	0.009	Valid
H4	*Emotional*	→	Behavioural	0.842**	0.037	16.620	0.000	Valid
H5	*Behavioural*	→	Cognitive	0.549**	0.105	7.243	0.000	Valid
H6	*Behavioural*	→	Emotional	0.513**	0.196	3.537	0.000	Valid

→ The arrow indicates the path influence relationship

** p<0.05, ** p<0.01*

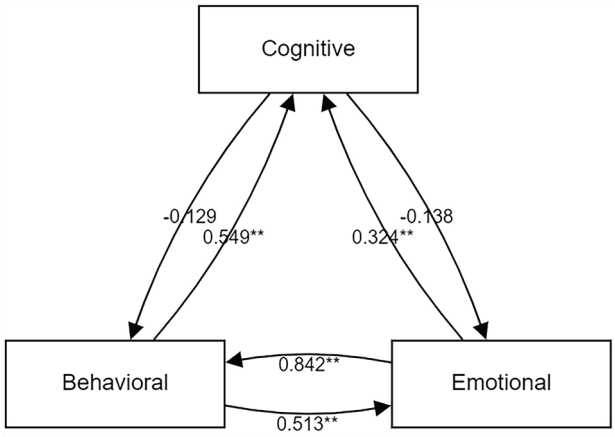

Figure 2. Model results of the path analysis

As the cognitive dimension does not have a significant impact on the emotional and behavioural dimensions, hypotheses 1 and 2 are invalid. However, the hypotheses 3, 4, 5, and 6 are supported, indicating that the emotional dimension and the behavioural dimension exhibit significant mutual influence, and both significantly affect the cognitive dimension. The interview results of this study verified and supplemented the hypothesised outcomes derived from the variables and path analysis within the three dimensions.

Cognitive dimensions

Among the four variables in the cognitive dimension, the average score for cultural value was the highest, indicating that residents generally place greater importance on the cultural value of the HUL in the study. This aspect also predominantly influences the residents' cognitive perceptions of HUL. One interviewee remarked: "I grew up here and I heard from a very young age that the landscape here is famous and valuable, so I really recognise the cultural connotation of the landscape here, and I also consider myself a local who has been influenced by this culture".

Conversely, the variables of history and cultural location have a relatively minor impact on the residents' cognition. For instance, one interviewee stated: "I know that the landscape here has a lot of history, but I only understand the history of it from others, and I am not particularly clear about the specific places with a lot of culture and history, but these do not affect my feeling that this place is very valuable, and I have always identified myself with and I was attached to it".

In terms of the interaction of dimensions, the interview results support hypothesis 1 and 2, as respondents expressed deep emotional connections to the HUL and they frequently engage in activities there, irrespective of their understanding of its history

and culture. Some interviewees, born and raised in the area, simply acknowledge its status as a city landmark with significant value. Their lack of detailed knowledge about the history and specific cultural aspects of the HUL does not diminish their emotional attachment or their tendency to participate in activities there.

These findings from the interviews align with the results of the path analysis, reinforcing that the cognitive dimension of CI does not significantly impact the emotional and behavioural dimensions. However, the interview results also revealed views that were not entirely consistent with the hypothesised outcomes. Some respondents believed that personal cognition, shaped by culture and education, can also influence behaviour to some extent. For instance, one interviewee, influenced by the Confucian cultural education from a young age, believed that children should live as close to their parents as possible, to care for them, and to be ready to respond to their needs. Although she recognised that leaving might lead to better career opportunities, her cognition led her to choose to stay.

This shows that while the overall trend in the survey data and most of the interview data confirmed the hypotheses, some individual interviews expressed differing opinions. This adds significant value to understanding CI more deeply, both from a collective and an individual perspective.

Emotional dimension

Cultural pride emerged as the dominant sentiment among the residents, reflecting the highest score in the emotional dimension. Respondents expressed a strong sense of pride in living near such a renowned HUL. One interviewee remarked: “Sometimes when I talk to people from the county and I mention that I have lived next to Jiaxiu Tower since childhood, it makes me feel very proud”. Another interviewee echoed this sentiment, stating: “This is Guiyang city's best business card, and since I grew up here, I am proud of this place”.

However, the results also indicated relatively low expectations among the residents for the HUL. Respondents expressed satisfaction with the current state of the HUL, indicating a lack of strong expectations for its future. One interviewee commented: “I think the architecture and landscape here are very beautiful, and the ecological environment is also very good. The government has restored the place very well, so there is not much more to expect”. Another respondent noted: “We hope it will be well protected, but we don't particularly expect it, because it's all the government's responsibility, not ours”. These findings suggest that the residents' satisfaction with the current condition of the HUL and their perception of the government's role in its protection contribute to their low expectations for the site.

Clearly, the emotional dimension has a significant impact on both the cognitive and behavioural dimensions of residents' CI with the HUL. Specifically, the residents'

emotional connection to the HUL, particularly their pride in the culture, influences their understanding of the site's knowledge and history. This supports the validity of hypothesis 3. In the interview results, respondents of different ages and backgrounds expressed how emotions affected their cognition. For example, an older respondent said: "I am a local, and every time I mention it, I feel proud. When I was younger, I didn't understand much about this place's cultural significance, but now I'm very interested in learning about the history of its construction and the cultural meaning behind each element". A younger respondent expressed that due to their sense of pride, they particularly hope to pursue work and careers that resonate with the culture of this place. Additionally, most respondents indicated that the deep emotional connection and place attachment they have with the HUL and their community helped them to appreciate and to embrace the local culture.

The interview results also confirmed the validity of hypothesis 4, showing that emotions strongly influence the residents' behaviour. For long-term residents, especially the elderly, behaviours such as walking, socialising, and relaxing near the Jiaxiu Tower in their spare time are attributed to the deep emotional connection and attachment that they have developed over time. One respondent shared: "Although I am getting older and my health isn't great, I have a strong emotional bond with this place. It's where I feel most familiar, and I come here almost every day to rest and to chat with the people I know". Moreover, most resident respondents mentioned that their pride in and interest in the site's culture motivate them to participate in the cultural activities held there. For instance, one respondent expressed that their deep emotion for HUL makes them very eager to participate in cultural events and that they hope their children will also join and learn about the culture that makes them proud. Some respondents also noted that this emotional connection influences their choice of workplace and career, with some residents being keen to stay in the area and to contribute to HUL-related initiatives. Thus, it is evident that the emotional dimension of the residents' CI with the HUL is closely linked to place attachment, and it significantly influences both cognitive and behavioural dimensions.

Behavioural dimension

In the behavioural dimension, the residents' conversation behaviour regarding the culture of the HUL received the highest average score, indicating that conversation is the predominant behaviour related to the HUL and a key expression of CI. This finding was supported by the interview results, with most interviewees expressing a propensity to discuss the place with others due to their strong identification with it. They exhibit a keen interest in elaborating on various aspects of the place during such discussions.

Conversely, the average score for participating in activities was relatively low. According to the interviews, this is primarily attributed to two factors. Firstly, many residents have limited spare time to engage in cultural activities, particularly those

who are employed and that have not yet retired. They often cite busyness as a reason for their inability to participate. Secondly, many activities are tailored to specific demographics, limiting the universal appeal. For instance, activities such as tai chi and choral singing in the mornings are primarily attended by the elderly residents; while painting and calligraphy classes cater exclusively to children and parents.

Regarding the interaction of the dimensions, the interview results confirmed hypothesis 5, showing that the residents' behaviour dimension significantly influences their cognitive dimension. The interviews also revealed that while respondents reached similar conclusions, the reasons varied across different groups. Older residents who have lived in the area for a long time have developed attachment and familiarity with the local culture and lifestyle through their daily activities. This place attachment extends to how they describe their friends and family. For example, one interviewee stated: “I often go there to walk and exercise. I've gotten to know others who go there regularly, and I often chat with them. So, this is my usual way of life. I've always been fully immersed in this culture, and I feel like a true local. It's not just me living here; my family and friends are here too”. But, younger or newly relocated respondents indicated that because they hadn't formed strong social circles yet, their daily behaviours made it challenging to integrate into the local culture. For them, activities like participating in community events helped them gradually enhance their understanding of the area.

The interview results also confirmed hypothesis 6, showing that behaviour can significantly influence emotions. Regardless of how long they had lived there, most respondents felt that long-term activities and behaviours in the area not only brought them happiness and emotional attachment but also helped them to alleviate the negative emotions and to boost cultural pride. For instance, one interviewee mentioned: “Regularly visiting places for rest and relaxation really helps with my emotional adjustment. The positive emotions I get from walking and resting here every day make me gradually become attached to it". Furthermore, most respondents believed that local activities could increase their sense of attraction and pride.

However, the residents from different backgrounds expressed varying impacts of behaviour on their emotions. Those who had lived there since childhood emphasised the importance of daily gatherings and conversations with lifelong friends in enhancing feelings of anticipation and happiness. Conversely, some newly relocated residents or those less inclined to participate in social activities mentioned that certain activities and behaviours of others led to negative emotional experiences. For example, events that were too commercialised or lacked diversity made them feel disappointed and angry. This was especially true for newer residents, who, due to these negative feelings, might be less likely to participate in community activities and interactions. Thus, both individual and collective behaviours have a diverse and rich impact on the cognitive and emotional dimensions of the residents.

Other factors influencing CI

Through the open-ended questions in the questionnaire's final section, this study gathered information on additional factors affecting CI as perceived by the interviewees. Given the diverse responses, we categorised them into 10 groups and we conducted the proportional analysis. These categories included cultural sites, beliefs, personal experiences, environment, social networks, lifestyle, spatial patterns, familiarity, visual beauty, and others. The varying proportions highlighted the different impacts that these aspects have on CI formation. Notably, spatial patterns had the highest proportion at 81.09%, emphasising the significant influence of the urban layout on CI. Beliefs accounted for 65.82%, social networks for 59.27%, and familiarity for 55.27%. These findings offer valuable insights for a comprehensive understanding of CI construction.

Discussion

Dimensions of CI

Through the confirmatory factor analysis and the reliability analysis, we thoroughly validated the CI model's rationality and reliability. The fitting index further confirmed the model's good adaptability and fit. Collinearity analysis results indicated the overall model's high reliability, demonstrating that the model's three dimensions were suitable for measuring and analysing the residents' CI of the HUL. The correlation analysis revealed a significant correlation between the model's dimensions. The path analysis confirmed that the emotional and behavioural dimensions significantly influence each other as well as the cognitive dimension.

While the cognition of HUL cannot directly influence the residents' emotions and behaviours, this study provides additional insights into the relationship between the cognitive dimension of CI and its emotional and behavioural dimensions. These findings underscore the multidimensional complexity of CI.

The results indicated that cultural value predominantly influences the residents' CI at the cognitive level, affirming the notion that CI is fundamentally a form of value identity (Zuo and Wen 2017). Although most residents' cognition did not significantly influence their emotions and behaviour, some individuals' choices, such as where to live and how to live, were affected by the knowledge that they gained through education. This suggests that each resident's cognition and how it is formed deserve attention, as this can lead to a deeper understanding of the processes and reasons behind how different residents develop CI.

Within the emotional dimension, residents' pride in their culture emerges as a significant emotional experience, reflecting their affirmation and affection for the local HUL cultural

values. This pride serves as the foundation for cultural evaluation (Wang 2011). Moreover, the positive emotions that HUL brings to the residents not only foster emotional attachment but also influence their cognition and behaviour. Feelings of pride and anticipation increase the residents' willingness to understand and to engage with the local culture. A strong emotional attachment can lead the residents to engage more frequently in activities like socialising and participating in events, and it can even impact their career choices. Therefore, gaining a deep understanding of the emotional dimension of the residents' CI is a crucial prerequisite for understanding their motivations and behaviour.

Notably, conversation behaviour emerges as the primary expression of the residents' cultural identification with HUL, representing they're most willing and with an effortless behaviour post-identification. Through behavioural engagement, the residents develop cognitive and emotional ties to the HUL's culture, with conversation behaviour continually reinforcing pride and value identification in the HUL. This process plays a pivotal role in shaping CI. Additionally, various behaviours, both from oneself and others, can have different effects on the residents. Themed activities can influence the residents' perception and understanding of a place, while unpleasant behaviours may even lead to negative emotions. This helps in understanding the emotional and cognitive shifts behind the residents' behaviour within the HUL.

Conservation and the sustainable development of HUL according to the dimensions of CI

Based on the findings regarding the three dimensions of CI, this study delves into the conservation and sustainable development of the HUL.

The cognitive dimension involves the residents' understanding of the city's HUL. The study reveals that the residents prioritise the actual value of the HUL. Deep understanding of the historical and cultural background leads the residents to recognise the value and cultural significance of these landscapes. This awareness fosters a CI with the HUL, instilling a sense of responsibility for its conservation. Therefore, decision-makers should emphasise the local values in urban planning and design, integrating the cultural and heritage values of landscapes (UNESCO 2011). Additionally, it's important to pay attention to the varying levels of cognition among different residents and to provide them with more tailored cultural education and outreach to enhance their cultural awareness and identity.

Secondly, the emotional dimension involves the residents' emotional experiences with the HUL. Emotional connections with the HUL often lead the residents to support and to participate in its preservation and inheritance, thus fostering a more participatory community in sustainable development. The study found that strong pride positively influences CI, whereas the residents' low sense of expectation poses a potential threat.

This is attributed to a general lack of public participation, as the residents have become accustomed to the government unilaterally deciding on preservation and development. Therefore, policymakers can enhance the residents' sense of responsibility and expectation through conservation practices for HUL that encourage public involvement. This inclusive approach, involving all stakeholders, helps identify the true value of the HUL and to develop diverse visions and coherent actions for conservation and sustainable development (UNESCO 2011).

Finally, the behavioural dimension indicates that conversation behaviour is a primary form of CI expression. When individuals identify culturally with the HUL, they are more likely to engage in practical actions, such as advocating for the HUL and actively participating in protection activities. However, besides conversation behaviour, active participation in cultural activities is limited. This limitation stems from the lack of cultural activities for all age groups and busy work schedules. Therefore, decision-makers should consider expanding and promoting cultural activities across various time periods and age groups. Spatial planning and design should provide the residents with spaces for interaction and social engagement, enhancing the diversity and accessibility of cultural activities. This approach better meets the residents' cultural needs, it promotes their CI, and it supports the conservation and sustainable development of the HUL.

The comprehensive impact of other factors on CI

Among the various factors influencing CI, the spatial pattern, belief, social network, and others were found to have a significant impact. The high proportion attributed to the spatial pattern highlights its substantial influence on CI, affirming urban planning as a crucial tool for preserving the authenticity of the HUL and for enhancing the quality of life and space (UNESCO 2011). Contemporary planning and design should prioritise HUL's public spaces to foster the residents' CI.

Additionally, the high proportions for belief, social network, and other factors indicate that CI is influenced at both individual and societal levels, suggesting that changes in individuals and society contribute to the dynamic nature of CI. It can be seen that CI is the result of interaction of many factors. Therefore, it is necessary for future research to continue to explore the complex relationship between these factors from different dimensions, and given the diversity of the influencing factors, interdisciplinary research is necessary.

