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**EXISTENTIAL MIGRATION DURING THE PANDEMIC IN LATVIA:
INSIGHT INTO SOLUTIONS AT THE INTERSECTION OF
RELIGIOUS SCIENCE AND HUMAN GEOGRAPHY**

**EKSISTENCIĀLĀ MIGRĀCIJA PANĒMIJAS LAIKĀ LATVIJĀ: IESKATS
RISINĀJUMOS RELIĢIJPĒTNIECĪBAS UN CILVĒKGEOGRĀFIJAS
SASKARSMES LAUKĀ**

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Abstract

Recent research trends related to the understanding of the meaning of philosophy and its use in interdisciplinary research in human geography. Therefore, the article aims to demonstrate a pilot model of an innovative methodology that forms the interface between human geography and philosophy. The terms “home experience” and “existential migration”, conceptualized by psychotherapist and philosopher Greg Madison, have been used to summarize interviews with migrants who have voluntarily chosen to integrate into another country, society, and culture in order to find a place to live in harmony with their individual being. Research on authenticity of life as a motive for migration has not developed so far, but it makes it possible to link the analysis of human experience, which is the focus of phenomenology, with empirical data sources. The mediation of human geography findings and axiological theory ensures that concepts of a philosophical nature form the architecture of a unified system of knowledge, in which empirical data are organically incorporated. In this case, they are the data from the many large-scale studies conducted in Latvia on the impact of the Covid-19 pandemic, particularly of the lockdown, on the population of Latvia. They all form a single text, which is examined by qualitative content analysis and cohort methods, revealing the nature of interpersonal relations in Latvian society, which are important in solving migration issues.

Keywords: Home experience, existential migration, impact of Covid-19, relationships between human geography and philosophy.

Introduction

For the first time in Latvia in the study of human geography, religious science, and philosophy of religion researchers are also involved together with lawyers, sociologists, demographers, and migration specialists. In Latvia previously research on religion and migration processes has developed separately. Only recently researchers of different fields have begun to understand their interrelationships. This new turn is reflected in the State Research Program implemented by the Faculty of Geography and Earth Sciences of the University of Latvia in the project DemoMigPro (“New research solutions on demographic and migration processes for the development of the Latvian

and European knowledge society”. VPP-Letonika-2021/4-0002). The DemoMigPro project aims to provide new knowledge and solutions for studies of demographic change and migration processes to foster the sustainable development of society in Latvia. It presupposes the evaluation of newcomers into various areas, their integration into Latvia, and how inclusive European society is. One aspect covers newcomers’ integration through religious communities. Recent research worldwide has demonstrated the role of religion and religious organizations in immigrants’ social, medical and existential well-being within their host societies; it has highlighted the connection between existential well-being, integration and social cohesion (Dahlin et al. 2021). Philosophy and especially the philosophy of religion and religious research for its part can offer deeper insight into the human factors that influence migration processes and could explain them from the perspective of human experience.

Geography has always had a relation to philosophy:

“Many of the great thinkers of the Western philosophical tradition have written explicitly on many of the key issues of concern to geographers. [...] Geography has always been based on philosophical positions, but until relatively recently these were largely unexamined” (Elden 2009, 144; 149).

One of the newest and most profound analyses of contemporary philosophy trends in relation to human/ humanistic geography is provided in the collective monograph *Contesting Geography* (Philipps 2017, 29-30).

Addressing the issue of migration, the strategy of current philosophical research has four trajectories.

First, thinkers are trying to develop a completely new and universal philosophical mindset to understand migration and local community experiences in the context of state-centric order: “The migrant hints at the possibility of a different arrangement of the world: she represents deterritorialization, the fluidity of movement, autonomous crossing, the hybridization of identity” (Cesare, 2020, 9). However, the arrival of a large number of migrants can exacerbate tensions and give rise to violent clashes between local populations and recent arrivals. Thus, at the same time, researchers do not miss the analysis of the critical role of the state as both an actor and arena in the migration-conflict nexus (Côté et al. 2018).

Secondly, philosophical archeology analyses the genesis and dynamics of views on migration that are current but rapidly becoming outdated. For instance, in order to understand the current attitude towards immigration with all its challenging aspects, it is necessary to go back to the origin of the European migratory regime, based on the concept of the guest worker. The latter defined migration as a purely economic phenomenon but “since it clashes with the philosophy of rights and solidarity embedded in European democracies, this model has been repeatedly remoulded.

Therefore, European countries have had to come to terms with the instances of inclusion, equalization and the recognition of diversity, [...] thus shaping the image of a Janus-faced Europe” (Zanfrini 2018). Consistent with this is migration discourse analysis, which focusing on how history and historical memory are used to make claims about the inclusion of some and the exclusion of others in public discussions on immigrant integration in Europe. These debates often sustain categorizations and classifications of the population in terms of “natives”, who are allegedly historically rooted, and “non-natives”, lacking historical roots (Bertossi et al. 2020; Dessewffy 2021).

Thirdly, it is an analysis of various concepts and their historical explanations, and assignment of new meanings to such concepts as hospitality, identity (a turn from national to regional and cultural identity) and language, to mention a few. In the case of Latvia, for example, one of the first questions about the relationship between migration and identity was the socio-linguistic research on the very sensitive issue of the impact of the migration on the situation of the Latvian language (Latviešu valodas aģentūra 2012).

Fourthly, the philosophy of religion and study of religion is the most relevant philosophical theoretical and methodological basis for analysis of the links between religious communities and migration in the interdisciplinary realm.

On the one hand, the increase in migration in the 20th and 21st centuries has had social, political and economic implications, but has also effected change in the religious landscape, in religious beliefs and practices and in the way people understand themselves, each other and the world around them. Therefore, religious study addresses questions which originate in various geographical locations and demonstrates new modes of interconnectedness between religion and migration (Frederiks et al. 2016). On the other hand, despite the dramatic worldwide spread of religious-based discrimination, persecution and conflicts, both official data and academic literature have underestimated their role as a root cause of contemporary migrations (Zanfrini 2020). The most important source for research on the relationship between migration and local religious communities can be found in the field of pastoral care ‘because assistance to migrants is a task and challenge for the Church’ (Pontifical Council for the Pastoral Care of Migrants and Itinerant People, 2004) and for all the religious centers. For instance, in Poland the Divine Word Missionaries of Fu Shenfu Migrant Centre help Vietnamese migrants to integrate into the Catholic Church and local communities in Poland through pastoral care, legal advice, Polish language classes and charitable work (Hounaké 2018). In this context, the above mentioned research project has yet to obtain data on the work of the Pro Sanctitate

movement with the growing Vietnamese religious community in Latvia, and they would be of internationally comparable value throughout Europe.

Meanwhile, this article pays considerable attention to the possibility of applying a philosophical approach to the Covid-19 pandemic in Latvia. The aim is to get an insight into the possibility of solutions at the intersection of philosophy and human geography.

Methodology

According to the philosophical methodology, the concept serves as a principle for the development of data interpretation architecture. It allows us to see and distinguish the essential human experience that, supported by data, characterizes the dynamics of human life during the pandemic.

In terms of unified innovative knowledge system, there is need for its architecture principle. One could refer to Aristotle's ontology of human engagement with the world (Kavanaugh 2007) or to Immanuel Kant's architectonic principle in the transcendental doctrine of method, by which he means "the unity of the manifold of cognitions under one idea" (Manchester 2002, 622). Such a unifying architectural principle is necessary because of the epistemological state of the human mind, which must process an immense amount of the production of other human minds, namely images, speeches, and writings, to distinguish specific forms of experience in this mirror of reality.

The daily experience of the Covid-19 pandemic leads us to a preliminary conclusion about the significant impact of lockdown on the dynamics of human life. "Existential migration" is a suitable concept to analyze this, because nominally it coincides with the "migration" term, which is so important for our project, although each of the sciences involved explores it differently. In the realm of reality, it resonates with our study, because it reveals new essential aspects of human existence in order to enrich the overall study. What, then, is "existential migration"?

The use of the concept of existential migration, invented by phenomenologist and psychotherapist Greg Madison, allows us to provide an understanding of "home experience", which took on a completely new meaning during the pandemic lockdown, affecting people's lives. On the one hand, during the Covid-19 pandemic, home became the safest place to stay; on the other hand, home appeared to be both a workplace and a test site for sometimes-excessive social communication in a small social group.

Returning to the roots, Greg Madison conducted research with migrants, but his findings allowed for further generalizations. Phenomenological interviews with voluntary migrants, individuals who choose to leave their homeland to become

foreigners in a new culture, reveal consistently deep themes and motivations, which could be labelled “existential”. Rather than migrating in search of employment, career advancement, or overall improved economic conditions, these voluntary migrants are seeking greater possibilities for self-actualizing, exploring foreign cultures in order to assess their own identity, and ultimately grappling with issues of home and belonging in the world generally. Therefore, Greg Madison insists that home is not only connected with a territory, the usual “home as place”, but is the result of human interactions, which are able to create a home feeling in any time and place (Madison 2006).

In opposition to this, Madison describes an “existential migration”, while defining it as the necessary way to truly ‘home experience’. He stresses that existential migration seems to sustain enhanced possibilities for self-awareness; authenticity arising from confrontation with the alien and the non-ordinary. ‘Authentic homelessness’ may offer the potential for human dwelling in awareness of the *unheimlich* (germ. “not-being-at-home”, a reference to Martin Heidegger’s ontology). In the broadest sense, as Madison writes, “the existential migrant, the term I used to describe us, chooses to leave his or her homeland, pushed out by deep questions that can’t be answered at home, pulled into the wide world in order to discover what life is.” (Madison 2009, 7). In this way, the concept of existential migration clarifies the possibility that “home” in its conventional sense constitutes true exile from values such as authenticity, awareness, pursuing self-potential, freedom and valuing the ineffability of existence. In terms of existential migration, the suggestion is that we are *not-at-home* not because we have been exiled from home, but rather because we have been exiled by home from ourselves.

Consequently, it is possible to speak about the home experience in connection with the authenticity of human beings. Therefore, the application of this research tool is quite appropriate for the analysis of data on the pandemic situation in Latvia. From the hermeneutical point of view, it is possible to generate home experience as the experience of a human being everywhere and any time. Paradoxically, but during the lockdown due to the Covid-19 pandemic people had to face existential migration in order to survive at home.