However, the study has some limitations. Firstly, it focused on a single representative HUL in one city without comparing the commonalities and differences with other sites. Future research could conduct comparative studies across different cultures and regions to further explore similarities and differences. Secondly, in addition to the three-dimensional model of CI verified in this study, CI is also affected by many other factors at multiple levels. Therefore, future research should explore other influencing factors

and dimensions of CI to more comprehensively understand its formation mechanism and to provide more targeted guidance for urban planning decisions.

Conclusions

The study results affirm the pivotal role and the intricate interrelationships among the three dimensions of residents' CI within the HUL. These findings unveil both primary and ancillary influencing factors. They hold significant implications for the conservation and sustainable development of the HUL.

Urban policies should prioritise the protection and development of the HUL to prevent and to mitigate potential threats to the CI of the local residents. At the same time, an in-depth understanding of CI is essential for making informed planning and to design decisions. Recommendations are proposed across three dimensions: cognition, emotion, and behaviour. In terms of residents' cognition, the government should integrate local values into urban planning and enhance the residents' cultural awareness. Emotionally, city managers can enhance the residents' pride by highlighting historical values and to promote the residents' sense of community and responsibility through public participation. To encourage positive behaviour, urban planners can organise cultural activities and they can provide spaces for social interaction, thereby enhancing the residents' CI while promoting their active participation in the HUL conservation and sustainable development practices.

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ROMA GHETTOIZED URBAN STRUCTURES: A BIBLIOMETRIC ANALYSIS

Nadezhda Ilieva, Desislava Varadzhakova

Bulgarian Academy of Sciences, Sofia, Bulgaria

Abstract: Roma is the largest minority in Europe and the problems considering its segregation have to be investigated. The main goal of the present paper is to realise a bibliometric analysis which is going to find: the primary authors who investigated the topic of Roma segregation and the ghettoized urban structures; their publishing interactions based on factors such as their affiliation with the research organisation, and their country; and the most cited publications. The bibliometric analysis is based on the Scopus database. 265 selected documents, published between January 1999 and December 2023, were analysed. The papers of researchers from the United Kingdom, Hungary and Romania are the most cited. The co-occurrence analysis showed that, logically, the word "Roma" is the keyword with the greatest total link strength. The study also gives an insight into the collaboration between the main researchers, scientific organisations, and countries..

Keywords:

ghetto;
slum;
social segregation;
ethnic minority;
Roma population

Email: dvaradzhakova@gmail.com

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Introduction

Roma is considered to be the largest ethnic minority in Europe with a population of about 10-12 million people, of which 6 million reside in EU countries (European Commission 2020). Four Roma communities can be identified depending on their place of residence, in relation to cities and their sedentariness: (1) Roma communities living concentrated in disadvantaged areas in large cities, in some cases close to other underprivileged ethnic minorities; (2) Roma communities living in disadvantaged parts of small towns or villages, isolated from large urban centres; (3) mobile Roma communities with citizenship of the country in which they are located or of another EU country; (4) Roma communities who are third-country nationals, refugees, stateless persons or asylum seekers (European Commission 2020).

The specific thing about the Roma is that they take part of the customs, culture, language and religion of the ethnic group in whose territory they live, but they always preserve their identity, cultural practices and, above all, a value system that is characteristic of the Indian subcontinent and quite foreign to the European one (Ilieva and Bardarov 2020). Regardless of which country they live in, regardless of its economic development and form of government, the problems with the Roma are the same. This enables, through some adaptation, the successful integration models in one country to be applied in the others.

The Roma live scattered among the rest of the population and they do not form territories with a high density of displacement. Each specific Roma group is economically connected to its foreign ethnic environment, and the contacts between individual Roma groups are often completely absent (Marušiakova and Popov 2000). One of the reasons why Roma live all over the territory is the specific nature of their professions and trades, through which they make a living, but which do not provide an opportunity to feed large groups of Roma, forcing them to divide into relatively small units.

One of the main challenges facing modern cities is related to increasing inequalities in the society and the socio-spatial polarisation, which is directly related to integration processes. Studying the socio-economic integration of Roma is essential to overcoming segregation (Ilieva et al. 2019), including school segregation that is a serious social and educational problem in many European countries (Ravnachka et al. 2020). Much of the recent scientific research in the field of geo-urbanism has focused on the transformations in the urban space and the related social, cultural, and economic problems.

The main goal of the present paper is to realise a bibliometric analysis to find: the primary authors who contributed to the topic of Roma segregation and who analysed the ghettoized urban structures; their interactions between authors, based on factors such as their affiliation with the research organisation and country; and the most cited publications.

At the beginning, in the literature review, the main terms are clarified, based on which the keywords for the bibliometric analysis were defined. The methods applied for this study include: the classical bibliometric analysis, including the citation analysis by authors, documents, countries, and organisations; the co-citation analysis by cited authors; the bibliographic coupling by documents, sources and countries; the co-authorship analysis made by authors, and by countries; and the co-occurrence analysis. The results of these analyses are presented using science mapping tools. A distribution analysis is also conducted, considering the publications' year, type, and topic areas. These analyses will support the future research on Roma ghettoized urban structures while evidencing the most relevant literature to investigate for future research gaps.

Literature Review

Immigration flows and social inequalities reflect the growing social and multi-ethnic segregation in contemporary urban Europe. Ilieva (2019) clarified the essence of the factors that influence the processes of spatial segregation. It mainly reviewed European and American scientific literature, and it examined various theories, concepts and perspectives related to the factors influencing the formation of different patterns of spatial segregation (Ilieva 2019). These factors can be divided into two groups: internal (voluntary) and external factors. The first group includes ethno-cultural and demographic factors, and the second one: political and institutional, socio-economic and discriminatory factors (Ilieva 2019). Only empirical research can further answer the question of the causes of spatial segregation.

The post-socialist transformation in Central and Eastern Europe has been accompanied by an increase in social inequalities. These processes reflect an increase in spatial disparities, especially in those territories that are inhabited by marginalised groups, and more precisely by the Roma population. In recent years, this process has intensified, which is inconsistent with the policies aimed at overcoming spatial segregation. The formation and development of segregated spaces are also the result of neoliberal economic restructuring and of the withdrawal of the "social" state from the beginning of the 1990s. For a long period of time, publications related to ethnicity have been outside the scope of scientific research in former socialist countries. All this explains the increase in publications aimed at this problem in the recent decades, especially in countries with a high absolute and relative share of the Roma population.

Ladányi (2016: 1104) found: "in the countries where serious attempts have been made to establish Eastern European versions of the neo-liberal state, it is justified to speak of the underclass, ethnic ghettos and hyper ghettos – even if in several respects they differ from what we can see in the United States". It should be noted that cities in former socialist countries are characterised by a lower degree of spatial segregation compared to other European countries. This is explained by the policy during the socialist period

based on an apparent social equality, weak income differentiation and housing policy. In the publications of Sýkora (1996, 2009), Matoušek and Sýkora (2011), Marcińczak (2007), Musterd et al. (2017), and others, it is stated that the different forms of spatial segregation are related to the territorial concentration, above all, of the Roma ethnic group, and the level of this segregation has been increasing in recent decades.

The researchers who study the housing conditions of the Roma communities after the political transformation of the countries in Central and Eastern Europe in the early 1990s focus their attention mainly on two dimensions of the growing levels of social exclusion of the Roma: the economic dimension (worsening of socio-economic status); and the spatial dimension (increasing levels of spatial segregation). Publications touch on various issues but the main part of them is related to the formed ghettoized structures and their living conditions. These publications address the main characteristics and driving forces of segregation associated with the post-communist urban development, and a number of them propose measures to improve the living conditions aimed at integrating their inhabitants into the urban space – for Romania (Tátrai 2011, Berescu 2013, Vincze 2013, Mionel and Gavriș 2015, Hognogi et al. 2021, Lancione 2022); Slovakia (Scheffel 2008, Filčák and Stager 2014, Rochovská and Rusnáková 2018, Sika et al. 2020, Filčák and Škobla 2021); Serbia (Šabić et al. 2013, Grbic 2014, Vuksanović-Macura 2020); Croatia (Šlezak 2009, Šlezak 2023); Hungary (Váradi and Virág 2015, Siptár et al. 2016, Dunajeva and Ciaschi 2017, Keresztély et al. 2017, Tóth et al. 2017, Balogh et al. 2018, Virág and Váradi 2018); Slovenia (Komac 2015, Zupančič 2018); Czechia and Slovakia (Sýkora 2009, Růžička 2011, Ruzicka 2012, Stejskalová 2013). Special attention is also paid to some consequences related to the spatial segregation of the Roma population, such as the risk of intergenerational poverty transfer in ghettoized structures (Džambazovič 2007).

Since the beginning of the new millennium, intense immigration processes of the Roma have been observed in the countries of Western Europe. Settling in these countries, the Roma most often try to preserve their social networks in order to be able to adapt more easily to the foreign ethnic environment and in this connection preserves their territorial identity. The Roma migration in a number of countries in Western Europe and the problems that arise with the spatial isolation of the Roma in their living environment were reflected in a number of publications. They found the greatest response in France (Bessone et al. 2014, Potot 2016, Chaudhuri 2017, Manson 2017, Bourgois 2021), Italy (Baldoni 2012, Clough Marinaro 2015, Kakouch 2016, Manzoni 2017, Maestri 2019, Vergnano 2020), Spain (Lago Ávila 2018), and Greece (Maloutas et al. 2024).

In the scientific literature, it is difficult to find a clear and generally accepted definition of what constitutes spatial segregation. In most cases, the terms "spatial segregation", "socio-spatial segregation", "residential segregation", "segregation", "ethnic (residential) segregation", and "social segregation" are often mixed, sometimes used

synonymously, and sometimes with different meanings without being precisely defined. According to Huttman et al. (1991), spatial segregation refers to the physical separation of population groups within a certain area, but most often the term is applied only in cases where the ethnic groups that occupy a given territory are disadvantaged (Brun and Rhein 1994).

Closely related to the theories of spatial segregation is the formation of territorial entities of different character – ghettos, ethnic enclaves, ghettoized urban structures, slums (UN-HABITAT 2003), which are named differently in different parts of the world ("favelas" in Latin America; "kampungs" in Southeast Asia; "shanty towns" in Africa; and "jhuggi-jhopri" or "bustees" in South Asia). The forms of segregation can be observed on a different spatial scale depending on the research objectives – between cities and their surroundings; between individual neighbourhoods within the city; between residential blocks in a given neighbourhood; and even on a vertical scale (between individual floors in a block). But, despite the great interest in the subject by researchers from various fields of science, there is still a lack of a clear definition of what a poor neighbourhood, slum, ghetto, etc. is.

The term "slum" was originally defined as "racket" or "criminal trade" in the convicts of Vaux's (1812) book "Vocabulary of the Flash Language" (Prunty 1999). At that time, the general opinion was that all slums were a mixture of dilapidated housing, overcrowding, poverty and vice (Wright 2019). According to UN-HABITAT (2003), a group of people sharing a roof but not meeting one or more of the following criteria is referred to as a slum household: availability of enhanced water; availability of good sanitary facilities; a sufficient living space that is not crammed; durability and structural quality of homes; the stability of employment.

According to Slater (2009), the term ghetto is one of the misunderstood terms that is often misused in the social sciences. He defines it as an extreme and rare urban form associated with the involuntary spatial limitation of a group based on ethno-social characteristics (Slater 2009). The study distinguished the ghetto from other forms of urban marginality by associating it with discrimination and the overall spatial exclusion of a particular ethnic group (Slater 2009). It also defined it as a unique form of social organisation in which parallel institutions are formed (Slater 2009). The author noted that ghettoized structures in several cities in Europe and North America were incorrectly identified as being ghettos, firstly because they were not the result of enforced spatial containment and control, and, secondly, because they have not developed their own parallel institutions (Slater 2009).

In the countries of Central and Eastern Europe, the term ghetto is often associated with the Roma population. Mionel and Gavriș (2015) associate this term with the spatial concentration and ethnic homogeneity of the Roma population in a given territory, so the term ghetto, compared to slums, has predominantly ethnic and/or racial

connotations (Mionel and Gavriș 2015). The residents of these areas are somehow forced to live in such spaces mainly due to lack of income, low level of education, and lack of professional qualifications, while these disadvantages exclude the individuals from social participation and access to urban areas with good housing (Mionel and Gavriș 2015).

Asenov (2018) introduced the concept of ghettoized urban structures by making the following comments: as the vocabulary itself suggests, ghettoized means similar to, bearing some of the hallmarks of the ghetto, without being a ghetto, but still in the making that may never materialise; urban because it is about urban ethnic topographies. The term structure refers to a system, organisation, and any entity composed of several components, including the relationships between them as observed in the scientific research (Asenov 2018). Structure can be an abstraction, such as the social structure, or it can be tangible, such as buildings constructed from architectural or construction materials or particles (Asenov 2018). This concept is used in all attempts to understand the scientific phenomena and theories in the humanities, social and natural sciences.

According to Asenov (2018), the "ghettoized urban structure" is a distinct ghettoized settlement – a section of an urban area (a district, micro-district or neighbourhood) – usually with fixed boundaries, and characterised by: (a) underdeveloped or absent street, buildings, electricity, social infrastructure, etc.; (b) a group of people who are predominantly segregated along social, cultural, racial, or ethnic lines; (c) pre-modern social norms frequently govern relationships inside the settlement; (d) the existence of a distinct subculture. Asenov (2019) pointed out also that the formation of ghettoized urban structures is a process whose genesis is still not sufficiently well studied.

According to Ilieva (2019), the ghettoized urban structure is created because of the needs of its residents to occupy a given space. Although it may be formed initially as a result of a certain decision of the local authorities and not of the natural desire of the community, in the future it is established and developed as an independent spatial unit (Ilieva 2019). Ghettoized urban structures form a homogeneous area with a certain stereotype of behaviour of its inhabitants, who are largely similar in terms of their social status and financial potential. The division of land in many cases is based on internal inter-family agreements, although the buildings are built on municipal and not on their private property, so on this basis, conflicts often arise (Ilieva 2019).

Characteristic of ghettoized urban structure is the formation of a specific attitude towards the city – their residents use it, but "refuse" to live in it; they do not feel part of it; there is a lack of communication with the urban population. For this reason, the relations between its inhabitants are strengthened, deepened, and they become closer. An independent structure emerges, becoming more distant and less dependent on the state, and the internal rules and "laws" become stronger. It can be argued that a "city

within a city" is forming, becoming increasingly autonomous, and duplicating the institutional structure of the state. Wacquant and Wilson (1989) refer to these structures as hyper ghettos, adding that the hyperghetto life is the life outside the mainstream society. Málovics et al. (2019b) established how the Roma's personal attachment to place functions as a basis for their daily activities in the ghetto and its surroundings, and how the Roma living in segregated urban areas relate to the places and communities in which they live.

There are new patterns of socio-spatial polarisation based increasingly on income inequality and ethnicity. Social inequalities, as well as long-term ethnic interactions, sooner or later affect the structure of the space. In the planning of measures and policies to reduce poverty, social capital is essential to strengthen social mobility and to overcome spatial segregation among the Roma (Méreiné Berki et al. 2017). But only this is not enough for desegregation. Méreiné-Berki et al. (2021) also discussed the role of social mixing in this process as an option. However, one of the main problems remains the stigmatisation of the urban Roma population, which has deep historical roots, and it makes desegregation efforts to represent a serious challenge (Creţan et al. 2020). So, desegregation has become an important part of the local development policy agenda. In this sense, Silver and Danielowski (2019) examined the impact of creating mixed neighbourhoods in social housing on reducing spatial segregation in Europe. Creţan et al. (2020: 294) explained the failure of these policies with the processes of stigmatisation that are deeply rooted in the past, "as stigmatisation remains in the collective mentality".

Quality education and access to it is considered one of the ways to eliminate widespread discrimination and poverty among the Roma, which is reflected in the deteriorated living and housing conditions, limited access to health services, and high unemployment (Chinole 2007). One of the main problems in the education system is related to the deteriorated academic results of Roma students and the segregated Roma schools in a number of countries (Márquez and Padua 2016). Through the tools of scientific knowledge, attempts are made to discover the relationship between spatial segregation and school achievements (Papp and Neumann 2021), and the degree of family involvement (Merchán-Ríos et al. 2023), to highlight the difficulties that arise with the education of travelling Roma and to give suggestions for overcoming them according to the lifestyle and culture of the Roma population (Lecomte 2020).

Various documents and policies are being developed for the desegregation of the Roma in Europe, such as the Framework Convention for the Protection of National Minorities (Council of Europe) and the Racial Equality Directive 2000/43/EC (Van den Bogaert 2018). In the scientific literature, the available policies are examined by making comparative analyses (for example, between Czechia, Hungary and Slovakia – Messing 2017), and more often the focus is placed on this topic in specific countries, such as Finland (Stenroos and Helakorpi 2021); Republic of North Macedonia (Ananiev 2019);

Czechia (Cashman 2017, Merhaut et al. 2022, Cada and Gheorghiev 2023); Spain (Draoui et al. 2019); Poland (Grzymała-Moszczyńska et al. 2019); Slovenia (Klun and Bartol 2021); Romania (Toma 2023); Albania (Lame 2014); Italy (Barberis and Violante 2017); and Hungary (Neumann 2017).

Methodology

For the purposes of this paper, the bibliometric analysis was used (Figure 1). Its application required a large database of scientific publications. Two of the richest databases of scientific literature in the world are Scopus and Web of Science. A number of studies based on bibliometric analysis use the first or the second database. According to Durán Sánchez et al. (2017), it cannot be determined which one of the two is more suitable for this type of analysis or it has advantages over the other. Most of the quality scientific journals are indexed in both databases and to avoid the duplication of results, the present study was based on only one of them, namely Scopus. It has been selected as one of the world's main databases, in which leading articles are published in 4 broad subject areas: Physical sciences, Health sciences, Social Sciences, and Life Sciences.

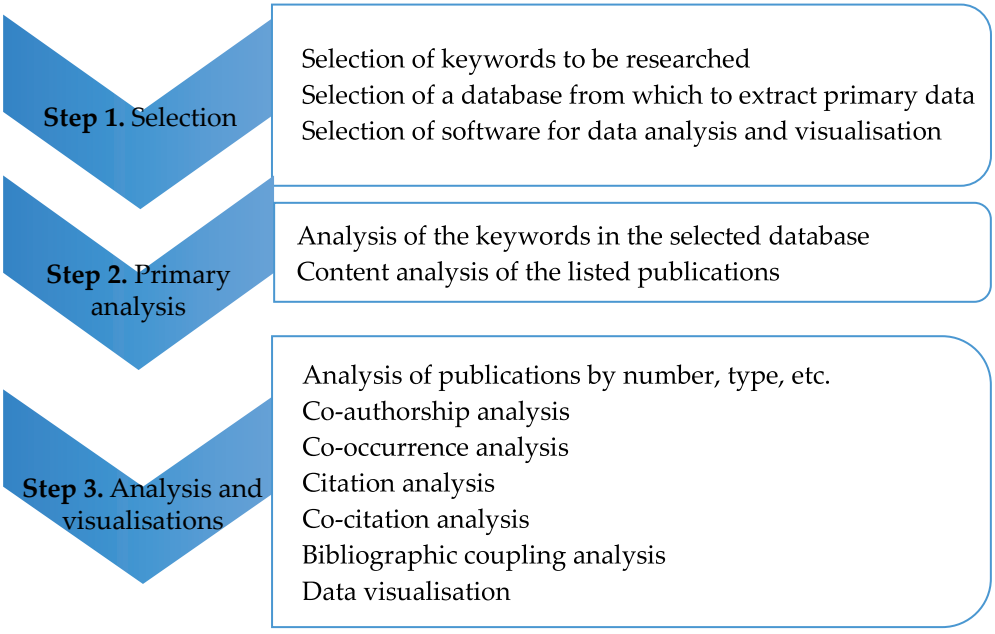

Figure 1. Flow Chart of Methodology Stages

The chosen keywords to search papers in Scopus were "Roma" and "ghetto", "slum" or "segregation". The presence of the word "Roma" was obligatory, which is why the conjunction "and" was used. As different terms are used for the distinct areas inhabited by the Roma population, the conjunction "or" was used for the terms: "ghetto", "slum"

and "segregation". According to these constraints, 298 documents came out in Scopus. Of these, 265 documents were selected after the manual content analysis was made.

The bibliometric analysis included the analysis of publications by years, authors, subject area, type of publication, source title, co-authorship (by authors and by countries), co-occurrence, citations (by authors, documents, countries, and organisations), co-citation (by cited authors), and the bibliographic coupling (by documents, sources, and countries). For the visualisation of the results, the so-called science mapping was applied, using the VOSviewer software (van Eck and Waltman 2023). It offers two main types of visualisations: density visualisation, and network visualisation (and we used this last one).

Results

Analysis of the publications by years, subject area and country

The 265 selected documents that were listed in Scopus were published between 1999 and the end of 2023. Until 2005, there were only single publications on the subject. An increase in interest in the topic of Roma ghettos is noticeable after 2007. Two peaks in the number of publications stand out, namely in 2018 (31 papers) and 2021 (30 papers). The highest number of publications (5) is marked by the authors: Babinská (Jarcuska et al. 2013), Creţan et al. (2020), Halánová (Madarasová Gecková et al. 2014), and Maestri (2017). All their articles are published in 2013 or later, in different subject areas.

Of the 265 papers, 226 are in social sciences (86% of the papers). In second place is the subject area "Arts and Humanities", with only 53 papers. In third place are "Environmental sciences" with 25 papers, followed by "Earth and Planetary Sciences" (24 papers), and "Medicine" (20 papers). The next subject areas have fewer documents indexed in them. The total number of papers by subject area exceeds the total number of analysed documents because some journals where the articles were published are indexed in several subject areas.

The spatial analysis of the papers shows that most of them are realised by European authors (Figure 2). Most documents in Scopus regarding Roma segregations are from Hungary (42 papers) and the United Kingdom (30 papers), with 30 and more papers. In the next group, with 20-29 documents, are Slovakia, Italy, Romania, and Czechia. The United States, Spain and the Netherlands have between 10 and 19 documents, while less than 10 papers have Serbia, France, Canada, Croatia, Portugal, Germany, Bulgaria, Greece and Slovenia.

According to the type of publications, the largest number of publications is of articles (210), followed by book chapters (36), reviews (13), books (4), and conference papers (2). The largest number of Scopus publications on Roma segregation is in the

International Journal of Environmental Research and Public Health (8 papers). Also, there are 5 journals (source titles) where 5 documents by the topic are published: Ethnic and Racial Studies; Geographica Pannonica; Intersections. East European Journal of Society and Politics; Journal of Ethnic and Migration Studies; and Szociologiai Szemle.

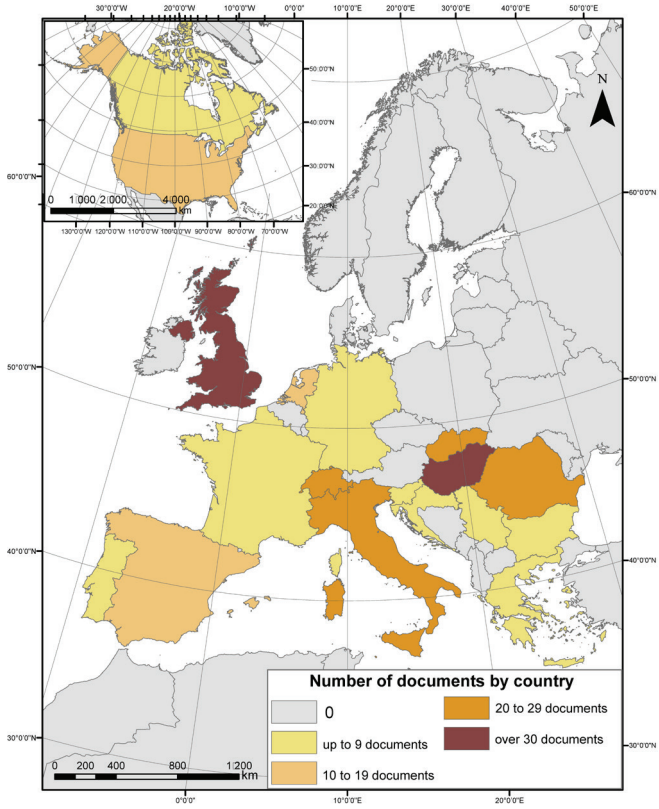

Figure 2. Analysis by type of publications and source title

Citation Analysis

The citation analysis realised in VOSviewer was made by authors, documents, countries, and organisations. For the analysis by authors, we selected the minimum number of documents of an author to be 2. Of the 251 authors, 11 met this requirement. The most cited authors on the selected documents regarding Roma segregation and ghettos were O'Nions (2010), Maestri (2017), and Belak et al. (2018). O'Nions had 79 citations on 2 papers matching the search done in Scopus; Maestri had 48 citations on 4 papers; and Belak had 41 citations on 2 papers. The citation analysis by documents was made with the limitation of the minimum number of citations by document to be 5. Of the selected 265 items, 117 met the threshold. The most cited document (135 citations) was the one of Sigona (2005). On the second place (105 citations), it was the

one by Arbaci and Malheiros (2010); and on the third place (86 citations), it was the paper of Sýkora (2009) (Figure 3).

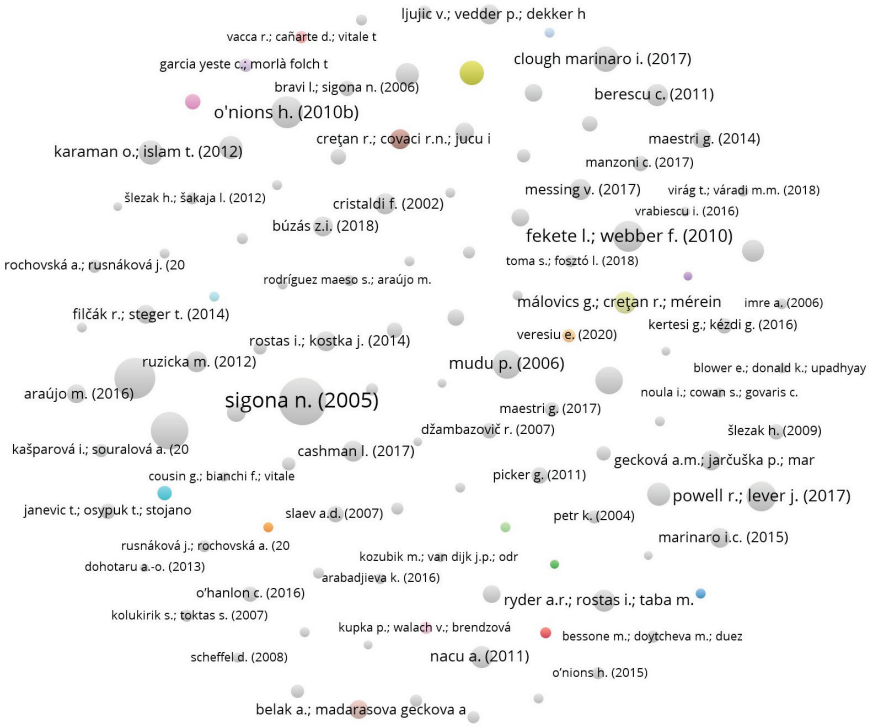

Figure 3. The most cited documents related to Roma segregation

The citation analysis by countries was realised with the requirement of minimum 5 documents per country. Of 40 countries, only 18 met this threshold. The first 6 countries were: United Kingdom (725 citations of 30 documents); Hungary (313 citations of 42 documents); Romania (274 citations of 24 documents); Czechia (264 citations of 22 documents); and Italy and Slovakia, with very similar results: Italy – 218 citations of 26 documents, and Slovakia – 217 citations of 26 documents.

The citation analysis by organisations was made with the limitation of a minimum of 2 documents per organisation. Only 8 of 401 organisations met the threshold. The most cited organisations were the Department of General Anthropology, Faculty of Humanities, Charles University, Prague (Czechia); and Olomouc Society and Health University Institute, Palacky University Olomouc (Czechia), with 41 citations of 2 documents each, followed by the Health Psychology Unit, Faculty of Medicine, Pavol Jozef Šafárik University in Košice (Slovakia), with 40 citations of 2 documents, and the Central European University, Budapest (Hungary), with 30 citations of 5 documents.

Co-citation analysis

The co-citation analysis was made by cited authors. The minimum number of citations of an author was selected to be 20. In the selected papers, there were 9206 cited authors and 50 met the selected threshold. The greatest total link strength and 91 citations of his papers in the topic selection was for Wacquant. With a total link strength of 766 and 54 citations was for van Baar (2012), and, in third place, with 700 total link strength and 41 citations was Powell.

The items in the co-citation analysis were then divided into 5 clusters (Figure 4). In cluster 1 (in red), there are 14 items (authors). The greatest links there were of authors Wacquant and van Baar. In cluster 2 (green), there are 13 items, and the greatest links were of Madarasová Gecková and Škobla. Cluster 3 (blue) consists of 12 authors, and, with the greatest total link strength, there were Hofmann (Hofmann and Óhidy 2018) and Kertesi (Kertesi and Kézdi 2011). In cluster 4 (yellow), there are 8 authors and with the greatest total link strength, there were Ladányi (2016) and Kemény (2005). Cluster 5 (violet) consists of only 3 authors. With the greatest total link strength, there was the author Filčák.