From the point of view of methodology, a middle-level theory would allow the linking of general philosophical positions with the interpretation of empirical data. This is exactly what human geography has to offer in researching Covid-19’s impact on the well-being of the population in Latvia at various geographical scales: “These set the need to assess the extent and ways in which socio-demographics have determined different spatial behavior, and attitudes and shifts in employment patterns. Moreover, Covid-19 displays geographic inequalities among the age groups of the

population in Latvia: the outbreak is causing severe health, social and economic challenges, many of them being directly related to demographic factors” (Krisjane et al. 2020). In such aspects of daily life, behavior patterns such as work-life balance, alcohol usage and work regime show variations between regions (Apsite-Berina et al. 2021). The findings of these studies shed light on the aspects for analysis in the body of empirical data and can reveal something important about a person's relationship to the authenticity of his or her life. Data presented in research projects about impact of the Covid-19 pandemic on the population of Latvia serve as a source for qualitative content analysis, and the hermeneutical method of the texts' interpretation (Gadamer 1961) supplements it. For description of the new-emerging values, the axiological approach is relevant. The qualitative content analysis detects the character of existential migration during a pandemic in Latvia. Several large-scale and smaller studies, and reports on the impact of the coronavirus Covid-19 pandemic on the population of Latvia made up a single body of the text for content analysis (Aptauja 2021a; Aptauja 2021b; Centrs 2020; Karnīte 2021; Latvijas Banka 2021; LETA 2021; LETA 2022; LKA 2020; LR TM 2021; Naudiņa 2021; Oficiālās Statistikas Portāls 2021; Rancāns et al. 2021; Reine et al. 2021; RSU 2020; RSU 2021). Cohort analysis units are experts' practical solutions for overcoming ill-being and indicate level of 'cohesive social capital'.

Results

Even a cursory glance at social networks is enough to discern phenomena associated with the time of the pandemic lockdown: personal anxiety due to the alarming and frightening manner of information in the mass media; societal divisions over vaccination; lack of communication skills in small groups such as family members; fear of dialogue with oneself in silence. The pandemic revealed that a person in Latvia in self-perception is a function rather than a self. Consumption and the various activities that inevitably stopped during the pandemic had had obscured the fundamental truths of human existence. People quite often coped with those symptoms, which actually indicate a lack of authenticity of life, with medication, or “medicating” such as over-eating, alcohol, disputes, aggression and shouting to relieve stress, self-isolation from social contacts etc. However, a clarification of values in everyday life also developed, and this became the cornerstone of the architecture of existential migration during the pandemic in Latvia.

Hermeneutical interpretative analysis of the population's statements on social networks allows for newly discovered values to be distinguished. They are indicated by applying a table of values to specifically described life situations and the value-based conclusions provided by respondents.

Value of Life: the rise in deaths from Covid-19, personal contact with the deaths of family members, friends or co-workers has led to a reassessment of what had previously been lost in the everyday rush – the crucial importance of the presence of close ones. This affects also a change in the perception of the Other: instead of being seen in a functional role, the whole of the human being was revealed.

The Value of Truth proved to be very important both for information on treatment of the Covid-19 disease and orientation in a mixture of information and conspiracy theories, as well as for issues of social justice, such as the use of state funds in the pandemic, access to medical services, job retention and economic support of small businesses.

The value of communication and interpersonal relationships was also rediscovered; the lockdown was like a litmus test, showing both the weaknesses in relationships and individual shortcomings which needed to be fixed in order to maintain the relationship.

The pandemic lockdown seemed to force a rediscovery of the value of human freedom and thus led to a rethinking of how human freedom could be better exploited, particularly in searching for an authentic way of life. Thus, through axiological measurement, it is possible to link specific expressions to the very general concept of existential migration. It is the rediscovery of values during a pandemic lockdown that “takes people out of their homes” in some kind of existential migration in order for them to be at home as a relationship, not only a place. Meanwhile the sharing of values takes place in interpersonal communication, which was limited during the pandemic and revealed shortcomings in the quality and authenticity of the human interpersonal relationship. For instance, in the sphere of culture, only 20% of creative people estimate that they can continue fully with their creative activity. They are disproportionately representatives of architecture, design, literature, media and the visual arts. Obviously, on the other hand, lockdown had a great influence on the population's ability to satisfy their needs for culture and social communication in the sense of attending concerts, theatres, and other large-scale cultural events (LKA 2020).

The term “wellbeing” could be at least partially the empirical equivalent of the “home experience”. It’s noteworthy that the concept of subjective wellbeing is not considered a homogeneous concept among researchers: “Also in Latvia subjective well-being is most often identified with life satisfaction, happiness, success and achievements, at the same time it is just one of the components of life quality” (Apsite-Berina et al. 2021, 29). However, in this context as the main indicator appears to be work-life balance: “According to the survey results, the most significant changes during the Covid-19 pandemic were related to the balance between work and personal life. There was a strong sense of loneliness observed for those respondents who live

alone in households, as well as non-employed retirees and students” (Krisjane et al. 2020, 53). In human geography research it was found that work-life balance was significantly more disturbed among those living in more densely populated, core parts of the country. Moreover, involvement in remote education has put additional pressure on the assessment of subjective wellbeing and work-life balance among those living in the Pierīga region (capital-city region). Subsequently, “targeted emotional and practical local, regional or national level support to families with under aged children and those in full-time employment would allow to harmonize daily work-life duties, particularly targeting exposed groups such as women, for example” (Apsite-Berina et al. 2021, 34). In accordance with this, other surveys also show that the main concerns of employees during lockdown were: 1) balance between work duties and personal life (32%); 2) “whether the Covid-19 crisis will affect my company” (31%); 3) how to find motivation to work (15%) (Aptauja 2021 a). These results lead experts to an understanding that there must be use of more intangible stimuli like emotional support, personal interest on the part of the employer in the employees, and mutual understanding.

Apart from individual struggles to maintain one’s work-life balance, there were also intra-family and distant learning challenges in Latvia. This may have contributed to the increased levels of parental burnout and family violence (Krisjane et al. 2020, 56). In addition, the number of weddings decreased sharply during lockdown (12.03.2020–09.06.2020) and was 36% lower than in the corresponding period of 2019. Conflicts in marriage and even divorce cases due to permanent co-existence at home during lockdown were noticed, as well as a rise in violence at home. (In any of these areas there are no accurate quantitative data.) Improving communication skills and respecting the private space of others were highly recommended as solutions. It is obvious that the root cause of illbeing phenomena in a very important sphere of subjective sphere of wellbeing is shortcomings in communicative strategies, both in the public sphere and in the field of interpersonal relations, as the emergency adversely affected populations’ wellbeing: “It affected behavior and communication with other people within family and society” (Krisjane et al. 2020, 54). In turn, communication shortages are linked to disturbance of the authenticity of human existence.

Another important indicator of illbeing during the pandemic is mental health. In the experts’ evaluation, the mental health of young people is at a critical level, as 63% of young people in Latvia admit that their mental health has deteriorated during the pandemic (LETA, 2020). As a healing tool the young respondents themselves mention their urgent needs: “more time with friends” (60%), “physical activity or sports” (48%), “psychologist’s consultations or psychotherapy” (37%), “assistance in studies”

(29%), “joint activities with family” (28%) (Centrs 2020). Moreover, half of the population considers that the pandemic is having a negative impact on their mental health (Leta 2022). Latvians are concerned about the economic situation in the country (73%) and admit that they have felt fear about their future because of the Covid-19 pandemic (51%), and desire to plan their finances more actively (52%) (Aptauja 2021b). Consequently, in all the mentioned cases, an inability to properly share values in communication are diagnosable.

In social science terminology, researchers point to the character of “cohesive social capital” during the Covid-19 pandemic in Latvia. Namely, respondents agree that they can rely on the closest circle of people to them: relatives, friends and like-minded people. However, as social distance increases, trust in other people declines. Closeness to people in their place of residence drops, but the reliability of “people as a whole” becomes even lower. There is avoidance of permanent relationships with strangers and people driven by a shared interest rather than an emotional experience (RSU 2021, 83). In the context of our research with respect to the crisis of the Covid-19 pandemic, this can be interpreted as meaning that the social environment is quite weak for making connections and interactions, which constitutes the home experience for a wide variety of people in society.

The importance of outdoor activities in gardens, parks and other natural areas increased significantly during the Covid-19 pandemic and was associated with a positive effect on the physical and mental health and wellbeing of individuals. Consequently, in the context of human geography research, “regional differences in subjective well-being can be explained not only with changes in daily routine – remote work and education – but also with population density and outdoor leisure opportunities. The subjective wellbeing of residents is affected to a lesser extent in those regions where population density is lower and access to outdoor activities more open” (Apsite-Berina et al. 2020, 34). This kind of indisputably beneficial experience was during the pandemic a form of existential migration *par excellence*, which allowed one to engage with oneself and to return home to generate there, in the place of close co-existence with people, some kind of home experience, i.e. genuine human interactions.

Conclusions

From a methodological point of view, this study reveals the possibility of creating a unified knowledge system with the aim of promoting the growth of the knowledge society. In the interdisciplinary study of human geography on the challenges of migration, the creation of an intersection with philosophical research can be evaluated as an innovative methodological approach. The philosophical concepts

“home experience” and “existential migration” were used in a pilot model of the methodology, showing how concepts with a high degree of generalisation can be linked to empirical data sources and their interpretation.

For this purpose, the use of value theory mediation ensures that general concepts are linked to empirical research. In its turn, human geography research on the impact of Covid-19 on the Latvian population was integrated as a middle-level theory. This identified two main areas of subjective wellbeing, characterised by the most dynamic changes during the pandemic: work-life balance and mental health assessment. These clues led to the main points in an analysis of data from a variety of surveys. The data set forms a single text that is interpretative of the social cohesive capital of the society.

An indisputable beneficial experience during the pandemic was a walk in nature, going outside the home as a form of existential migration, which allowed one to engage with oneself and to return home to generate there, in place of close co-existence with other people, some kind of home experience, i.e. genuine human interactions.

In our society genuine human interaction is, obviously, limited and does not provide enough possibilities for the home experience which Greg Madison talked about. However, in the global world, during large-scale difficulties and limitations, mutual solidarity between people or a much larger “cohesive social capital” in society would be of very great importance. Such an aspect would certainly be taken into account in research into migration challenges in the formation of a Latvian-European knowledge society.

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Kopsavilkums

Raksts ir eksperiments vienotas zināšanu sistēmas izveides laukā, jo parāda, kā ir iespējama vispārnozīmīgu filozofisku jēdzienu, cilvēka ģeogrāfijas pētījumu un empīrisku datu sintēze. Šajā nolūkā ir izmantots “māju pieredzes” un “eksistenciālās migrācijas” jēdziens, ko ir aprakstījis psihoterapeits un filozofs Gregs Medisons, apkopojot intervijas ar migrantiem, kas ir labprātīgi izvēlējušies iekļauties citā valstī, sabiedrībā un kultūrā, lai tālumā no mājvietas atrastu savai esamībai atbilstīgu dzīves ceļu. Dzīves autentiskuma kā migrācijas motīva pētījumi līdz šim nav bijuši attīstīti, taču šajā gadījumā tie dod iespēju saistīt filozofiju ar cilvēka ģeogrāfiju un pēc tam ar empīriskiem datiem. Cilvēka ģeogrāfijas jomā veiktie pētījumi par Covid-19 pandēmijas ietekmi uz Latvijas iedzīvotājiem veido t.s. vidējā līmeņa teoriju, kas norāda uz divām subjektīvās labbūtības sfērām, kurās pandēmijas laikā notikušas

visdinamiskākās pārmaiņas: darba un dzīves līdzsvarošana un psihiskā veselība. Atbilstīgi šīm norādēm ir iespējams interpretēt dažādo citu pētījumu datus par Covid-19 pandēmijas, jo īpaši mājāsēdes, ietekmi uz Latvijas iedzīvotājiem. Dati veido vienotu tekstu, ko var pētīt ar kontentanāli, par kohortācijas vienībām izvēloties ekspertu ieteiktos risinājumus situācijas uzlabošanai. Tie ir kā norādes uz trūkumiem starppersonālajās attiecībās un komunikācijā, kas ikdienas steigā pirms pandēmijas mājāsēdes bija palikušas neievērotas. Tāpat datu interpretācijai palīdz filozofisko vērtību teorija un hermeneitiskā metode.