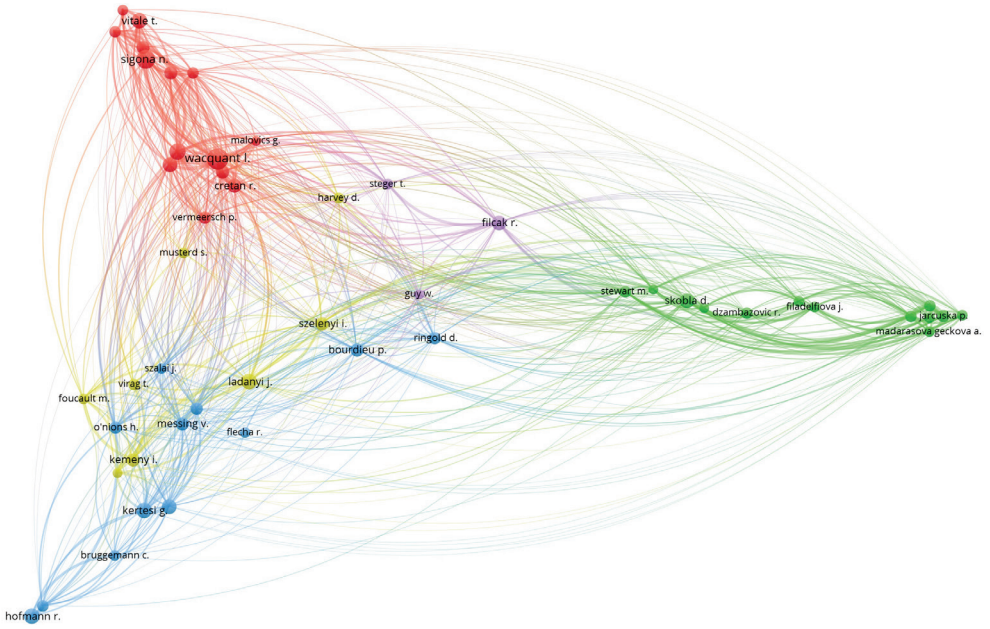

Figure 4. Co-citation by authors

Bibliographic coupling

Bibliographic coupling expresses the link between two items that both cite the same document (van Eck and Waltman 2023). This analysis could be made by documents,

sources, authors, organisations, and countries. We realised it by documents, by sources and by countries.

For the bibliographic coupling by documents, the minimum number of citations that we selected for a document was 5. Of the selected 265 documents, 117 met this requirement. The greatest total link strength of 33 was for the publication authored by Powell and Lever (2017). It was followed by the publications of Creţan et al. (2020), with a total link strength of 29, and of Creţan and Powell (2018), with a total link strength of 28. As some of the documents in the network were not connected to each other, only 95 documents participated in the cluster analysis. They were divided in 13 clusters (Figure 5).

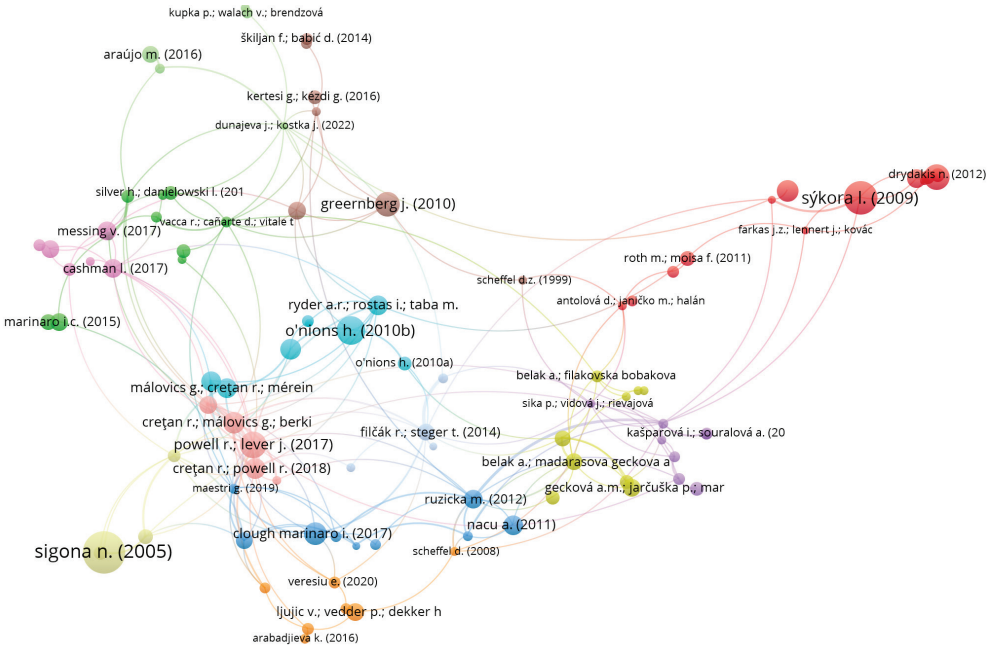

Figure 5. Bibliographic coupling by documents

In cluster 1, there are 13 documents and with the greatest total link strength of 7 is the paper of Sýkora (2009). Cluster 2 consists of 10 items. With the greatest total link strength of 12, there is the article of Vacca et al. (2022). Cluster 3 has 9 items. With the greatest total link strength of 20 in this cluster, there is the paper of Ruzicka (2012). Cluster 4 consists also of 9 items. The greatest total link strength of 13 has the publication of Belak et al. (2018). Cluster 5 has 8 items. With the greatest total link strength of 18 in this cluster, there is the paper of Růžička (2011). In cluster 6, there are also 8 items. With the greatest total link strength of 12, there is the paper of Málovics et al. (2019b). In cluster 7, there are 7 items, and, with the greatest total link strength (6), there is the paper by Scheffel (2008). Cluster 8 consists also of 7 items. With the greatest total link strength of 7, there is the article of Rostas and Kostka (2014). In cluster 9, there are 6 documents.

With the greatest total link strength of 10, there is the article of Cashman (2017). Cluster 10 consists of 5 documents and, with the greatest total link strength of 33, there is the paper by Powell and Lever (2017). In cluster 11, there are also 5 items. With the greatest total link strength of 11, there is the article of Dunajeva and Kostka (2022). Cluster 12 and cluster 13 consist of 4 items each. In cluster 12, with the greatest total link strength of 19, there is the article of Filčák and Stager (2014). In the last cluster, with the greatest total link strength of 15, there is the article by Maestri (2017).

he bibliographic coupling analysis by sources was realised with the limitation of minimum 5 documents of a source. Of the 198 sources that we analysed, only 6 met this threshold and 5 journals were connected to each other. These journals were: Journal of Ethnic and Migration Studies, with a total link strength of 9; Ethnic and Racial Studies (total link strength: 7); Geographica Pannonica (5); Szociologiai Szemle (3); and Intersections. East European Journal of Society and Politics (2). They were distributed in 2 clusters. The first one includes the journals: Ethnic and Racial Studies; Intersections. East European Journal of Society and Politics; and Journal of Ethnic and Migration Studies. The second one includes Geographica Pannonica and Szociologiai Szemle.

The analysis by country was made with the requirement of a minimum of 5 documents per country. In this case, of 40 countries, only 18 met the criteria (Figure 6); these are: Slovakia, with greatest total link strength of 1280, with 26 documents and 217 citations; followed by Czechia, with a total link strength of 969, 22 documents and 264 citations; Hungary, with a total link strength of 904, 42 documents and 313 citations; Netherlands, with a total link strength of 894, 10 documents and 107 citations; and United Kingdom, with a total link strength of 822, 30 documents and 725 citations. The rest of the countries have a total link strength of less than 400.

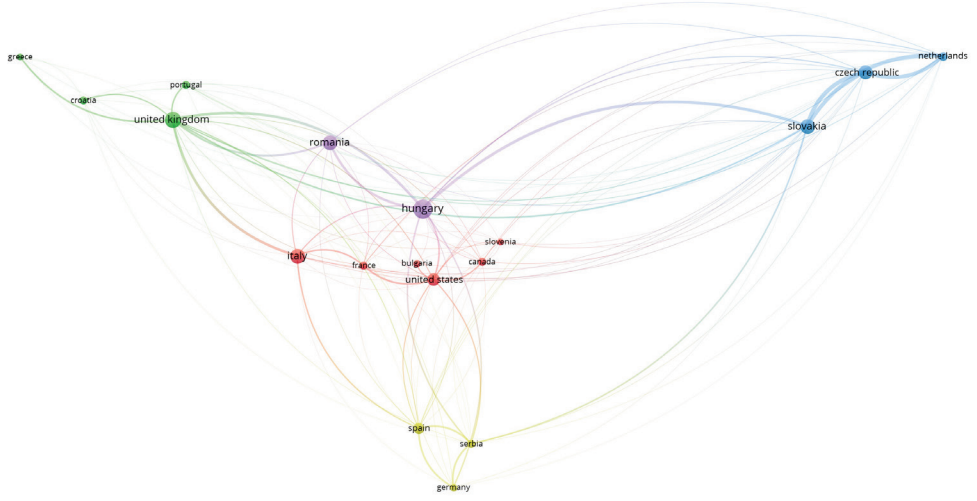

Figure 6. Bibliographic coupling by countries

All 18 items (countries) were divided into 5 clusters. In cluster 1 (in red), there are 6 items, including: Bulgaria, Canada, France, Italy, Slovenia, and the United States. With the greatest total link strength in this cluster is Italy (393). Cluster 2 (green) consists of 4 countries. These are: Croatia, Greece, Portugal, and the United Kingdom. The greatest total link strength in this group is the United Kingdom (822). In cluster 3 and 4, there are 3 items in each of them. Cluster 3 (blue) includes Czechia, Netherlands, and Slovakia. With the greatest total link strength in this cluster is Slovakia (1280). In cluster 4 (yellow), there are Germany, Serbia and Spain. The greatest total link strength in this group is Serbia (378). In the last cluster 5 (violet), there are only 2 countries. These are Hungary and Romania.

Co-authorship analysis

The co-authorship analysis was made by authors, and by countries. For the analysis by authors, there was selected a limit of 2 minimum number of documents of an author. In the analysed selection, there were 251 authors. 11 of them met the aforementioned requirement. All of them had a zero total link strength and no cluster could be defined.

By country, the analysis was realised with the limit of 5 minimum number of documents by country. In the selected papers, the authors were from 40 countries, and 18 countries met the threshold. With the greatest total link strength of 19 and 26 documents was Slovakia, followed by Hungary, with the greatest total link strength of 14 and 42 documents. Czechia and the Netherlands had the greatest total link strength of 13 each, but Czechia had 22 papers, and the Netherlands only 10. Slovenia had the greatest total link strength of zero, so it was excluded from the cluster analysis. The other 17 countries were divided into 5 clusters. In cluster 1 there are 5 countries: Bulgaria, Canada, France, Italy, and the United States. The greatest total link strength in this cluster had the United States – 7, with 18 documents, followed by Italy, with 5, and 26 documents. Cluster 2 includes Croatia, Greece, Portugal, and the United Kingdom. In this cluster, the United Kingdom had the greatest total link strength of 11, with 30 documents. Cluster 3 and cluster 4 consist of 3 countries each. Cluster 3 includes Czechia, Netherlands, and Slovakia. With the greatest total link strength in this group was Slovakia (19). In cluster 4, there are Germany, Serbia, and Spain. In this cluster, Serbia had the greatest total link strength of 5. In the last cluster 5, there are only 2 countries – Hungary and Romania.

Co-occurrence analysis

The co-occurrence analysis was realised with the limitation of minimum 5 occurrences to a keyword. In the analysed papers, there were 1211 keywords, and 83 met this criterion. The top 5 keywords with the greatest total link strength were: Roma (485 and 94 occurrences); social segregation (total link strength 346 and 39 occurrences); human (total link strength 313 and 23 occurrences); Romani (people) (total link strength 292

and 20 occurrences); and Italy (total link strength 288 and 34 occurrences).

All 83 items were divided into 3 clusters (Figure 7). In cluster 1 (red), there are 50 items (keywords). The keyword Roma in this cluster had the most links – 81, and the greatest total link strength of 485. Cluster 2 (green) was the second largest cluster consisting of 27 items. The keyword human in this cluster had the most links – 60, and the greatest total link strength of 313. In the last cluster 3 (blue), there are only 6 items. The keyword with the greatest total link strength of 148 was: ethnic group, with 58 links.

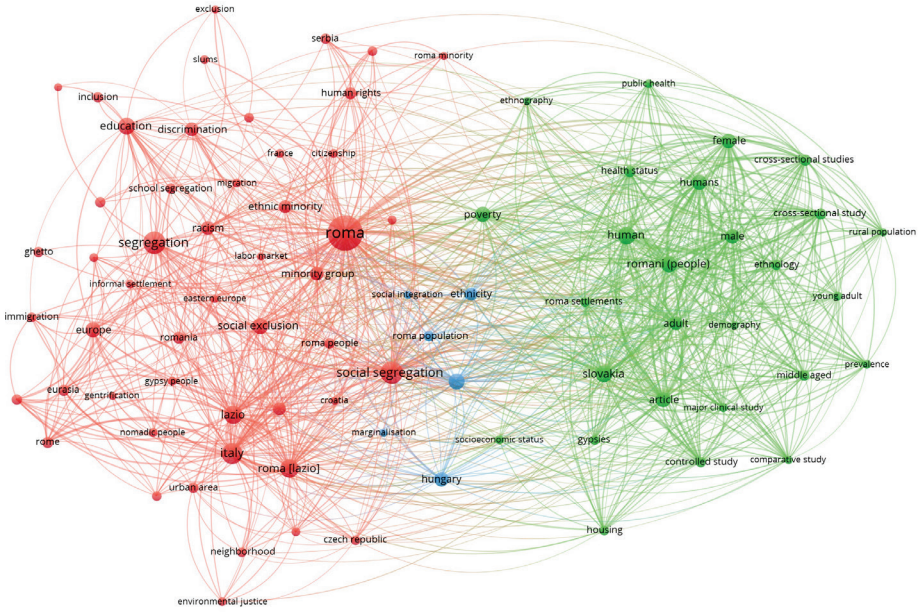

Figure 7. Co-occurrence analysis

Discussion

Roma segregation problems are discussed by many authors. In this section, the focus is on the most cited authors and papers, as this is a testament to their popularity, quality of work and contribution to problem solving through scientific methods. The reviewed most cited articles focused their attention on different aspects of Roma segregation, such as Roma marginalisation (Sigona 2005), stigmatisation (Creţan and Powell 2018), different types of segregation (Sýkora 2009, Arbaci and Malheiros 2010, O'Nions 2010), etc.

The scientific contribution of the 20 most cited articles is discussed (Annex 1). In one of the most cited articles, Sigona (2005) examined the spatial dimensions of Roma marginalisation, with attempts to clarify the "Gypsy problem" in the Italian context, and how cultural concepts such as nomadism were used in Italy to legitimise

segregation policies. Its contribution to the academic literature is related to the role of the cultural characteristics of the Roma population in its segregation process. The presentation of the Italian case study is a basis for future comparisons and to look for approaches to solve the segregation problem, considering the cultural specificities of the Roma. Also, Málovics et al. (2019a) elucidated the understandings of Roma marginalisation by bringing together notions of social and environmental justice under a single analytical framework. A new form of urban marginalisation was defined by Nacu (2011), together with the politics of Roma migration at European level and its specifics.

Arbaci and Malheiros (2010) challenged the commonly accepted thesis that desegregation can be seen as an integration form or process or even assimilation, and they provide evidence that the deconcentration of the immigrants in their residential environment is not necessarily associated with improved social inclusion and housing conditions. Also, the use of the term ghetto and the analysis of informal settlements which transform into new ghettos was presented by Berescu (2011).