“Eksistenciālās migrācijas” visizteiktākā izpausme bija cilvēku došanās brīvā dabā. Cilvēka ģeogrāfijas pētījumi apliecina, ka pandēmijas mājāsēdes negatīvās ietekmes pārvarēšanai ir reģionālas iezīmes, proti, vislabāk tās izdevās pārvarēt vietās ar mazāk blīvu apdzīvotību un attiecīgi lielākām iespējām laika pavadīšanai ārpus mājām. Citiem vārdiem, bija vairāk iespēju “eksistenciālajai migrācijai”, kas cilvēkam deva iespēju nonākt kontaktā ar sevi, izvērtēt savas dzīves patiesās vajadzības un pēc šādas dzīves autentiskuma atjaunotnes, atgriežoties mājās, īstenot labākas, cilvēciskākas starppersonālās attiecības, kas veido patieso “māju pieredzi”. Taču tādu cilvēks vēlas piedzīvot arī visā apkārtējā sabiedrībā un kultūrā. Tas pieprasa cilvēka dzīves un komunikācijas stratēģijas uzlabošanu kā sabiedriskajā telpā, tā arī starppersonu attiecībās, kas ir nozīmīgi arī migrācijas jautājumu risināšanā.

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GEOGRAPHY OF TWO COVID-19 WAVES IN LATVIA**COVID-19 PANDĒMIJAS ĢEOGRĀFIJA LATVIĀ****Elīna Apsīte-Beriņa, Toms Skadins, Ģirts Burgmanis, Zaiga Krisjane,
Maris Berzins**University of Latvia, Department of Human Geography
Elina.apsite-berina@lu.lv**Abstract**

The COVID-19 pandemic and its waves of incidence have had a significant impact on our personal and professional lives. This has led to scholarly interest in various fields, including geography. A growing body of scholarly literature is trying to understand the reasons why some places were and still are more affected than others.

The aim of this study was to shed light on the geography of the Covid-19 pandemic in Latvia and explain the geographical patterns of the pandemic during its first two waves. This was done, firstly, by mapping the number of cases per 10,000 in the municipalities of Latvia; secondly, the analysis also combined that same data with a total of eleven variables, by using bivariate correlation.

The results show that during the first wave, Covid-19 incidence was relatively low. However, during the second wave, there were several large clusters of municipalities with a rather high number (over 500) confirmed Covid-19 cases per 10,000 inhabitants. Results of the correlation analysis suggest that geographical patterns of COVID-19 incidence were a result of a complex set of factors, varying throughout the country. Also, the presence of large clusters of municipalities with a rather high number of cases per capita (mostly) during the second wave points to the possible impact of proximity.

Keywords: geography, COVID-19, Latvia, pandemic

Introduction

A new scholarly chapter has opened in studies on the Covid-19 pandemic since the first publications on the subject back in 2020. It has also been acknowledged that geography plays a crucial role and provides explanations for the spread of the virus. Regardless of the various challenges that the Covid-19 pandemic poses in both our personal and professional lives, it provides an excellent opportunity for geographic analysis (Aalbers et al. 2020).

A growing body of scholarly literature is trying to seek examples and give answers to why some places were and still are more affected than others (Florida & Mellander 2022). The virus's uneven distribution throughout and within countries poses fundamentally geographical questions from which we can learn more about the political, economic, financial, sociocultural and demographic dimensions of the pandemic (Aalbers et al. 2020).

At first, it was assumed that population size, particularly density, played a significant role in shaping the geography of Covid-19. Some researchers linked geographical variation in Covid-19 to factors such as overpopulation, household characteristics, income level and injustice (Credit 2020; Drefahl et al. 2020; Florida & Mellander 2022). Whilst large cities were the first areas to be significantly affected, over time Covid-19 spread to other areas, with a large increase in both cases and deaths in smaller towns, suburbs and remote areas (Carozzi et al. 2020).

Previous research on the Covid-19 pandemic in Latvia has shown geographical discrepancies between age groups. The outbreak is creating serious health-related and socioeconomic problems, many of which are related directly to demographic characteristics (Krisjane et al. 2020; Apsite-Beriņa et al. 2021).

The aim of this study was to shed light on the geography of the Covid-19 pandemic in Latvia and explain the geographical patterns of the pandemic during the first two waves. Consequently, this study sheds light on geographical patterns of Covid-19 in Latvia by mapping the available statistical data and by combining data on Covid-19 cases per 10,000 inhabitants in municipalities of Latvia with several variables, by using bivariate correlation.

Data and methods

The study utilised statistical data from the Central Statistical Bureau of Latvia (CSB) at the municipal level. Data from the Latvian Centre for Disease Prevention and Control (*Slimību profilakses un kontroles centrs*, abbreviated as SPKC), including the number of confirmed cases, the 14-day cumulative number of cases per 100,000 people and the outcomes, as well as the total number of confirmed cases of Covid-19 by municipality was also used.

Information from Latvian government websites (or websites related to the government), along with articles from the news websites Apollo.lv, Public Broadcasting of Latvia (*Latvijas Sabiedriskie Mēdiji* or LSM) and TVNET, was systematised. These sources allowed us to characterise the situation in Latvia during the first two waves of Covid-19, i.e., to provide background.

To show the geographic spread of Covid-19 for both waves, the number of cases per 10,000 inhabitants (also referred to as “per capita”) was calculated and then mapped. For the first wave the average population for 2020 was used, whereas for the second wave, it was the population at beginning of 2021. This allowed for the employment of cartographic analysis.

The analysis also combined data on Covid-19 cases per 10,000 inhabitants in municipalities in Latvia with several variables which had been previously identified (or a variety of which had been identified) as possible factors related to the

geographical spread of incidence. For this purpose, bivariate correlation with a total of eleven variables was used. These variables were: total population, population density, share of population aged 65 and older, average monthly neto salary (except for private sector enterprises where the number of employees was less than 50), share of people with higher education, average size of a household, share of single households (all provided by the CSB), the average share of unemployed people among those aged 15-64, i.e. the working-age population (provided by the State Employment Agency; *Nodarbinātības valsts aģentūra* or NVA), the presence of social care centres, the number of social care centres and the number of potential clients staying in them (all provided by the Ministry of Welfare, abbreviated as MW).

Results: geography of Covid-19 in Latvia

The first case of Covid-19 in Latvia was recorded on 2 March 2020 (LSM.lv 2020a). A state of emergency to limit the spread of Covid-19 came into effect on 13 March. Consequently, numerous decisions were made regarding numerous aspects of the pandemic. For example, full-time studies in person had to be discontinued at all educational establishments and resumed online. Social distancing measures were also introduced, with no more than two people, who had to be separated by at least two metres, being allowed to gather in public or outdoor areas. Exceptions were, for instance, persons living in the same household and their children, as well as persons performing work or official duties (Likumi.lv 2020).

The aforementioned total number of confirmed cases of Covid-19 by municipality was first published on 19 March (SPKC 2022a). Hence, for the purposes of this study, it is considered to be the beginning of the first wave.

A peak of 48 new cases was recorded on 1 April. Before and after that, the number of new cases was considerably lower. The first death was reported on 3 April. During the first state of emergency, a total of 24 people died from Covid-19 or complications related to it (further on also referred to as “Covid-19 related deaths”). Overall, there were a total of 993 Covid-19 cases during the first wave (SPKC 2022b).

The end of the first wave could be considered as being on 29 May, when the number of cases per 100,000 people was almost on the same level as on 19 March (SPKC 2022b). The Covid-19 state of emergency was extended several times, eventually coming to an end on 9 June. Still, not all restrictions were lifted, and it was decided that the support measures would continue for as long as they were needed to address the threat and consequences of Covid-19 (TVNET 2020).

Figure 1 shows the low level of incidence that characterised the first wave and the first state of emergency: 37% percent of municipalities (44 out of 119) had no recorded cases at all, while in most municipalities (55 or 46.2%) the number

confirmed cases per 10,000 inhabitants did not surpass 10. Thus, it was not surprising that municipalities with these levels of incidence made up large contiguous areas, covering most of Latvia. Elsewhere, in western Vidzeme there was a cluster of municipalities with a slightly higher level of incidence. The few remaining municipalities with comparatively higher level of incidence were scattered across the country.

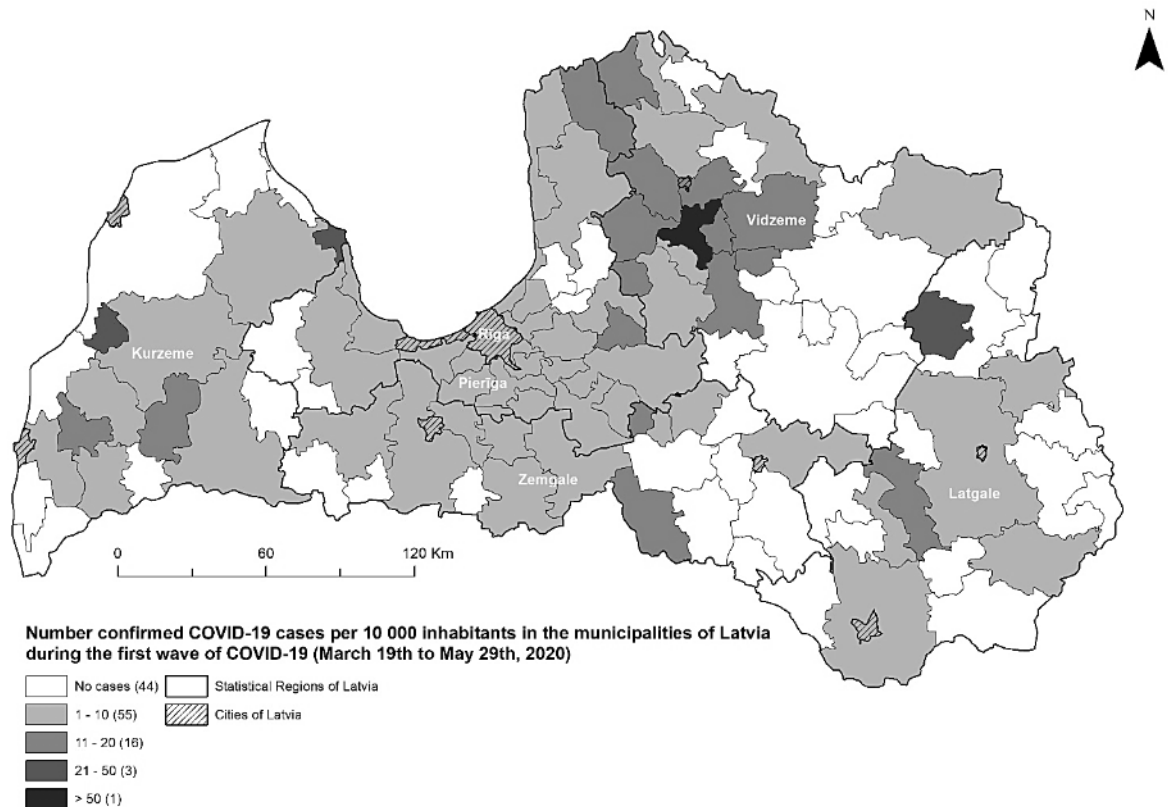


Figure 1. **Number confirmed COVID-19 cases per 10,000 inhabitants in the municipalities of Latvia during the first wave of COVID-19** (authors' figure based on CSB 2022 and SPKC 2022a data)

Table 1 shows bivariate correlation analysis for the total number of confirmed Covid-19 cases per 10,000 inhabitants in the municipalities of Latvia during the first wave. Only one of the 11 variables correlated significantly with cases per capita: the unemployment level. This significant negative correlation could be explained by the fact that those who are unemployed tend to have a smaller probability of interacting with other people, thus leading to lower incidence rates (Florida & Mellander 2022).