Sýkora (2009) contributed to the scientific literature on Roma segregation by examining the new socio-spatial divisions in cities in Czechia, in the context of the post-socialist transformation, and it outlined the main types of localities of segregation and separation in contemporary Czechia. Málovics et al. (2019b) further examined the attitudes of Roma living in segregated urban areas to the place and communities, and how the Roma's strong attachment to place affects their everyday activities in the ghetto and its surroundings. Similar problems regarding the nature of intra-urban boundaries, based on the Romani neighbourhood, were presented by Karaman and Islam (2012), while Mudu (2006) approached the current patterns of residential segregation in Rome, brought about by the significant immigration flows to Italy.

Creţan and Powell (2018) analysed and highlighted the strong stigmatisation applied to wealthy Roma, regardless of their economic status or housing circumstances. They identified different defence strategies that the wealthy Roma use to resist stigmatisation. At the same time, on the example of the rich Roma, the authors opposed the Wacquant's theory of territorial stigmatisation (Wacquant et al. 2014). Clough Marinaro (2017) also extended Wacquant's theorisation about the condition and control of the racialised poor groups by state institutions.

A different aspect of segregation was examined by Mingione (2009), tracing the growing economic competition between different types of immigrants, the segregation and the discrimination of immigrant children in schools, and the associated ethno-spatial conflicts. So, educational segregation turns out to be one of the most discussed topics in the most cited papers. Lauritzen and Nodeland (2018) aimed at identifying the main problems of the Roma in education, applying Bacchi's critical analysis approach. Like them, O'Nions (2010) contributed to the understanding of the

educational segregation of the Roma by paying special attention to the fact that the education of Roma children in segregated schools is a manifestation of discrimination and it contradicts the decision of the Grand Chamber of the European Court of Human Rights.

Cashman (2017) then examined a more specific problem in the field of Roma education, by focusing on the specifics of Roma children with special educational needs, and by identifying the gaps that are allowed in the applied policy in Czechia. Messing (2017) also examined a more specific aspect of educational segregation, namely how ethnic segregation in education affects the everyday life and future aspirations of Roma students. Ryder et al. (2014) used the term "inclusive community development" as a tool for educational desegregation. And Greenberg (2010) made an interesting parallel between both Roma and African-American school segregation, and he gave suggestions on how some successful practices applied in the USA can contribute to the successful desegregation of Roma in the educational system of some countries in Eastern Europe. Powell and Lever (2017), also, on the basis of Elias's theory of established–outsider relations and the theory of Wacquant et al. (2014), try to understand the roofs of stigmatisation and marginalisation of the Roma in Europe.

Although not among the 20 most cited articles, with great potential, it is the contribution of Méreiné Berki et al. (2017, 2021) who used qualitative data from a participatory action research to examine the impact of desegregation policies on segregated Roma communities.

The discussion shows the contribution of the authors of the most cited papers, presenting the problem of Roma segregation as part of the bibliometric analysis. But the present study has a few limitations that must be mentioned. First, for the analysis, only the database of Scopus was used. The selection excluded many other quality papers, some of which expressing local research published in proceedings or books which are not in English or without an abstract in English, and which are not indexed in this database. Also, some limitations were applied when the different analyses were made because of their better understanding and quantity expression. There were certainly a number of other valuable publications that contributed to the analysis of Roma segregation, but covering the global literature is a huge challenge. Therefore, the choice of one of the world-renowned databases gives us the hope that we have covered at least a representative sample of the most significant publications on the subject, without claiming complete comprehensiveness, which we believe would not be possible regardless of the chosen database. Despite these limitations, the results provide insight into the contribution of the authors who have worked on the topic of Roma segregation and the main research that has been done on it. Also, it gives an insight into the collaboration between the main researchers, the scientific organisations, and countries in relation to the study of this topic.

Conclusions

There is an increasing interest in the topic of Roma ghetto and Roma segregation in the last 20-25 years. However, the largest number of publications appeared in the last five years. The papers of the most active authors on the topic, who have published papers in journals or books indexed in Scopus, were also concentrated in the last 10 years. Publications on Roma segregation have a significant share in the social sciences. So, this was an expected result, given the fact that Roma segregation is primarily related to social inequalities and specificities of the Roma minority.

The analysis of the most cited papers showed that the year of publication is a factor for the number of citations but it's not the most important. The specific topics in these papers shown in the discussion presented their quality and contribution to the academic literature. Most of them present specific case studies, mostly in Italy, and Central and Eastern European countries. The main aspects of Roma segregation in the most cited papers focus on the segregation reasons at all, and on how and why ghettos appear, on educational segregation, the marginalisation of this ethnicity group, and on some options for desegregation.

The bibliometric analysis concerning the Roma ghettoized structures showed that, despite the growing academic interest in the problems of the Roma ethnicity in recent years, there are still research gaps that need to be filled in. The problems of the Roma community are diverse and multifaceted, and their research is extremely important in order to find optimal solutions to improve their quality of life.

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Annex 1

The most cited papers on the topic of Roma segregation

No.	Author	Paper
1	Sigona (2005) *https://doi.org/10.1080/13691830500109969*	Locating 'The Gypsy Problem'. The Roma in Italy: Stereotyping, Labelling and 'Nomad Camps'
2	Arbaci and Malheiros (2010) *https://doi.org/10.1080/13691830903387378*	De-Segregation, Peripheralisation and the Social Exclusion of Immigrants: Southern European Cities in the 1990s
3	Sýkora (2009) *https://doi.org/10.1111/j.1467-9663.2009.00550.x*	New socio-spatial formations: Places of residential segregation and separation in Czechia
4	O'Nions (2010) *https://doi.org/10.1080/14675980903491833*	Different and unequal: the educational segregation of Roma pupils in Europe
5	Fekete and Webber (2010) *https://doi.org/10.1177/0306396810362868*	Foreign nationals, enemy penology and the criminal justice system
6	Powell and Lever (2017) *https://doi.org/10.1177/0011392115594213*	Europe's perennial 'outsiders': A processual approach to Roma stigmatization and ghettoization
7	Mudu (2006) *https://doi.org/10.2747/0272-3638.27.5.422*	Patterns of segregation in contemporary Rome
8	Greenberg (2010)	Report on Roma education today: From slavery to segregation and beyond
9	Clough Marinaro (2017) *https://doi.org/10.1177/0268580917706629*	The informal faces of the (neo-)ghetto: State confinement, formalization and multidimensional informalities in Italy's Roma camps
10	Creţan et al. (2020) *https://doi.org/10.5937/gp24-28226*	On the perpetuation and contestation of racial stigma: Urban Roma in a disadvantaged neighbourhood of Szeged
11	Karaman and Islam (2012) *https://doi.org/10.1016/j.cities.2011.09.007*	On the dual nature of intra-urban borders: The case of a Romani neighborhood in Istanbul
12	Mingione (2009) *https://doi.org/10.1177/0969776409104690*	Family, welfare and districts: The local impact of new migrants in Italy
13	Lauritzen and Nodeland (2018) *https://doi.org/10.1016/j.edurev.2018.04.002*	"What is the problem represented to be?" Two decades of research on Roma and education in Europe
14	Creţan and Powell (2018) *https://doi.org/10.1111/1468-2427.12626*	The Power of Group Stigmatization: Wealthy Roma, Urban Space and Strategies of Defence in Post-socialist Romania
15	Málovics et al. (2019b) *https://doi.org/10.1111/area.12426*	Urban Roma, segregation and place attachment in Szeged, Hungary
16	Málovics et al. (2019a) *https://doi.org/10.1016/j.cities.2018.11.013*	Socio-environmental justice, participatory development, and empowerment of segregated urban Roma: Lessons from Szeged, Hungary

No.	Author	Paper
17	Nacu (2011) *https://doi.org/10.1080/1369183X.2010.515134*	The politics of Roma migration: Framing identity struggles among Romanian and Bulgarian Roma in the Paris region
18	Ryder et al. (2014) *https://doi.org/10.1080/13613324.2014.885426*	'Nothing about us without us': the role of inclusive community development in school desegregation for Roma communities
19	Berescu (2011) *https://doi.org/10.1080/17535069.2011.616750*	The rise of the new European Roma ghettos: A brief account of some empirical studies
20	Cashman (2017) *https://doi.org/10.1080/13613324.2016.1191698*	New label no progress: institutional racism and the persistent segregation of Romani students in the Czech Republic

Journal of Urban and Regional Analysis 16–2 (2024): 321–343, https://doi.org/10.37043/JURA.2024.16.2.6

PUBLIC TRANSIT OPERATORS' RESILIENCE AND SUSTAINABLE DEVELOPMENT AMID THE COVID-19 PANDEMIC: THE CASE OF RICHMOND, VIRGINIA

Xueming Chen
Virginia Commonwealth University, Richmond, Virginia, USA

Abstract: The Greater Richmond Transit Company (GRTC) is used as an empirical case to demonstrate how a relatively small transit operator in the Richmond, Virginia, United States (RVA) region survived and thrived during the COVID-19 pandemic period. During that time, GRTC experienced a substantial downturn in its system transit ridership. In response to this emergency, GRTC immediately took bold measures to protect its operators and riders, such as: serving essential trips, improving bus interior seat design, modifying operating schedules, matching service with the demand, implementing new boarding process, offering free transit services, broadening funding sources, and others. As a result, GRTC successfully and quickly overcame the pandemic crisis, and it embarked on the road to full recovery in its transit operation. In the post-pandemic future, GRTC expects that many of the adopted pandemic workplace safety and cleaning protocols will continue long-term as it takes time to rebuild people's trust in public transit. The successful lessons (in particular, in four areas: putting people's safety first; giving priority to serving essential trips; using a dynamic scheduling approach; and increasing and diversifying its funding sources) from GRTC could also be transferable to other similar transit services in the U.S. and elsewhere.

Keywords:

transit operation; public mobility; COVID-19 pandemic; Greater Richmond Region

Email: xchen2@vcu.edu

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Introduction

The novel coronavirus disease 2019 (COVID-19), initially starting in March 2020, challenged the entire world. During the initial months of its outbreak, with no vaccines available and limited medical capacity to treat the disease, nonpharmaceutical interventions were the main strategies to contain the pandemic (Gössling et al. 2021). With the elapse of time and the availability of vaccines later on, the containment strategies also changed accordingly.

Although the federal COVID-19 Public Health Emergency declaration ended in the United States (U.S.) on May 11, 2023, it is still worthwhile and necessary to retroactively summarise the success stories and lessons learned (Gartland et al. 2023) from the American public transit industry's response and recovery efforts during this unprecedented pandemic period, which will guide the industry's future development and implementation of emergency management strategies for other unexpected disasters.

There has already been a large volume of literature examining the impacts of COVID-19 on public transit operations, and public transit operators' response and recovery plans (Wilbur et al. 2023, Lee and Eom 2024, Tapiador et al. 2024). However, several research gaps still exist. First, the study on the subject of smaller or medium-sized public transit operators' resilience and sustainable development amid the COVID-19 pandemic is still lacking. These public transit operators are typically located in smaller metropolitan regions with limited resources. Second, a comparative analysis among peer transit agencies is missing or insufficient. Third, both the successes and failures of public transit agencies in combatting the pandemic are yet to be systematically summarised.

To fill the existing research gaps, this paper intends to use the Greater Richmond Transit Company (GRTC) as an empirical case to demonstrate how a relatively small transit operator in the Richmond, Virginia (RVA) region survived and thrived during the pandemic period. Based on this case study and peer analysis, the paper will summarise the success stories and the lessons learned, which may guide local sustainable transit development and emergency management in the future.

Literature Review

Largely stemming from the U.S. perspective, this literature review focuses on two topics only: (1) impacts of COVID-19 on transit operations; and (2) transit agencies' response and recovery plans.

Impacts of COVID-19 on transit operations

During the initial months after the outbreak of COVID-19 in March 2020, the public transit operations of the entire world suffered a varying degree of decreased ridership

demand, reduced service level/fare revenue, change in route choices, and others (Tirachini and Cats 2020, Parker et al. 2021, Marra et al. 2022). The United States (U.S.) was no exception. Out of fear for the COVID-19 viral transmission and due to the absence of vaccines, widespread lockdown orders, and businesses shifting work from offices to homes, the U.S. overall transit ridership hit a 100-year low in early 2020, with bus ridership at the lowest level since the 1930s. June 2021 marked the beginning of the recovery for transit ridership in the U.S. However, even by June 2022, rail and bus ridership were only about two-thirds of the pre-pandemic levels in most metropolitan statistical areas (Ziedan et al. 2023).

According to the American Public Transportation Association (APTA) survey conducted in March 2020, 76% of transit agencies indicated that they had experienced a ridership decrease, especially large and medium-sized agencies because larger cities have seen more directives for people to shelter in place (Dickens and Grisby 2020). Some agencies reported ridership decreases of 70% more. For example, large cities like New York, Seattle, Chicago, Nashville, and Chattanooga experienced ridership reductions of 90%, 80%, 79%, 66.9%, and 65.1%, respectively, within the pandemic's first few months (Liu et al. 2023). In Washington DC, Metro-rail ridership declined by more than 90%, and bus ridership declined by a maximum of 75%, compared with the transit ridership in 2019 (WMATA 2020, Qi et al. 2023, Sablik 2023).

Other countries had a similar situation as the U.S. For example, in Sweden, Stockholm suffered a 60% decrease in public transit ridership between March and May 2020 (Jenelius and Cebecauer 2020). The spread of the COVID-19 pandemic resulted in the implementation of emergency measures to restrict travel, movement, and participation in various types of events in many countries around the world (De Vos 2020, Basu and Ferreira 2021, Borowska-Stefańska et al. 2023, Lee and Eom 2024).

Meanwhile, the impacts were not as significant among lower-income individuals and essential workers who rely on transit as their primary mode of transportation (captive riders). So, public transportation gained widespread attention as a way to advance equity (Morales-Burnett and Freemark 2021).

Burris et al. (2023) found that as of 2022, transit ridership in the U.S. has not yet rebounded to pre-pandemic levels, largely due to the following factors based on their survey: high annual household income; high fear of contracting COVID-19 when using transit; larger household size (due to the perception that the more persons a household has, the more likely one household member contracts with the virus through the interaction with other household members); preference for shorter travel times; and increased telecommuting flexibility since the pandemic (Burris et al. 2023).

In addition to the above factors, one Israel-based study also found that psychological motivations underlying reduced transit use can help transit authorities and operators

to take proactive action toward returning to the "new normal" and to increasing their preparedness for future pandemics (Kaplan et al. 2022).

Transit agencies' responses and recovery plans

Since March 2020, most U.S. transit agencies' response plans were primarily driven by their immediate safety concerns for their employees and riders (Navarrete-Hernandez et al. 2023), which were reinforced by federal, state, and other governmental mandates. The impacts from federal governments were particularly tremendous. Many public transit agencies responded with rapid service adjustments, and they made varying efforts to communicate with the riders and the public so that the users could understand how the service was changing and how it would affect them (Karner et al. 2023).

Federal financial supports and guidelines

On the financial side, to reduce the funding gaps faced by transit operators due to declining fare revenues, through the 2020 "Coronavirus Aid, Relief, and Economic Security (CARES) Act", the "Consolidated Appropriations Act", and the 2021 "American Rescue Plan Act", the federal government provided a total of nearly $70 billion of support to transit agencies, which greatly relieved many public transit agencies' financial burdens and it helped their fast recovery (Sablik 2023).