Such a lack of significant correlation coefficient values could be attributed to the comparatively low level of incidence - both in comparison with the situation during the second wave and compared to some European countries during the first wave, such

as Italy (see e.g. Ascani et al. 2020) and Sweden (see e.g. Yarmol-Matusiak et al. 2020).

Table 1. Correlation analysis for Covid-19 cases per capita in the municipalities of Latvia during the first wave (authors' elaboration based on CSB, MW, NVA and SPKC data)

Variable	Bivariate correlation	Variable	Bivariate correlation
	Cases per capita		Cases per capita
Population	- 0.008	Share of single households	- 0.098
Density	- 0.26	Unemployment level	- 0.211*
Share of population aged 65 and older	- 0.25	Presence of social care centres	- 0.163
Neto salary	- 0.013	Number of social care centres	- 0.092
Share of people with higher education	0.012	Number of potential clients in social care centres	0.13
Average household size	0.126		

* *Correlation is significant at the 0.05 level*

** *Correlation is significant at the 0.01 level*

During the summer of 2020, the number of new daily cases remained low. The situation began to worsen in September, especially the second half of the month (SPKC 2022b). The start of the fourth quarter is considered to represent the beginning of the second wave (Kruks et al. 2020, 170). This eventually led to the second state of emergency, which started on 9 November. Initially, it was set to last until 6 December (LSM.lv 2020a) but was eventually extended until 7 April 2021 (Apollo.lv 2021a; Apollo.lv 2021b). During this time restrictions were significantly tightened. This included, for example, restriction of trade and face-to-face services. On 17 December, it was announced that for the next three weekends people would not be allowed to leave their place of residence from 10 p.m. to 5 a.m., unless it was for work purposes (LSM.lv 2020b; LSM.lv 2020c).

Still, the number of cases tended to increase and during the second state of emergency there were a total of 19 days where the number of new cases was above 1,000. All of these occurred in late 2020 and early in 2021, with the last such instance being on 20 February. The record number of daily cases (1,831) was reported on the final day of 2020. Overall, there were 84,634 confirmed cases and 1,584 Covid-19 related deaths during the second wave (SPKC 2022b).

After that, the situation began to improve. From 9 February through most of March the number of new cases, both total and the 14-day cumulative incidence per 100,000 people tended to decline, with a more pronounced decline taking place during February. After that, the number of daily new cases sometimes increased compared to a week before, though the situation overall remained rather stable (SPKC 2022b). Therefore, 1 March could be considered the end of the second wave.

Figure 2 further highlights the more notable spread of Covid-19 during the second state of emergency. That was not the only shift, as the patterns had also changed. There were large contiguous areas with an average level of incidence (201–500 cases per capita) – 61.3% (73 of 119) of all municipalities were a part of this group. Also, there were several clusters of municipalities with a rather high number (above average; over 500, but less than 1,000) of confirmed Covid-19 cases per 10,000 inhabitants. A total of 33 municipalities (27.7 % of all) had this level of incidence.

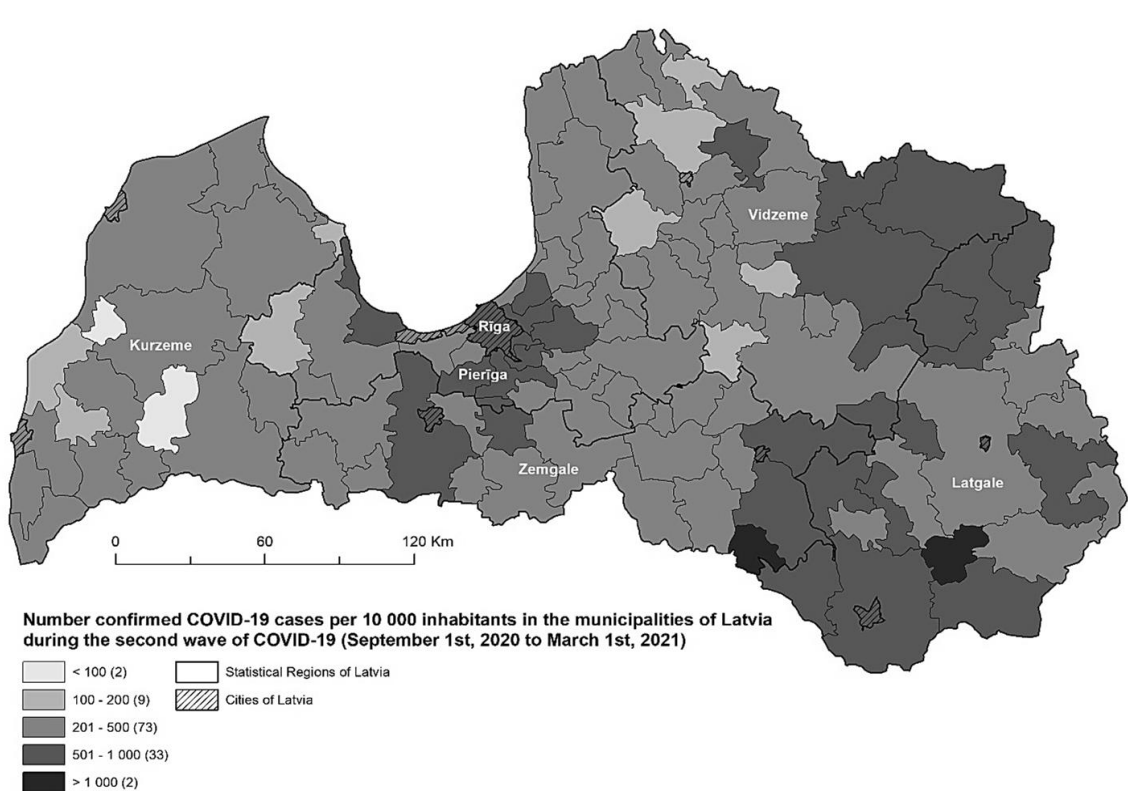


Figure 2. Number of confirmed Covid-19 cases per 10,000 inhabitants in the municipalities of Latvia during the second wave of Covid-19 (authors' figure based on CSB 2022 and SPKC 2022a data)

Table 2 shows bivariate correlation analysis for the total number of confirmed Covid-19 cases per 10,000 inhabitants in the municipalities of Latvia during the second wave. Unlike the first wave, in this instance four variables correlated significantly with cases per capita.

Table 2. Correlation analysis for COVID-19 cases per capita in the municipalities of Latvia during the second wave (authors' elaboration based on CSB, MW, NVA and SPKC data)

Variable	Bivariate correlation	Variable	Bivariate correlation
	Cases per capita		Cases per capita
Population	0.090	Share of single households	0.144
Density	0.204*	Unemployment level	0,213*
Share of population aged 65 and older	- 0.031	Presence of social care centres	0.262**
Neto salary	0.098	Number of social care centres	0.174
Share of people with higher education	0.091	Number of potential clients in social care centres	0.170
Average household size	- 0.233*		

* Correlation is significant at the 0.05 level

** Correlation is significant at the 0.01 level

The first of these variables was population density which had a significant positive correlation with incidence per capita, whereas (again) no such relationship was found in the case of the total population. Numerous studies have shown that density can have a significant impact in spreading of diseases (Tarwater & Martin 2001; Wood et al. 2017; Holmager et al. 2021). Though it should be mentioned that there are examples in literature indicating high incidence in, among other places, smaller towns and remote rural areas where population density is considerably smaller (Carozzi et al. 2020). Such examples can certainly be found among municipalities in Latvia, as some of the municipalities with high levels of incidence have a low population density. Therefore, the impact of population density was not uniform. Average household size had a significantly negative correlation, which is contrary to the findings of other research papers, as Covid-19 tends to spread more easily indoors and thus larger households could be more affected (Martin et al. 2020; Florida & Mellander 2022). Unemployment level is also positively associated with cases per capita. This change, in comparison to the first wave, could be the result of the municipalities of central Latvia (which have relatively low unemployment levels) having an average or above average level of incidence. The presence of social care centres was significantly (at the 0.01 level) and positively associated with the number of cases per capita. However, it should be noted that no such relationship was found for the two other social-care-centre-related variables. This indicates that the impact of social care centres was not as pronounced.

The second state of emergency came to an end on 7 April (Lvportals.lv 2021a). Nonetheless, most epidemiological safety rules remained in place. The exceptions were, for example, that on-site sales were no longer be restricted to product lists and street trade was allowed (Apollo.lv 2021b).

Conclusions

This paper focused on the Covid-19 outbreak in Latvia, explaining chronological course of the pandemic in Latvia and shedding light on geographical patterns. Results suggest that during the first wave, the number of Covid-19 cases per 10,000 inhabitants was relatively low: 44 municipalities out of 119 had no recorded cases, while 55 municipalities (46.2%) had 10 or less confirmed cases per 10,000. However, the second wave was characterised by several clusters of municipalities with a rather high number (over 500) of confirmed Covid-19 cases per 10,000 inhabitants.

A lack of significant correlation coefficient values for the first wave could be attributed to the comparatively low level of incidence. Four variables correlated significantly with cases per capita during the second wave, which was still less than half of all variables used for this study. This could mean that the geographical patterns of Covid-19 incidence were the result of a complex set of factors varying throughout the country. Also, the presence of large clusters of municipalities with a rather high number of cases per capita (mostly) during the second wave points to the possible impact of proximity.

Acknowledgment

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Kopsavilkums

Covid-19 pandēmija un tās izplatības viļņi ir būtiski ietekmējuši mūsu personīgo un profesionālo dzīvi. Tas ir izraisījis zinātnieku interesi par dažādām jomām, tostarp ģeogrāfiju. Arvien vairāk zinātniskajā literatūrā mēģināts noskaidrot iemeslus, kāpēc dažas vietas tika un joprojām tiek ietekmētas vairāk nekā citas. Šī pētījuma mērķis ir izprast Covid-19 pandēmijas ģeogrāfiju Latvijā un izskaidrot pandēmijas ģeogrāfiskos modeļus tās pirmajos divos viļņos. Tas darīts, pirmkārt, kartējot saslimšanas gadījumu skaitu uz 10 000 iedzīvotāju Latvijas pašvaldībās; otrkārt, analizē dati tika apvienoti ar vienpadsmit mainīgajiem, izmantojot divfaktoru korelāciju. Rezultāti liecina, ka pirmā viļņa laikā saslimstība ar Covid-19 bija visai zema. Savukārt otrā viļņa laikā bija vairākas lielas pašvaldību kopas ar diezgan augstu (virs 500) apstiprināto Covid-19 gadījumu skaitu uz 10 000 iedzīvotāju. Korelācijas analīzes rezultāti liecina, ka Covid-19 izplatības ģeogrāfiskie modeļi bija sarežģītu faktoru kopuma rezultāts, kas visā valstī ir atšķirīgs. Tāpat par iespējamu tuvuma (proximity) ietekmi liecina lielu pašvaldību klasteru

ar visai augstu saslimšanas gadījumu skaitu uz vienu iedzīvotāju izveidošanās (pārsvarā) otrā viļņa laikā.

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**PATTERNS OF INTERNAL MIGRATION DURING THE
FIRST YEAR OF THE COVID-19 OUTBREAK IN LATVIA****IEKŠZEMES MIGRĀCIJAS IEZĪMES LATVIJĀ COVID-19
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Abstract

The COVID-19 pandemic has profoundly changed our daily lives in ways that might have far-reaching effects on societal norms and human behaviour. However, little research has yet been devoted to the pandemic's impact on internal migration. In this article, we analyse the interconnection between COVID-19 and internal migration in Latvia. This article aims to evaluate internal migration patterns during the first year of the COVID-19 outbreak in Latvia, using available data at the municipality level. We compare migration flow statistics from the 2011–2019 period and the single year of 2020, which marked the start of the COVID-19 outbreak in Latvia. The analysis identifies similar patterns regarding internal migration activity among observed geographical units. In both time periods, the highest migration levels around Riga have been witnessed and several other large cities. Comparing these time periods highlights slightly higher migration intensity in 2020 than before COVID-19.

Keywords: internal migration, COVID-19, net-migration, crude migration intensity, municipalities

Introduction

The novel coronavirus (SARS-CoV-2) disease (COVID-19) has spread quickly throughout Europe. In Latvia, the first case was confirmed on 2 March 2020 and reached all the municipalities by the end of the month (Disease Prevention and Control Center 2020). The COVID-19 pandemic has affected health care, education, labour markets and economies in unprecedented ways. Geographical mobility was significantly interrupted in March 2020 as several restrictions on population movement were imposed in the wake of the pandemic. However, less is known about how the COVID-19 pandemic has influenced the patterns of internal migration. This study aims to address this gap by exploring how the rates, intensity and spatial patterns of internal migration changed in 2020 compared with the pre-pandemic period between 2011–2019 in Latvia. Internal migration underpins the functioning of the national economy and is widely acknowledged as an integral part of human development (Bell et al. 2015a). Thus, the COVID-induced global economic recession is expected to affect internal migration (Bernard et al. 2020).

In the wake of the COVID-19 pandemic, the Latvian government also introduced restrictive measures, national lockdowns, and border closures, resulting in a disruptive shock to human mobility (State Chancellery 2022). International migration and tourism were discouraged, while countries selectively applied politics to the local daily mobility patterns (Duque-Calvache et al. 2021). Latvia registered as the only EU country not to impose movement restrictions or restrictive recommendations during 2020 on internal migration (Hale et al. 2021). The extent to which imposed restrictions and policy interventions have impacted internal migration is less understood. During the early phases of the pandemic, numerous studies assess the impact of internal migration on the overall spread of COVID-19 (e.g. Fielding & Ishikawa 2021; Matrin & Bergmann 2021; Shi & Lui 2021; Wankhede et al. 2021). While some other evidence has emerged reporting large out-migration flows from cities with speculations that this trend of ‘urban exodus’ would persist in the post-pandemic times (Nathan & Overman 2020). Drawing on administrative population register data, we aim to analyse the extent of change in the patterns of internal migration across the municipalities in Latvia during 2020 compared to the pre-pandemics. We specifically seek to address the following questions: how the internal migration patterns have changed over the first year of the pandemic (1), and how did these patterns vary across municipalities (2).

In the following section, we outline the data and methods. Section three briefly presents the research context of internal migration in Latvia, and the fourth section describes the empirical results. We conclude the paper with a summary and discussion of the key findings.

Data and methods

Internal migration research has long been a challenge for researchers in terms of how data is collected, the time intervals over which migration is measured, and the spatial frameworks employed (McCollum et al. 2021). An important distinction with data collection is between capturing migration events associated with population registers and data on migration transitions, derived by comparing place of residence at two points in time (Rees et al. 2016). Events count migrations and are usually measured over a single year, while migration transitions can be measured over any time interval, although the most common are one and five years (Bell et al. 2015b). To investigate the impact of the COVID-19 pandemic on internal migration in Latvia, we used and compared the annual data on internal migration between 2011–2019 (yearly) and 2020. Migration data were retrieved from the Population Register, where migration was measured as an address change covering inter-urban and inter-municipal migration flows (CSB 2021). Migration was thus measured as an event

rather than a transition. Event-based statistical systems better capture the full extent of population mobility, and its complexity as multiple migration events per person can be measured. Moreover, the extraction of inter-urban flows from the total migration at the municipal level also provides the flexibility to aggregate and reaggregate the data for different functional and hierarchical units of the settlement system. Our data capture all registered changes of residence across urban and municipal boundaries, containing information about the number of moves between urban areas and for all 119 municipalities in each observed year. The migration data is considered reliable and robust for the analysis, even though it is voluntary for a person to declare their residence in Latvia and there is no legal obligation to register a move to another place of residence. However, our data only covers the moment of registration and not the date of the actual move. Therefore, a time lag is possible, especially in the context of the COVID-19 pandemic in the spring of 2020, when the availability of public services was restricted due to the lockdown.

The methods employed were descriptive, given the nature of the aggregated tabular datasets available from the Central Statistical Bureau of Latvia. However, the time lag in registration and the nature of the available datasets did not affect the accuracy of the annual migration numbers or the applied scene-setting analysis used in this paper. To analyse internal migration patterns, we calculated widely used migration indicators (Bell et al. 2002). First, the overall level of population mobility is conventionally measured by the Crude Migration Intensity (CMI), computed as:

$$CMI = M/P \times 100 \quad (1)$$

where M represents the total number of registered migration events, and P represents the population at risk. We specify the population at risk in each municipality/urban area as the average annual population. The CMI indicates the percentage or level of internal migration and allows us to compare how the migration rate changed from the year before the COVID-19 to the first year of the pandemic when various restrictions and lockdowns were in place. Second, to identify changes in the impact of internal migration on the redistribution of the population across counties and between urban and rural areas, we compute the net internal migration rate (*NMR*):

$$NMR_i = (D_i - O_i)/P_i \times 1000 \quad (2)$$

where D_i are the total inflows (in-migration), O_i is the total outflows (out-migration), and P_i is the population at risk of the municipality or urban area i . Given the extent of the comparable time periods, we convert 2011–2019 statistics to yearly

values dividing them by 9. For both indicators, we visualise the changes in the spatial pattern of internal migration between 2011–2019 and 2020. In addition to these basic indicators, we also computed in-migration and out-migration rates per 1000 inhabitants.

Research context: Internal migration in Latvia

Internal migration can be considered a key catalyst in affecting population change and distribution within Latvia. In order to assess internal migration statistics and connection to COVID-19 pandemic in 2020, the pre-pandemic context should be provided beforehand.

The migration pattern within the country historically has been rather heterogeneous (Fig. 1) and mostly related to economic and political occurrences at that instant. The internal migration statistics mostly divide into two eras: before 2003 and after it. During the former period approximately 37,000 migrants were registered annually, whereas the latter period has seen considerably higher migration activity: 53,000 migrants. The pre-2003 era can be explained by a less organised and more bureaucratic residence declaration process. However, in 2002, the government of Latvia passed a law (Dzīvesvietas deklarēšanās likums 2002) that made the process easier and less time-consuming with less documentation needing to be provided. The system came in effect in July 2003 and resulted in the highest total migration Latvia has witnessed.

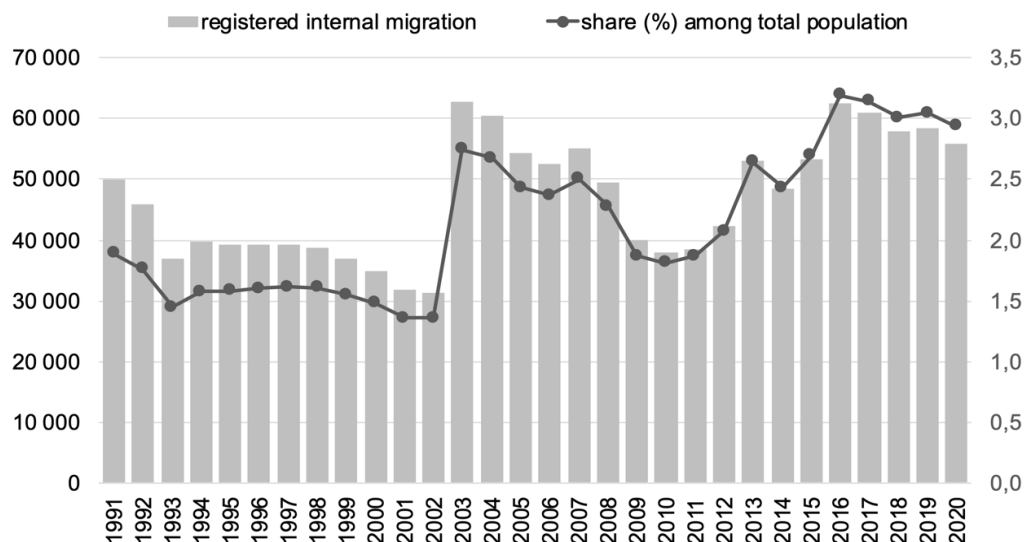


Figure 1. **Total registered internal migration in Latvia and share of migrants in total population** (authors’ figure based on data from Central Statistical Bureau of Latvia)

Since 2003, there have been similar smaller-term fluctuations that can be explained by the several amendments to the 1998 Law on Real Estate Taxation (Par nekustamā īpašuma nodokli 1997). The most notable difference from previous years was in 2012 when the amendment provided benefits via lower tax rates to persons who did not own uninhabited properties (Grozījumi likumā “Par nekustamā īpašuma nodokli” 2012), thus economically motivating residents to declare.