With respect to the federal Guidelines, on January 21, 2021, President Biden signed an Executive Order (EO 14001) mandating masks on all domestic modes of transportation. Within the following ten days, the Centers for Disease Control and Prevention (CDC) and the Transportation Security Administration (TSA) implemented the Executive Order by requiring face masks to be worn by all people while on public transportation and at transportation hubs. CDC also issued a series of other guidelines directly impacting public transit operations.

Best practices in American public transit agencies

According to the APTA survey conducted in March 2020, of 174 responding operators, 98% increased cleaning, 95% purchased extra supplies, 98% provided employees with information and guidance, 94% deployed social distancing messaging, and 75% of responding operators anticipated service cuts (Dickens and Grisby 2020, VDRPT 2023).

A later APTA report from April 2020 (Dickens 2020), which surveyed 121 member agencies, indicated that 87% of responding operators had either gone zero fare or they stopped enforcing fare collection. Over 200 agencies (21 of which are in Virginia) joined APTA's Health and Safety Commitments Program. The program is a pledge that agencies took to enact health and safety measures to make riders feel comfortable

(Sohrabi et al. 2023). The measures were informed by responses from over 2,200 transit riders across the country indicating which safety measures would make them feel comfortable in transit (Dickens 2020).

Another APTA survey conducted in July 2020 found that (Washington et al. 2020): nearly half of all public transit agencies have already implemented or they are planning service reductions, furloughs, and layoffs, and they have deferred or cancelled capital projects; nearly 90% of APTA's transit-related business members have implemented layoffs and furloughs due to declining sales; a third of these businesses are concerned about having to shut down their operations if additional federal emergency aid was not forthcoming soon.

Schwartz (2020) conducted a global research, and he summarised the best practices in the public transit and COVID-19 pandemic, including such empirical cases as Bay Area Rapid Transit, Central Ohio Transit Authority, Rock Island County Metropolitan Mass Transit District, and others. So, the importance of new technology applications cannot be neglected. Creating smart applications that can optimise passenger flow and utilise technology to reduce the spread of epidemic threats is essential to combating future epidemics (Burdzik et al. 2023). Also, in 2021, the Community Transportation Association of America made a series of recommendations on how to move transit forward from the pandemic (Mader 2021): (1) make public health a new focus area for transit; (2) make fare payment fairer and more equitable; (3) focus federal and state support on frequent, reliable service; (4) strengthen hiring and career development; (5) redesign routes and run more frequent service all day; (6) expand demand-response.

In summary, the U.S. public transit agencies have taken multi-phased approaches to cope with the COVID-19 pandemic. Different phases (e.g., response, stabilisation, pre-vaccination, post-vaccination, and recovery) had different approaches. Many transit operations have significantly recovered as time passed, yet still have not reached the pre-pandemic levels. The recovery speeds varied from one transit mode to another transit mode.

Methodology

Study area

Founded in 1860, GRTC is a local government-owned public service company that operates urban-suburban bus lines based in the Richmond, Virginia (RVA) region. GRTC currently operates a fleet of over 157 transit vehicles travelling along approximately 45 routes within Richmond City, Henrico County, and beyond (Figure 1). Most GRTC transit services are provided within the boundary of Richmond City, which is the central city of the region.

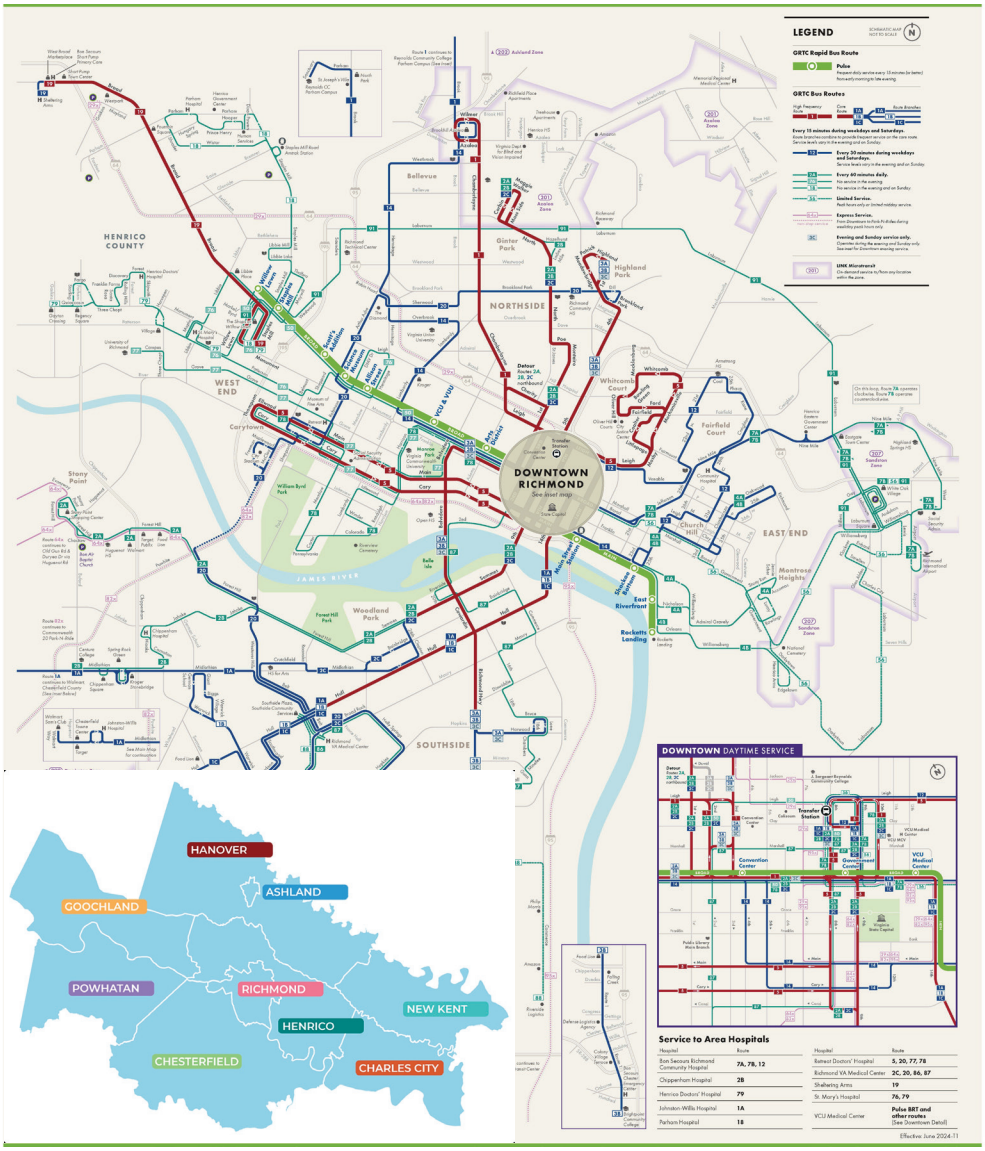


Figure 1. GRTC System Map, and RVA Region (bottom-left). Source: PlanRVA (2022a), GRTC (2024b)

GRTC primarily provides three types of transit services: local bus services, express bus services, and specialised transportation services. GRTC's local bus services operate in many areas from 5:00 am to 1:00 am daily, seven days a week, and they offer convenient stops close to many of Greater Richmond's popular destinations, plus everywhere in-between. GRTC both buses and cutaway vans. GRTC's four Express Routes operate on weekdays to transport commuters to and from work quickly.

In addition to local and express bus services, GRTC also provides specialised paratransit services called CARE (Community Assisted Ride Enterprise) with the following variations (GRTC 2024a): (1) CARE it provides the next-day origin-to-destination service under the guidelines of the Americans with Disabilities Act (ADA) for the eligible citizens of the Richmond Region who live within the ¾ mile of the GRTC fixed local routes. The fare is $0 currently (pre-pandemic fare was $3.00) for Richmond City, Henrico County, & Chesterfield County residents; (2) CARE Plus: this is the paratransit service for eligible citizens who live beyond the ¾ mile of the GRTC local routes. The fare is $0 currently (pre-pandemic fare was $6.00) for Richmond City and Chesterfield County residents. Depending on the location and time, some Henrico County trips cost $6; (3) CARE on-Demand: it offers CARE customers the option to utilise a same-day, direct, non-stop trip. This is an optional program open to CARE customers, so, you must first qualify for CARE to be eligible to utilise CARE On-Demand.

In terms of GRTC's ridership and rider characteristics, according to GRTC's 2021 Annual Report, GRTC served 7.8 million customer trips during the fiscal year (FY) of 2021 (July 2020 – June 2021), with the following racial composition: African-American/Black: 64%; Caucasian/White: 26%; Hispanic: 5%; and Asian: 5%.

Like in the rest of the U.S., COVID-19 swept across the Richmond Region starting in March 2020, when the World Health Organization declared the COVID-19 as a pandemic, and the transit operation of GRTC was dramatically impacted in multiple ways. Some important dates in the early stages of the COVID-19 pandemic in the Richmond Region are (PlanRVA 2022b): March 16, 2020: schools were closed; March 30, 2020: stay at home order was issued; May 15, 2020: phase one reopening began; May 29, 2020: the first night of protests (against George Floyd's killing in Minneapolis) happened; July 1, 2020: phase three reopening began; January, 2021: COVID-19 cases increased; April 4, 2021: Easter Sunday was observed; June 21, 2021: 70% of Virginia's adults were vaccinated with at least one dose.

Analysis approach

In the Richmond, VA (RVA) region, due to the COVID-19 pandemic lockdowns between 2020 and 2023, it was impossible, for this study aims, to directly interview the onboard GRTC bus passengers or to visit GRTC, which was closed for several years. Therefore, the data and materials used in this paper primarily come from the following sources: online agency search, published agency annual reports, literature review, second-hand interview reports, and data support provided by the GRTC Planning Manager, and other local planners.

The fragmentary nature of the GRTC transit operations data prevents a rigorous quantitative analysis from being conducted. Due to this reason, only a qualitative description and data analysis/synthesis are provided in this paper. In addition to the

GRTC case study, a peer analysis with other U.S. transit agencies will also be performed in the later part of this paper as a backdrop.

Results

Impacts of COVID-19 on GRTC Transit Operation

Annual view of GRTC's system ridership changes

The GRTC annual system ridership began to slide from 8,586,386 in FY 2019 (pre-pandemic) to 8,397,838 in FY 2020 and further plummeted to an all-time low of 7,457,551 in FY 2021 (Figure 2). After that, the GRTC system ridership began to bounce back and it increased to 8,182,225 in FY 2022, but never reached the pre-pandemic level. The overall trajectory exhibits an asymmetric U-shaped curve.

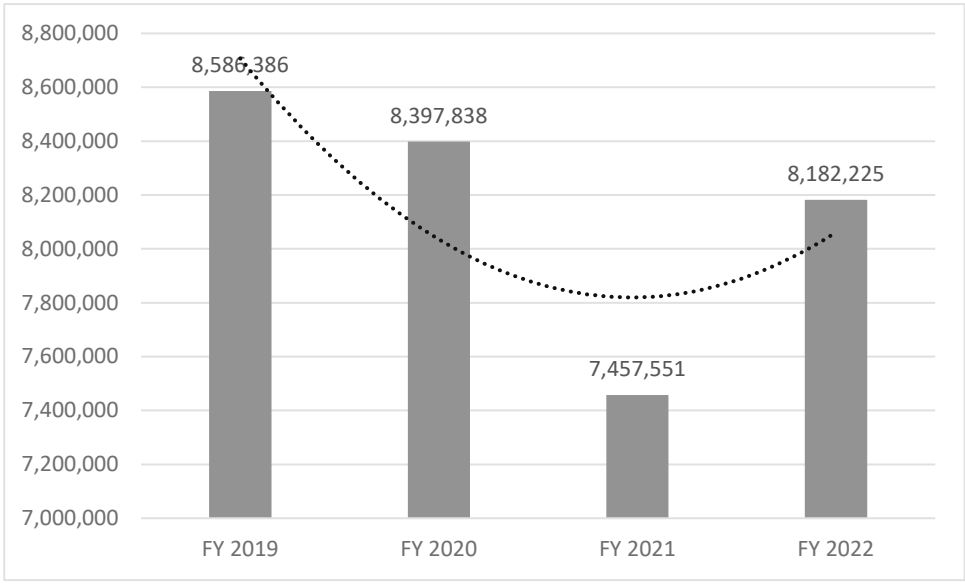
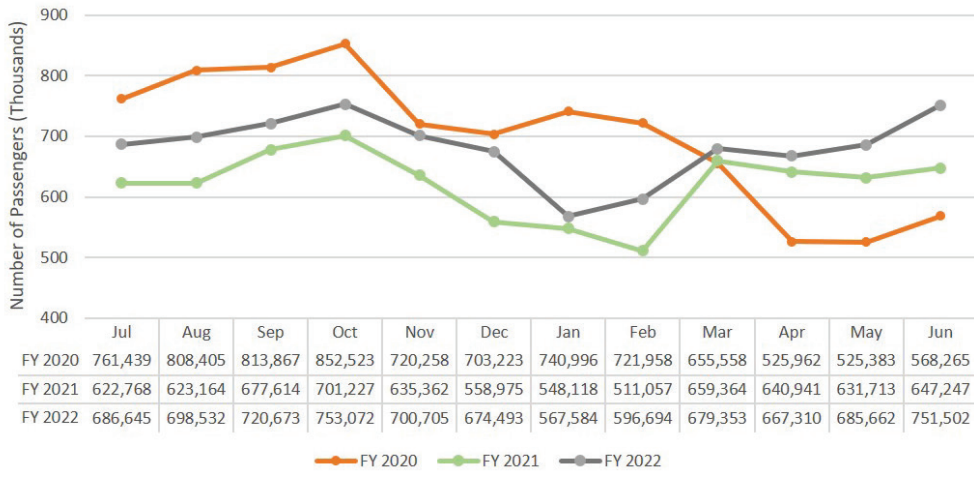


Figure 2. GRTC Annual System Ridership Trends FY 2019 - FY 2022. Source: GRTC (2022)

Monthly view of GRTC's system ridership changes

In FY 2020 (early pandemic), the monthly system ridership steadily declined after October 2019 and it reached the lowest points in April and May 2020 (Figure 3). In FY 2021, the monthly system ridership reached the lowest level in February 2021. After that, it gradually recovered. In FY 2022, the monthly system ridership remained relatively stable, and it began to bounce back after January 2022, signaling the weakening of the pandemic and the gradual recovery of ridership.



	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
FY 2020	761,439	808,405	813,867	852,523	720,258	703,223	740,996	721,958	655,558	525,962	525,383	568,265
FY 2021	622,768	623,164	677,614	701,227	635,362	558,975	548,118	511,057	659,364	640,941	631,713	647,247
FY 2022	686,645	698,532	720,673	753,072	700,705	674,493	567,584	596,694	679,353	667,310	685,662	751,502

Figure 3. GRTC's Monthly Motor Bus Ridership between FY 2020 and FY 2022. Source: GRTC (2022)

Modal variations of transit ridership

The overall decline in system ridership during the pandemic years masked the variations among different transit modes. The percentage changes of different transit modes' ridership between FY 2021 and FY 2020 were as follows (Figure 4): (1) Local Routes: -1%; (2) Bus Rapid Transit or BRT (Pulse): -32%; 3) Vanpool: -61%; 4) Express: -73%; 5) CARE: -10%; 6) CARE On-Demand: -4%. Since Local Routes served more diverse, essential trips, it suffered the smallest percentage decrease. In contrast, Express Buses (serving commuting trips) suffered the largest percentage decrease.

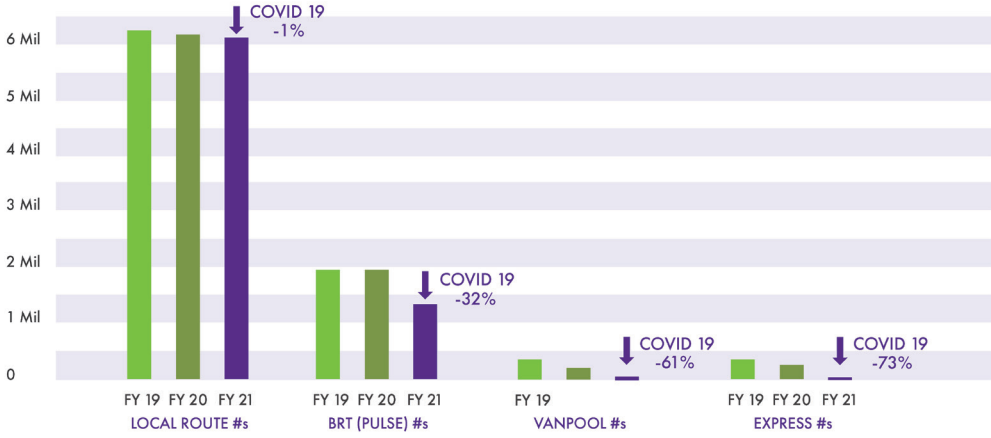


Figure 4. Variations of Modal Ridership. Source: GRTC (2021)

GRTC's local fixed route ridership initially declined from 503,029 in December 2019 to 444,298 in December 2020 (Figure 5). From December 2020 to December 2022, however,

the local route ridership level went up and it gradually exceeded its pre-pandemic level. The ridership in December 2022 reached 554,052, which was more than 10% higher than that in December 2019. The good and fast recovery of local fixed route ridership was primarily attributed to the "essential" trips which it served.

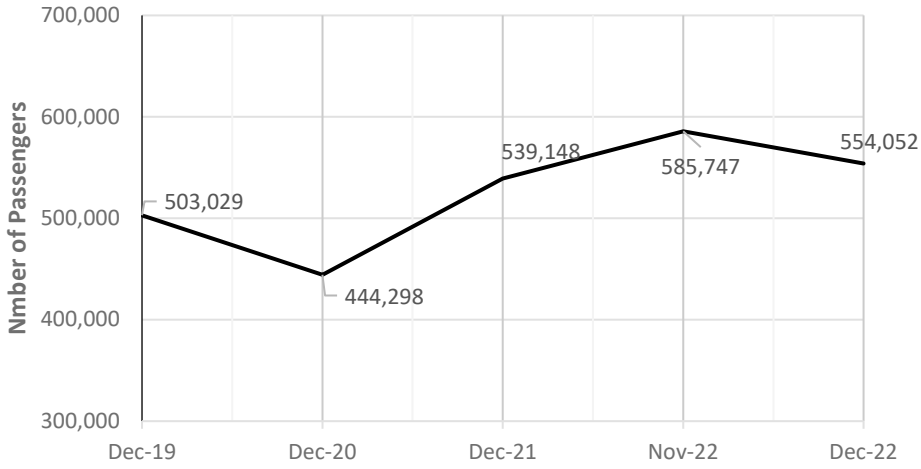


Figure 5. Monthly Ridership of GRTC local-fixed routes. Source: GRTC (2023)

However, Express and Pulse (Bus Rapid Transit) ridership remained depressed because many of their riders had virtual school and remote work options (Figure 6, Figure 7). GRTC Express route and Local-Pulse ridership began to reach higher levels starting in fall 2021 and afterward largely because of Virginia Commonwealth University resuming most on-campus activities. Although vanpool ridership remained lower while employers continued their liberal telework policies, vanpools do have the capacity to grow in the future for customes shifting from traditional daily express routes to targeted in-office commuting days.

CARE passengers rode less often during the pandemic, but their return to riding was slower than on buses (Figure 8). This delayed recovery may be a combination of factors related to the pandemic, including ongoing personal precautions to limit public exposure and medical appointment delays from the shut-down backlog demand.

In a nutshell, of all GRTC transit modes, the local fixed-route ridership returned to the pre-pandemic level at the earliest time. Other transit modes lagged in ridership recovery. The reasons accounting for this discrepancy might be that: (1) the local fixed-route buses serve more diverse but essential trip purposes than other transit modes do. Home-to-work commuting trips had relatively less impact on local routes than on express routes and vanpools; (2) GRTC adjusted its service levels throughout FY 2020 to prioritise vehicle and manpower resources for core local bus routes where demand remained high.

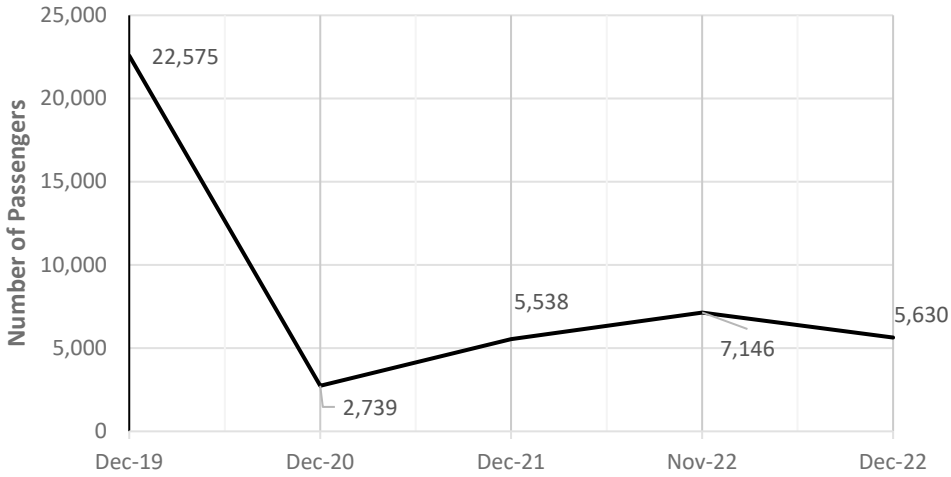


Figure 6. Monthly Ridership of GRTC Express Routes. Source: Timm (2021)

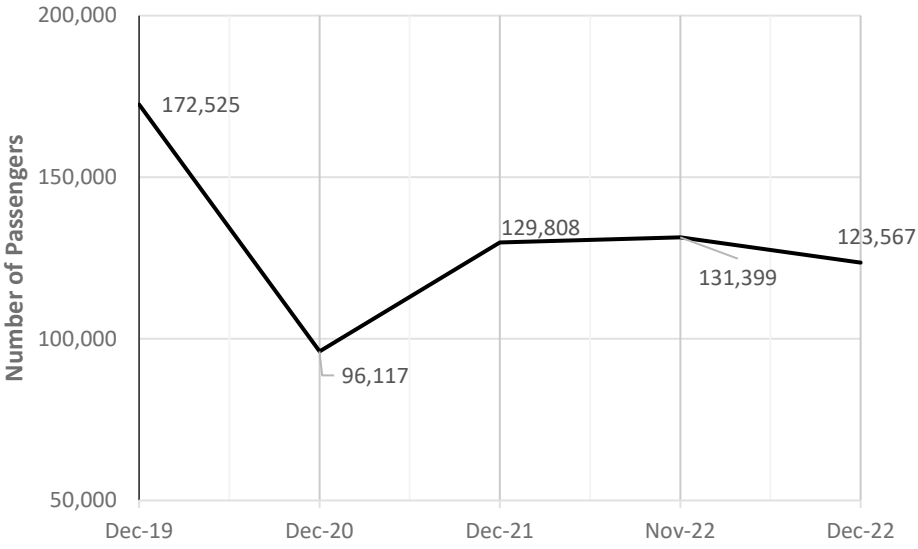


Figure 7. Monthly Ridership of GRTC Local-Pulse. Source: Timm (2021)

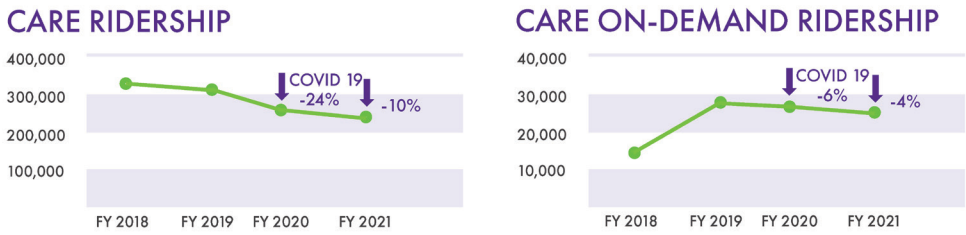


Figure 8. Changes in CARE ridership during the pandemic. Source: GRTC (2023)

GRTC's responsive measures taken during the COVID-19 pandemic

GRTC's emergency response guiding principles and summary of measures

Seeing the tragic life loss of more than 100 team members experienced by the Metropolitan Transportation Authority (MTA) of New York City Transit and projecting the likely impact on the Richmond, Virginia (RVA) region, GRTC immediately reacted to the pandemic by establishing and by closely following the Emergency Response Guiding Principles. These principles were used to define the agency's first, second, and third orders of priority to guide and to implement daily and sometimes hourly actions to protect staff, riders, and the RVA community:

- Health and safety of GRTC Staff and Family (First Priority): Job Protection for GRTC and Riders;
- Maintenance of Essential Service for the Community (Second Priority): Redistribution of service to essential lines; and
- Recovery of Regional Economy (Third Priority): Budget for Long-Term Recovery of Service and Community.

In mid-March 2020, with funding support from the Virginia Department of Rail and Public Transportation (VDRPT), GRTC suspended all fare collection to mitigate the risk of virus transmission to operators and riders, and it requested that riders only use transit for essential trips. Other operational changes included: rear-door boarding/-alighting, requiring face masks/covering at all times, maintaining on-board hand sanitiser stations, enhancing cleaning schedules and staffing to support daily complete-fleet disinfection, redistributing vehicle resources to the routes with greatest ridership needs, and encouraging social distancing as much as feasible on-board and in GRTC facilities. Schedules were reduced on express routes and lower-ridership local routes, while increasing the Operator extra board levels to ensure coverage when operators were pulled off duty to be quarantined and tested for possible COVID exposure. Also, GRTC's liberal leave and paid quarantine policies protected jobs, and they encouraged employees to voluntarily report potential exposure to mitigate possible spread among the workforce. To proactively catch any workplace exposure, free on-site testing events were held to screen for detected asymptomatic and pre-symptomatic cases.

GRTC's responsive measures by categories

GRTC took numerous bold measures to mitigate the negative impacts of the COVID-19 pandemic. These measures fell under the following categories: bus interior seat redesign, new boarding process, and daily sanitising; bus operation and scheduling modification; bus fare policy; bus passenger requirements; and on-demand service for essential trips.

Bus interior seat redesign, new boarding process, and daily sanitising

GRTC provided more space on-board for passengers at the bus Operator's discretion. The barrier cord was placed behind the priority seating area (its placement during the majority of the pandemic), forward, or entirely removed, which allowed for more standing room as ridership continued to increase on many local routes.

GRTC's top priority was the safety of its bus operators because the healthy staff ensured reliable service for the customers. GRTC allowed rear door boarding for most passengers to protect operators at the front. The front seats were reserved for disabled persons. Furthermore, daily disinfecting of the entire fleet continued, and onboard hand sanitiser stations were made available for the use and protection of passengers. Moreover, for ventilation purposes, the bus windows remained open while the buses were in motion.

Bus operation and scheduling modification

GRTC substantially changed the bus operating schedules during the pandemic, with information made available online and in area displays. The categories of service updates and examples of measures taken for local regular and express buses, as well as bus rapid transit bus (BRT, i.e. GRTC Pulse), are briefly summarised in Table 1.

Table 1. Summary of the GRTC service updates

Service Update Category	**Examples**
Schedule change	• Added more buses (including the Pulse BRT buses) on the busiest routes to keep social distancing while meeting higher demand, e.g., continued providing express bus services. • Decreased or canceled buses due to lower demand, e.g., *23x Glenside/Parham Express, 26x Parham Express, 27x Glenside Express, 28x White Oak Village* services were canceled until further notice because of very low ridership. *102x Kings Dominion* service was also suspended until further notice by Kings Dominion. • Some express bus services were reduced, such as *29x Gaskins Express, 64x Stony Point Express, 82x Commonwealth 20*. • While reduced services continued on most express routes, local route updates improved Sunday service, reliability, and destination connectivity.
Route change	• Services were consolidated into "trunk" routes, e.g., *Route 1 Chamberlayne & Wilmer to Southside Plaza*. • Redeployed express resources to local routes to balance the demand. • Rerouted passengers taking alternate routes • Route extension. • Route elimination. • Route interlining.

Service Update Category	Examples
Vehicle change	• On some express routes with lower ridership, passengers were transported in GRTC Vans instead of buses.
Bus bay location change	• Bus bay reassignment was implemented to better meet the changing demand of picking up and dropping off the passengers.

Source: GRTC (2023)

Bus fare policy

Before the COVID-19 pandemic, the zero-fare approach arose as a way to improve the quality of life of public transit users. Those initial motivations remained instrumental, but in the COVID-19 context, zero fares also allowed agencies to ensure safety and security for operators and riders. GRTC remained at Zero Fare on buses and CARE services (excluded CARE On-Demand) at least through June 30, 2022. As elaborated later, some benefits of the zero-fare included: reduced mobility inequities, increased ridership, improved boarding procedures, decreased potential of fare-related conflicts, and elimination of many costs and staffing burdens associated with fare collection.

Bus passenger requirements

Because of the increase in community transmission resulting from COVID-19, GRTC continued rear-door boarding for most passengers to protect the operators at the front. Front-door boarding remained open only for passengers needing assistance, the ramp, or ADA seating at the front. With the return to in-person school, unaccompanied minors were permitted to ride.

The Federal Mask Order remained in effect through January 18, 2022, which meant that all passengers were required to properly wear face masks throughout their trips with GRTC, regardless of vaccination status. However, GRTC planned to continue a mask mandate for passengers and staff beyond this date. As of 8/23/2022, however, masks were no longer required, and mask-wearing became optional on GRTC buses or in GRTC facilities.

On-demand service for essential trips

In addition to the normal services, GRTC also offered on-demand service for essential trips. Early-morning and late-night riders could request one ride per day from one GRTC bus stop to another. The on-demand service window was: Monday-Friday, 5 AM-6 AM, and 11 PM-2 AM. GRTC worked with multiple partners (Uber, UZURV, etc.) to provide this service under Zero Fare operations. Passengers could request a ride over the phone with Uber, UZURV (a local transportation network company similar to Uber), or a GRTC small vehicle. Trips needed to be requested approximately 30 minutes before the ride. Wheelchair-accessible vehicles (WAVs) were available upon request.