However, the highest internal migration total of recent years has been registered in 2016. This could be explained by more amendments in the aforementioned Residence Declaration Law of 2002, firstly, allowing to declare in auxiliary buildings, and, secondly, made the process available remotely via online declaration (Grozījumi Dzīvesvietas deklarēšanas likumā 2015). In addition, 2016 had also registered the highest migration intensity (3.4%).

Politics have been crucial in facilitating internal migration statistics in Latvia post-2002; however, economic factors are also important. The lowest migration activity was registered from 2009 to 2012 due to the global financial crisis, which started slightly before, resulting in decreased employment opportunities and thus facilitating emigration flows from Latvia.

Overall, changes in legislation have created multiple statistical fluctuations in specific years; however, these seem to be short-term, only impacting the statistical outcome of the one or two years following. However, the long-term changes are adherent to economic factors and can be more seen when analysing inter- and intra-regional patterns on a territorial unit level.

Total migration patterns and intensity among territories can be mostly related to geographical differences (regional scale) and settlement pattern.

- a) Closer geographical proximity to Riga can result in higher migration rates. Thus, Pierīga municipalities have had the highest in- and out-migration totals, whereas migration intensity is lower in peripheral regions of Latvia.
- b) Considerable differences can be found between cities and rural territories. The lowest migration intensities are characteristic of large cities and towns with the highest population density, whereas rural territories with smaller population are more impacted by internal migration.

However, within the scope of this article, we examine the geographical patterns of internal migration on a municipality level.

Internal migration and COVID-19: the curious case of 2020

In this section we compare the migration statistics of 2020 with those of 2011–2019. The major forces affecting patterns and overall levels of internal migration both

pre-COVID-19 and during the outbreak have usually operated over a longer time period and little change is expected within a single year. Therefore, we must bear in mind that during the first year of the pandemic migration will be primarily related to other reasons and only partially to the pandemic.

The total migration numbers confirm the notion above. In 2020, Latvia had 55,8000 internal migrants registered who had changed their residence to another municipality (Figure 1). In comparison, the total differs from the average for the pre-COVID-19 periods. For instance, in 2011–2019 there was an average of 52,500 migrants annually, while in 2015–2019 it was 59,300, whereas in 2019 58,300 migration cases were registered. It must be added that the period includes some of the fluctuations described in the previous chapter. Thus, the smallest difference can be witnessed between 2019 and 2020.

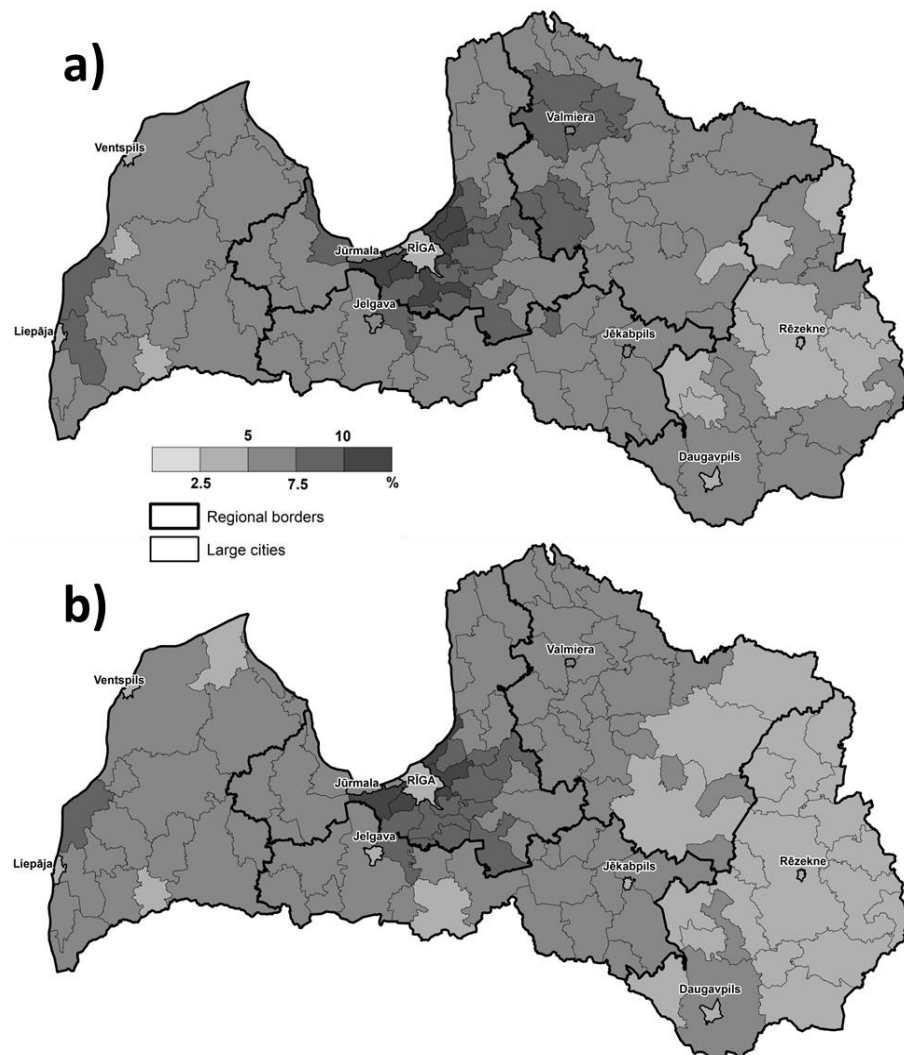


Figure 2. Yearly crude migration intensity in (a) 2020; (b) 2011-2019 among municipalities of Latvia (authors' figure based on data from Central Statistical Bureau of Latvia)

Riga, other large cities and other municipalities show the highest contrast with regards to net-migration rates. The capital city had positive net migration in the 2010s, whereas in 2020 it was negative, mostly at the expense of municipalities including the suburbs of Riga, regional and small towns, and rural areas. The suburbs have contributed most to Riga’s negative net migration.

The territorial factor plays a significant role in the overall development of migration pattern, with the municipalities closer to the capital city having positive net migration rates and the highest overall migration intensity (Bērziņš et al. 2019). Geographically net migration has registered as positive in administrative units in closer proximity to Riga (suburban area); whereas numerous peripheral municipalities had cumulative net migration below -500 in 2011–2020. This pattern of proximity as the main geographical determinant has not changed between the 2010s and the first year of COVID-19 pandemic. Therefore, it is necessary to examine the relation between Riga, other large cities and other municipalities (Table 1).

Table 1. Yearly migration rates in Riga, and other large cities and municipalities in Latvia (authors’ elaboration based on the data from Central Statistical Bureau of Latvia)

	2020			2011-2019 (yearly)		
	Riga	Other large cities	Other municipalities	Riga	Other large cities	Other municipalities
Crude migration intensity (%)	4.5	4.6	7.3	4.0	4.3	6.3
Net-migration (per 1000)	-3.4	1.5	1.7	3.3	0.4	-2.4
In-migration rate (per 1000)	21	24	37	22	22	30
Out-migration rate (per 1000)	24	22	36	18	21	33
Total population (%)	32.5	18.9	48.5	32.3	19.1	48.6

The aggregate crude migration intensity highlights the volume of registered in-migration and out-migration. Municipalities with higher inflow and outflow will most likely have the highest intensity rates. A higher intensity has been witnessed around Riga for both observed periods, whereas further away from the capital city migration has been less intense. The dependence of intensity on location was more evident for 2011–2019 (b in Fig 2.), with exceptions around Liepaja and Daugavpils, where the intensity for several municipalities is similar to those around Riga.

The yearly net migration rate allows us to compare all municipalities and assess relative population change due to internal migration (Fig. 3). This pattern of proximity as the main geographical determinant does not differentiate between the 2010s (b) and the first year of the COVID-19 pandemic (a). However, its extent has slightly changed, and 2020 has seen higher net migration rates. Especially around Riga and several other large cities, such as Liepāja, Valmiera and Jelgava.

Interestingly, rural municipalities around Latgale’s largest cities has had different patterns with regards to net migration and intensity rates. Daugavpils rural municipality has been an outlier for migration intensity among the easternmost units of Latvia, whereas Rēzekne rural area has considerably differentiated by net migration rate. In 2011–2019 (“(b)” in Fig 2.), Daugavpils *novads* has registered the highest rate in Latgale; whereas in 2020 (“(a)” in Fig 2), the overall intensity rate of peripheral municipalities had risen and equalled Daugavpils *novads*. In 2020, the outliers were rural municipalities with smaller populations in regions such as Vidzeme and Zemgale.

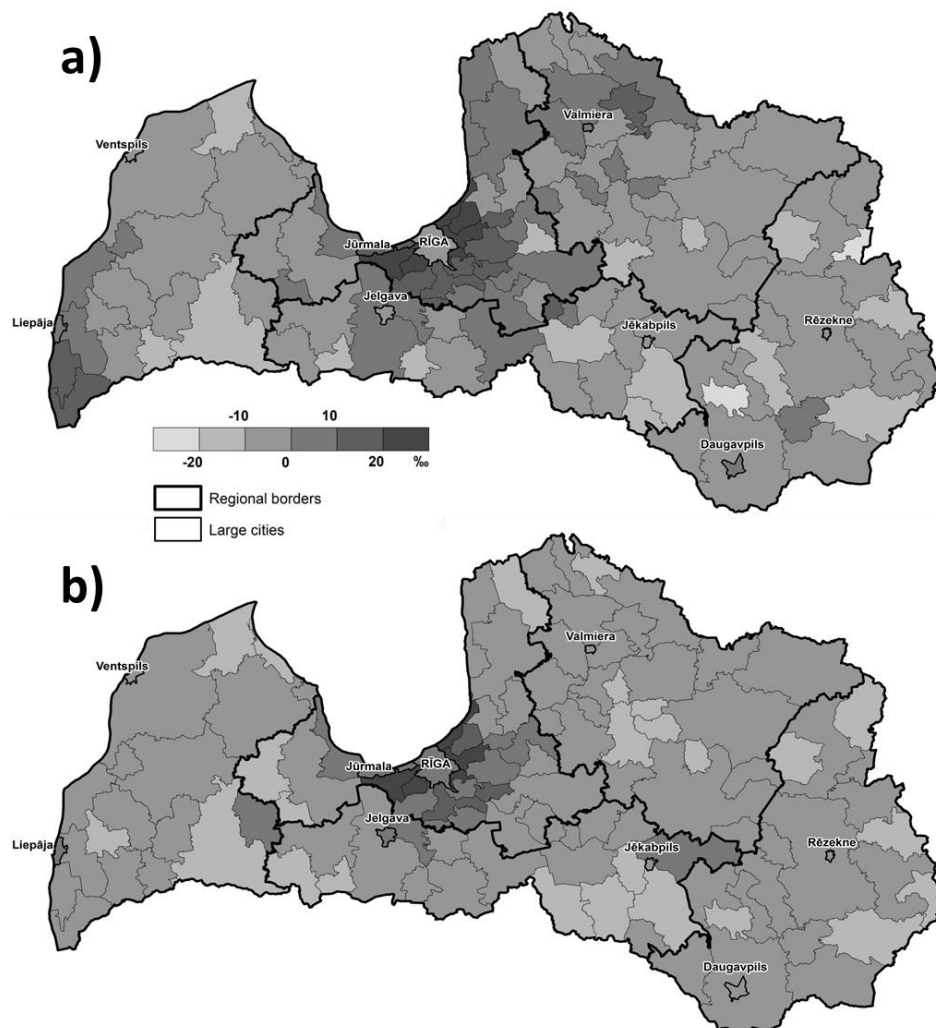


Figure 3. Yearly net migration rate in (a) 2020, (b) 2011–2019 among municipalities in Latvia (authors' figure based on data from Central Statistical Bureau of Latvia)