GRTC funding sources during the pandemic

In the past, GRTC received funds from riders in the form of fares. Due to the COVID-19 pandemic, GRTC implemented a zero-fare policy. This fare revenue loss was replaced by several other operating contributions. GRTC's total FY 2022 operating contributions exceeded $55 million. The most important funding sources in 2022 were (Table 2): First, the regional fund – the Central Virginia Transportation Authority (CVTA) is now the primary source of funds for GRTC with about $20 million in FY 2022. The authority was established in 2020 by the General Assembly of Virginia to help fund transportation, and it derives its revenue from an additional regional 0.7% sales and use tax (revenue collection began in October 2020) and a wholesale gas tax of 7.6 cents per gallon of gasoline, and 7.7 cents per gallon of diesel fuel (revenue collection began July 2020). Second, the state fund – VDRPT aimed to improve mobility in Virginia through transit and it provided $11.9 million to GRTC for FY2022. Third, the federal fund – the Federal Government (Federal Transit Administration, FTA) provided about $8.2 million for FY2022. Fourth, the city fund – the City of Richmond contributed almost $8.1 million.

Table 2. GRTC's 2022 proposed budget baseline

Operating Contributions	Budget Baseline
CVTA	$ 20,000,000
State	$ 11,906,647
Federal	$ 8,235,998
Richmond City	$ 8,069,887
Henrico County	$ 4,306,274
VCU	$ 1,656,912
Chesterfield County	$ 1,231,636
Petersburg	$ 200,000
Total	$ 55,607,354

Source: Timm (2021)

Comparative analysis with other U.S. transit agencies

To put the GRTC case in perspective, this peer analysis compares GRTC with other U.S. transit agencies in terms of their respective response and recovery strategies.

Summary of COVID-19 response and recovery strategies implemented in the rest of the U.S.

In 2022, FTA summarised the best practices implemented by the selected U.S. transit systems to recover from the COVID-19 public health emergency (U.S. Department of Transportation 2022). The acronyms of a few transit agencies in the FTA report are repeated in Table 3.

Table 3. Selected transit agency acronyms and full terms

Acronym	Full Term
AC Transit	Alameda-Contra Costa Transit District
BART	Bay Area Rapid Transit
CATA	Capital Area Transportation Authority
COTA	Central Ohio Transit Authority
CTA	Chicago Transit Authority
DART	Dallas Area Rapid Transit
LACMTA	Los Angeles County Metropolitan Transportation Authority
MARTA	Metropolitan Atlanta Rapid Transit Authority
MBTA	Massachusetts Bay Transit Authority
MUNI	San Francisco Municipal Transportation Agency
NJT	New Jersey Transit
NYCT	New York City Transit
UTA	Utah Transit Authority
VRT	Valley Regional Transit
WMATA	Washington Metropolitan Area Transit Authority

Source: U.S. Department of Transportation (2022)

The best practices documented in the FTA report can roughly be broken into six non-exhaustive, somewhat overlapping categories (U.S. Department of Transportation 2022): Category #1: Protecting Workers; Category #2: Protecting Passengers; Category #3: Cleaning, Disinfecting, and Ventilating Vehicles and Infrastructure; Category #4: Operational Considerations; Category #5: Passenger Communications; Category #6: Technology and Innovation. Each category has a number of subcategories, concrete measures, and example implementation agencies (Table 4). GRTC (highlighted) also implemented many similar strategies.

Table 4. The best practices implemented by the selected U.S. Transit Systems

Category	Subcategories	Example Implementing Agencies
1) Protecting Workers	Face coverings, PPE, and Vaccinations	Jacksonville Transportation Authority, MARTA, NYCT, NJT, **GRTC**
	In-Vehicle Protections	DART, MARTA, Denver RTD, NJT, **GRTC**
	Infrastructure Protections	NYCT, Miami-Dade, MBTA, NYCT, **GRTC**
	Worker Communications, Return to Work Policies, and Health Screening	Santa Clara VTA, MBTA, Metropolitan Transit System
	Sick Leave Policies	Sunline Transit, CTA
	Recruiting and Training	Denver RTD, LACMTA, DART, UTA

Category	Subcategories	Example Implementing Agencies
2) Protecting Passengers	Face Coverings and PPE	CARTA, CTA, MARTA, NJT, NYCT, UTA, AC Transit, BART, **GRTC**
	In-Vehicle Protections	CTA, MARTA, King County, Lawrence Transit, **GRTC**
	Infrastructure Protections	Denver RTD, Metrolinx, **GRTC**
3) Clearing, Disinfecting, and Ventilating Vehicles and Infrastructure	Vehicles	CATS, CTA, DART, Lawrence Transit, NYCT, **GRTC**
	Infrastructure	MARTA, NYCT, Long Beach Transit, NYCT, **GRTC**
4) Operational Considerations	Planning Recovery	LACMTA, WMATA, East Texas COG, **GRTC**
	Service Changes to Support Opening	Houston Metro, NYCT, CATA, Jacksonville Transit
	Service Adjustments to Manage Crowding	MARTA, Miami-Dade, WMATA, Santa Clara VTA, NJT, PRT
	Preparing for the future	LACMTA, MBTA, CTA, WMATA, **GRTC**
5) Passenger Communications	Welcome back campaign	AC Transit, BART, CTA, Denver RTD, MBTA
	Keeping riders informed in real-time	Ontario Northland, **GRTC**
	Collecting Information from Riders	Anchorage People Mover, Duluth Transit Authority, Miami-Dade
	Behavioral Science tools	Transit agencies
	Notifying passengers of potential exposure	Go Metro, Houston Metro, Jacksonville Transportation Authority
	In- or on-vehicle messaging	Tri-Valley Transit, **GRTC**
	Video campaigns ad promotions	Denver RTD, NYCT
	Vaccination Activities	Akron Metro, Capital Metro, **GRTC**
6) Technology and Innovation	Detecting Crowding	AC Transit, CTA, MBTA, LACMTA
	Passenger Monitoring	NJT, NYCT
	Cleaning, Sanitizing, and PPE	Pittsburgh Airport
	Payment Options	WMATA, DART, LACMTA, MBTA
	Micromobility	Arlington RAPID, LACMTA, MARTA

Source: U.S. Department of Transportation (2022)

The similarities and differences between GRTC and other peer agencies

Of the above six categories, GRTC largely implemented the first five categories of strategies. In addition, GRTC implemented some other unique strategies, such as route consolidation, bus bay relocation, demand-responsive vehicle size, etc. However,

GRTC seemed to do little or nothing in the technology and innovation-related category. The fact that GRTC did not adopt and implement new technologies in response to the COVID-19 pandemic might be attributed in part to its relatively weak technological capabilities as a small/medium-sized transit agency, located in a medium-sized city. GRTC only has local bus transit (including bus rapid transit, BRT), which is much simpler in terms of its transit modes compared to larger transit agencies in New York, Los Angeles, Chicago, and Washington D.C.

Discussion

This section discusses the successes and failures of GRTC strategies in dealing with the COVID-19 pandemic, and it pinpoints the limitations of this study.

Successes of the GRTC case

Success #1: Going fare-free

GRTC initially suspended fare collection on its buses in 2020 to minimise contact between passengers and drivers and to limit the spread of COVID-19. It has continued that practice throughout the recovery, and it recently received funding from the VDRPT's Transit Ridership Incentive Program to help maintain free fares at least through June 2024. A recent $4.5 million state grant from VDRPT has helped to make the continuation of free rides possible. In Richmond, regional leaders first dropped fares in March 2020 during the pandemic to support essential workers and to make it easier for people to get to hospitals and doctors. Scrapping fares also prevented passengers from clustering around fare boxes and they eliminated the need for some face-to-face interactions.

The benefits of free fare at GRTC were multifold (Sablik 2023):

- Retaining riders – ridership on GRTC's services did fall sharply in March 2020, along with the rest of the country, but it recovered much more quickly than in most places. By 2021, ridership had returned to pre-pandemic levels on many of its fixed-route bus lines, and it is now above the pre-pandemic levels for the system overall.
- Fostering equity of transit use – this has benefitted low-income riders.
- Causing less interaction between the driver and passengers, and less confrontations between the driver and nonpayers. This has safety benefits.
- Getting more state transit funding with higher ridership.

Whether making free fares permanent remains to be seen. But this policy has definitely helped GRTC to quickly recover from its initial ridership decline. Of course, for a relatively smaller agency like GRTC, state support is feasible. But for larger operations in larger cities, the state support would be insufficient. In addition, while free fare

makes sense to lower-income riders, it may not be equitable to wealthy riders who can afford the fares.

Success #2: Matching service with the demand

GRTC constantly updated its service routes and schedules to meet the dynamic demand. This realignment helped to ensure that GRTC's routes better served the workers who could not work from home, and they were most likely to continue relying on transit during the pandemic. GRTC set a priority to serve essential trips, which was a huge success.

At present, GRTC's local-fixed route ridership has reached the pre-pandemic levels, whereas other transit modes still lag in their ridership recovery primarily due to their emphasis on serving home-to-work commuting trips, which were significantly declined as a result of telework options offered by the riders' employers.

Success #3: Maintaining social distance among bus passengers

According to Gordon (2020), fare enforcement officers for the Pulse Bus Rapid Transit (BRT) line were instructed to assist with spacing out riders from the platform so that no bus got too crowded. To make that task easier, GRTC deployed buses which it normally reserved to reduce bunching during rush hour to operate all the time (Gordon 2020).

Success #4: More efficiently clean the buses

To keep its fleet as hygienic as possible, GRTC's cleaning team worked extremely hard. All custodial staff were voluntarily working up to fifty hours per week in an effort to clean every bus as frequently as possible with special prioritisation for the Pulse and for CARE vehicles which primarily serve older riders.

Paying overtime to increase the frequency of cleanings plus suspending the fares and running extra buses to assist with social distancing did not add up to sustainable finances for any transit agency, but the costs were necessary to preserve public health, the local economy, and the mobility of healthcare workers themselves.

Failures of the GRTC case

During the initial stages of the pandemic, GRTC lost two employees due to the COVID complications. And the agency did not apply new technologies in combatting the pandemic as GRTC is relatively weak in deploying new technologies.

Study limitations

This paper has several limitations. First, it does not have first-hand survey data, which precludes a detailed quantitative analysis. Second, GRTC is a relatively smaller transit

agency, which is different from other larger transit agencies in size, service area, and operational complexity. Due to this reason, the validity of this peer analysis remains weak.

Conclusions

This case study yields the following takeaway points from the GRTC's emergency management strategies during the pandemic:

- Putting people's safety first: this included the protection of both bus operators and passengers through taking different preventive measures (e.g., face masks, social distancing, hand sanitising, vehicle disinfecting, rear-door boarding, etc.);
- Giving priority to serving essential trips: GRTC adjusted bus routes and schedules to make sure that the busiest local routes with more essential workers had more frequent services and it deployed more vehicles. Meanwhile, the low-demand routes and express bus routes were reduced or cancelled;
- Using a dynamic scheduling approach to meeting the constantly changing travel demand. GRTC regularly updated its operating schedules, and it issued related notices;
- Increasing and diversifying its funding sources to cover the increasing operating costs and the fare revenue loss. GRTC aggressively pursued and obtained more funding support from various sources so it could provide free transit service to benefit its riders and to foster social equity.

However, GRTC also found its agency deficiency in the beginning: a low level of investment in cleaning the interior of its buses and vans – on average once every four days. Later, using the federal CARES funding, GRTC hired a local firm to provide daily cleaning and disinfecting service in the entire fleet. GRTC also bought specialised disinfecting sprayers to cover every surface more effectively.

The successful experiences and lessons from GRTC can be transferable to other similar regions and they are essential to protecting and to maintaining a sustainable public transportation system. In the post-pandemic future, GRTC expects that many of the pandemic workplace safety and cleaning protocols will continue long-term, as it takes time to rebuild people's trust in public transit.

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Aims & Scope

Urban and regional questions are crucial in understanding the present territorial conditions. From the World Bank's 'rediscovery' in its 2009 Report of the potential of cities in encouraging economic growth, to the multiple ways in which cities are being drawn into the processes of neoliberalism, to the dynamic growth of cities in the developing countries in Asia far out stripping the scale of cities in the older urbanized nations – everywhere there are signs of a rapidly changing urban condition. The same is true for the regions where 'old questions' of regional economic disparity and uneven development are being given a new twist as economic globalization impacts the national and local arenas.

JURA, the **Journal of Urban and Regional Analysis**, working as an **Open-access journal** (**with two issues/year, in February and in August - starting with 2020;** previously annually publishing in June and in December, for the period 2009-2019), was launched as a response to the exciting world of urban and regional research emerging in reaction to these changes happening in the real world.

JURA represents the initiative of the Interdisciplinary Center for Advanced Research on Territorial Dynamics (CICADIT) at the University of Bucharest working in collaboration with Ronan Paddison at the University of Glasgow, for the period 2009-2020. Starting with 2021, JURA is also supported by the Professional Association of Romanian Geographers (APGR). While the intention is that articles published by JURA will draw on examples throughout the world, particular emphasis will be given to urban and regional change as it is being experienced in Eastern Europe.

Transitional economies, and urban and regional shifts in the region since the end of the socialist regimes have been profound. The socialist regime had its particular effects on the regional economy and the cities, linked with structures that, in many ways, were very different from the trends apparent in Western Europe in the post-World War II period. Since 1990, change has been swift, challenging our theoretical understanding of the processes; for example, it is plausible to transport theories of contemporary urban change under neoliberalism developed in the advanced economies to the transitional economy. The legacy of the socialist regime, its imprint on the city physically and socially, provides further reason to suppose that urban (and regional) development in transitional economies is distinctive. These differences re-emphasise a consistent axiom underpinning the study of cities and regions: that if it is possible to point to broad theories that apply across different regions of the world, they often need to be modified to take into account local conditions.

Though JURA is primarily concerned with looking at urban and regional change in the transitional East European economies, case studies exploring similar problems but in other parts of the world are certainly parts of the journal's agenda. The remit of the journal is emphatically interdisciplinary. The analysis of the urban and regional conditions needs to be interdisciplinary. In reality, urban researchers usually tend to belong to a discipline reflecting their training whether as sociologists, geographers, planners or any number of subjects concerned with the study of space and place. Our training very often endorses an appreciation of how other disciplines explore the city. For the journal, the acknowledgement of the many disciplines that are concerned with understanding cities and regions will be indicated by the different disciplinary backgrounds reflected in the published papers. Articles will be published by geographers, sociologists, planners, economists, political scientists, to mention just a few of the disciplines involved in the urban and regional study.

JURA plans to be a key outlet publishing topical articles dealing with cities and regions. In later issues, we plan to include sections devoted to notes and comments as well as a policy section outlining and discussing state and non-state initiatives aimed at improving cities and regions, together with the problems confronted by their implementation.

Edited by Prof. PhD. Ioan IANOS
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