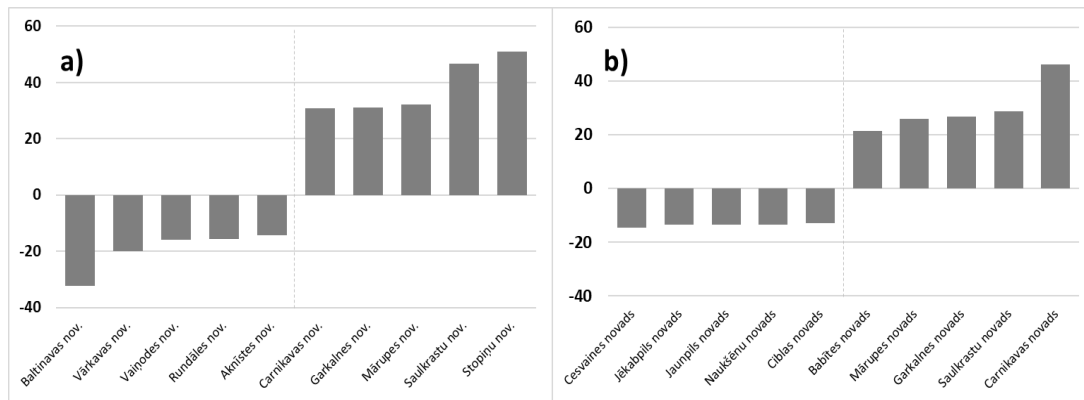


Figure 4. Yearly net migration rate extremes in (a) 2020, (b) 2011–2019 among municipalities in Latvia (authors' figure based on data from Central Statistical Bureau of Latvia)

Outliers or extremes are municipalities with the highest or lowest rates. Yearly net migration extremes even further highlight the difference between Pierīga municipalities closer to Riga and the others. Therefore, suburban municipalities are represented among the positive extremes (Fig. 4), whereas all other regions are among the negative extremes for 2020 and 2011–2019. Geographically, the contrast between Pierīga and the others is evident regardless of the observed time period; however, there have been differences quantitatively.

For 2020, net migration rates are more heterogeneous, resulting in higher and lower extremes. On the negative side, Baltinavas *novads* in Latgale region has registered -33 population loss per 1,000 people due to internal migration in a single year. On the positive side, Stopiņu un Saulkrastu municipalities have gained 51 and 46 per 1,000 respectively due to internal migration in a single year. In 2011–2019, the only outlier was Carnikava municipality. Logically, it is much more difficult to register extremely high or low migration balance in a nine-year period. Individual years from 2011–2019 have also had several positive and negative extremes that allows us to assess the impact of social, economic and political processes on an intra-regional scale. For 2020, the extremes are mostly municipalities closer to Riga or peripheral areas with smaller populations.

Conclusion

The major forces affecting patterns and overall levels of internal migration usually operate over a longer time period and little change is expected within a single year. Therefore, we must bear in mind that in the first year of the pandemic migration

is likely to be primarily related to other reasons and only partially to the pandemic. Therefore, geographical patterns between municipalities are mostly similar to those observed pre-COVID-19, with higher migration intensity concentrating around Riga and other larger cities.

The differences in migration patterns between 2020 and 2011–2019 are mainly due to slightly higher migration intensity in some municipalities. Overall, 2020 shows similar trends to the long-term period before. The slight decrease in migration rates could be explained by working and studying remotely. However, the main factors affecting internal migration remain largely unchanged, and the first year of the pandemic does not allow a full assessment of the potential impact.

The COVID-19 situation also affects the overall population from a demographic perspective. Among the ageing, high-risk population of Latvia, COVID-19 increases mortality rates, thus decreasing the population. Within the scope of this article, the total registered migration has been lower than pre-COVID-19 (55,800 in 2020 versus 59,300 in 2015–2019); however, the relative rates have slightly increased. At a time of population decrease, this could mean a more important role of internal migration in population redistribution.

The results of our study do not allow us to draw far-reaching conclusions on the impact of the COVID-19 pandemic on internal migration, as only the short-term effects of the first year of the pandemic were analysed. However, we should acknowledge that the pandemic is still ongoing and impacts human behaviour, including geographical mobility. Thus, further studies are acknowledged to understand how internal migration is changing and how persistent the patterns found are for migration-induced population redistribution.

Acknowledgment

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Kopsavilkums

Globālā COVID-19 pandēmija būtiski ietekmējusi mūsu ikdienas dzīvi, pielāgojot sociālās normas un cilvēku uzvedību visos līmeņos - globālā līdz individuālajam. Ar šīm pārmaiņām saistīta arī ietekme uz cilvēku pārvietošanos, ko pastiprina valdības īstenotie ierobežojumi, gan pārvietojoties uz ārzemēm, gan valsts iekšienē. Šajā rakstā analizēta COVID-19 saikne ar iekšzemes migrācijas procesu Latvijā. Darba mērķis ir izvērtēt iekšzemes migrācijas iezīmes pirmajā COVID-19 uzliesmojuma gadā Latvijā, izmantojot pieejamos iekšzemes migrācijas datus pašvaldību līmenī. Rakstā salīdzinātas iekšzemes

migrācijas plūsmu iezīmes 2011.–2019. gada periodā un 2020. gadā, kas atbilst pandēmijas sākumam Latvijā.

Rakstā secināts, ka pastāv līdzīgas ģeogrāfiskās iezīmes migrācijas pamatrādītāju tendencēs abās apskatāmajās laika vienībās. Lielākā migrācijas intensitāte novērojama tiešā Rīgas tuvumā, kā arī ap atsevišķām citām republikas pilsētām gan vienā, gan otrā laika nogrieznī. Tomēr statistiski, migrācijas rādītāji administratīvajās vienībās 2020. gadā bijuši augstāki nekā desmitgadē pirms pandēmijas.

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**THE IMPACT OF THE COVID-19 PANDEMIC ON THE CULTURAL
AND LEISURE INDUSTRIES: EVIDENCE FROM RIGA, LATVIA****COVID-19 PANDĒMIJAS IETEKME UZ KULTŪRAS UN ATPŪTAS
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Abstract

The aim of this study is to evaluate the impact of the Covid-19 pandemic on the creative-cultural and leisure-entertainment industries in Riga, Latvia. Socialising of individuals is one of the main factors in the success of these industries, and therefore, epidemiological restrictions posed a threat to their further operation. The study was conducted using a qualitative research methodology, namely, semi-structured, in-depth interviews with representatives of creative quarters in Riga. The findings suggest that restrictions imposing social distancing affected the whole industry, yet individual experiences were neither completely different nor identical: the preconditions and characteristics of certain venues were key factors in their successful operation during the pandemic, e.g., establishments with vast outdoor premises were able to adapt to ever-changing requirements easier than venues with limited outdoor space or which were mainly indoors. Likewise, it was found that introducing new services amongst the usual cultural consumption during the pandemic paved the way for developing new, multifunctional quarters in Riga.

Keywords: creative quarters, creative class, cultural consumption, Covid-19 pandemic

Introduction

Socialising of individuals is an integral part of cultural consumption, thus, the Covid-19 pandemic and the restrictions requiring social distancing presented a heavy challenge for the cultural and leisure industries around the world. This qualitative research aims to provide an insight into the impact of the pandemic on the culture and leisure industries in Riga, Latvia through interviews with representatives of the creative quarters of Riga.

Evidence from other parts of the world suggests that, in general, the impact of the pandemic on the creative class was rather negative. Before the pandemic, the cultural and leisure industries were some of the fastest-growing sectors in the world, but the pandemic left them heavily damaged (Khlystova et al. 2022). While many were forced to shut their businesses as a result of the pandemic, the unprecedented

situation paved the way for new ideas and improvisation, e.g., cultural events being held online (Vitalisova et al. 2021).

Before the pandemic, in the whole city of Riga the industry was experiencing rapid growth and expansion – with a fast-growing number of creative quarters, modern venues, and the transformation of ex-industrial urban areas into trendy hang-out spaces. However, the industry as a whole still hasn’t recovered to reach the operational levels of 2019. While, with some exceptions, most venues for cultural and leisure activities in Riga are located in the inner city, the residential patterns of persons who are employed in the creative and leisure industries suggest a different tendency (Figure 1; Figure 2).

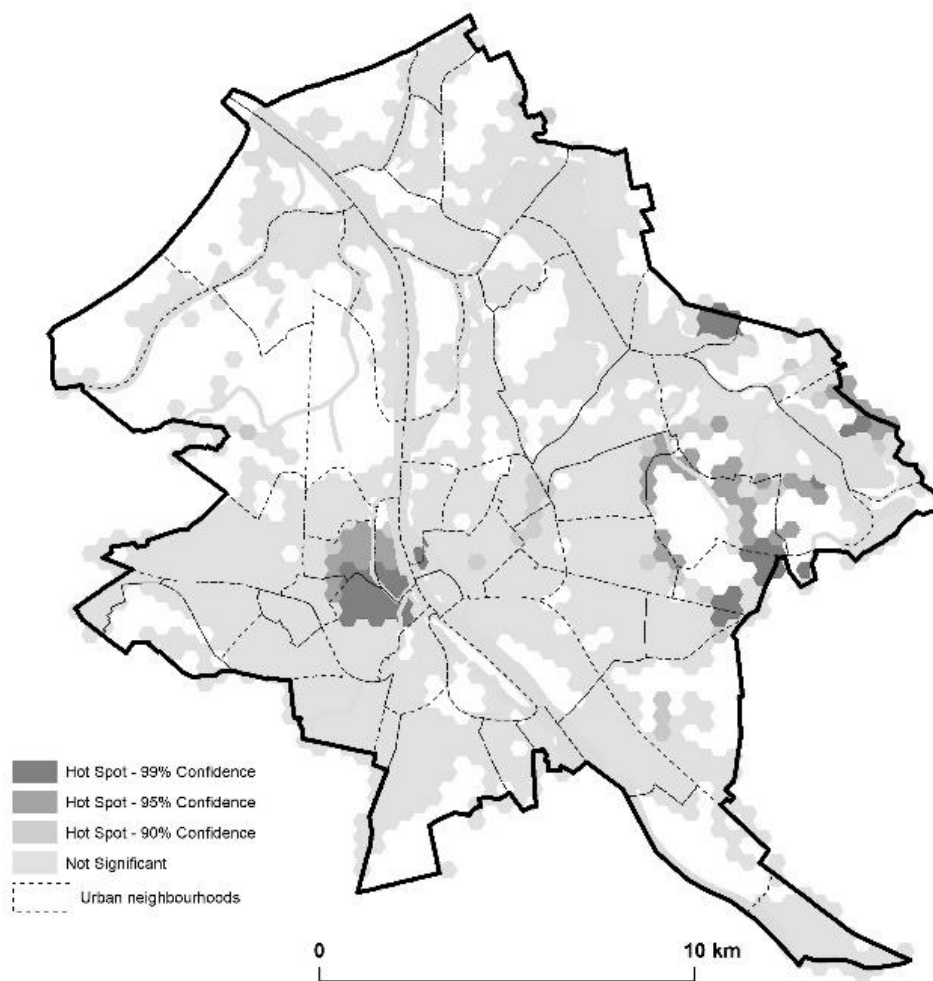


Figure 1. **The residential location of persons employed in the creative-culture industries** (Department of Human Geography, University of Latvia, based on data from Central Statistical Bureau of Latvia)

The creative-culture class in this case is comprised of multiple occupations, such as architects; marketing specialists; persons employed in the cinema, video, radio and television industries; and so forth. The leisure-entertainment class, on the other hand, consists of persons employed in bars, restaurants, sports and other entertainment

sectors. It has long been argued that creatives have an impact on shaping urban areas by either creating specific creative enclaves or contributing to various urban development processes (Bader & Bialluch 2008; Florida 2017; Gainza 2017).

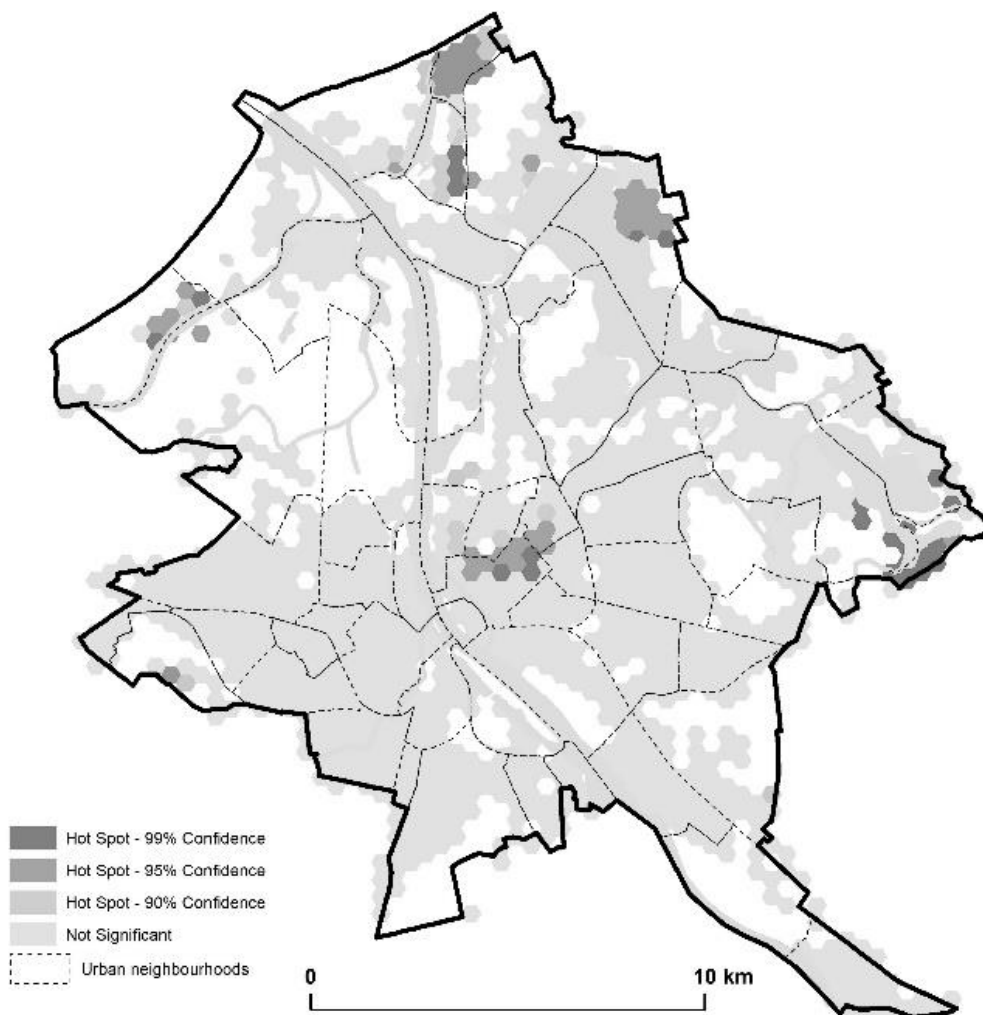


Figure 2. **The residential location of persons employed in the leisure-entertainment industries** (Department of Human Geography, University of Latvia, based on data from Central Statistical Bureau of Latvia)

In 2011, the highest concentration of persons employed in the creative industries was observed in the inner-city neighbourhoods Agenskalns and Kipsala, and the adjacent Dzirciems, while the highest concentration of leisure industry workers was not only in the inner-city neighbourhoods Centre and Brasa, but also in outer-city Jaunciems and Vecaki. Since the Covid-19 pandemic has had a tremendous effect on these two industries, it cannot be excluded that the main clusters of residence for professionals have been impacted as well, resulting in changes of population composition in the neighbourhoods of Riga.

The beginning of the pandemic – first responses

The data provided by the Central Statistical Bureau of Latvia reveals that the total count of unemployed persons in Latvia rose by 12,400 between February and August of 2020 (Centrālā Statistikas pārvalde 2020a). Furthermore, the data reveals that in the first days after the opening of applications for furlough benefits, 12% of applicants were representatives of the arts, music and leisure sectors. However, the aforementioned creatives only made up 10% of the beneficiaries of furlough benefits (Centrālā Statistikas pārvalde 2020b).

The interviews with representatives of the creative industries, however, provided a deeper insight into the response of the creative-culture and leisure-entertainment industries to the pandemic and its effects. The research was done by conducting semi-structured, in-depth interviews with representatives of three creative quarters in Riga. All three quarters are quite popular, one of them being more than 10 years old, whereas the other two have been operating since ca. 2017. All three quarters are prime examples of urban revitalisation in Riga and their main activities usually take place between March and October.

After the government of Latvia declared a state of emergency on March 12, 2020, the first responses of the creative quarters were obvious: they closed. This, however, did not last long. A representative of Creative Quarter 1 reveals that a decision to change the direction of business was made – the quarter, in collaboration with partners such as vendors and restaurants whose activities were also suspended, started a food delivery business, which turned out to be a successful move. A representative of Creative Quarter 2, on the other hand, states that although the quarter could have continued operating due to its vast premises, they made the decision to be responsible and temporarily close the leisure activities. Due to the unexpected lockdown the owners of this quarter realised that the entertainment business was not as reliable as it had seemed to be; therefore, they decided to open a car servicing centre on the site as well, since the requirements for social distancing did not affect this type of establishment.

“We thought that we wouldn’t have much work and it would be a calm time, since events were cancelled, but the reality was completely the opposite – the amount of the work we had to do doubled” – representative of Creative Quarter 1

When asked about June 2020, when some of the restrictions were lifted, the responses differ. It is clear that while the quarters have shared some similar experiences, there are notable differences as well. The representative of the Creative Quarter 2 shared that their venue experienced a major interest in their events, stating,

“It was obvious that our society was hungry for culture and events.”

He stresses that although the quarter was forced to introduce admission fees in order to control the influx of visitors, it was obvious that this measure did not affect the number of visitors – people were ready to queue and to wait to be let in. The representative of Creative Quarter 1, on the other hand, revealed that once the restrictions were reduced, the quarter introduced a new event concept that was focused on quality instead of quantity. Furthermore, an admission fee was introduced for concerts on the premises of this quarter. It was expected that people would be *thirsty* for culture and show a huge interest; however, this was not the case – in a situation where many had lost their sources of income, people started evaluating whether spending money on culture was worth it.

“People were used to free concerts and similar events; of course, not all will agree to pay now” – representative of Creative Quarter 1

In general, adapting to the new reality turned out to have several scenarios, which basically depended on the size of the premises of the quarter. Organisers emphasised that the social distancing requirements were not always crystal clear and were rather confusing, which provided space for different interpretation. Some concerns were also raised regarding the next waves of the pandemic and the potential repetition of a lockdown.

Further developments – the situation in 2021

In October 2020, the second wave of the pandemic in Latvia started, and both the culture and leisure industries were shut down again. This time, however, in-person operation of these industries could be partially resumed only eight months later, in early summer 2021. In the meantime, Creative Quarter 1 proceeded with the food and grocery delivery business, and the cafes and bars located on the territory of Quarter 2 continued operating takeaway and delivery, unlike during the first wave, when they were shut down. A representative of Creative Quarter 3, which can be characterised as one of the largest post-industrial areas in Riga currently operating as a space for creatives, reveals that during the winter of 2020/2021, which is usually a quiet time for creative quarters, the quarter saw interest in leasing some of its buildings as a storage space for restaurant equipment for restaurants that were forced to close and abandon their initial venues. Hence, some of the buildings in the territory are now temporary storage units. The representative states that:

“Here, I offer a cheap rent price, one of the cheapest in Riga. Of course, even with the cheap price, I have debtors too. But I tell them that if they were to move from here, it’s only their home they can move to. They won’t find anything better than this.”

There were various entertainment, creative and leisure businesses that were forced to terminate their activities due to insufficient funds, and it is not clear whether they will have the option to revive their businesses in the future. Generally speaking, there are a certain number of creatives/entertainers who decided to change their professional field and either go for a steady job or emigrate – be they musicians, cooks, persons providing equipment for concerts, etc.

In the second half of 2021, once Covid-19 certificates were introduced, most creative and cultural venues in Riga were able to resume their activities. While there were some venues that initially protested against the requirements that the industry needed to meet in order to operate – particularly the vaccination certificates – many of them were still allowed to operate, since the initial restrictions applied to indoor venues, not outdoor terraces and premises. Generally speaking, the creative quarters that are located in vast outdoor areas were the most successful in both 2020 and 2021. In both years, the large size of their outdoor property was an important factor in meeting social distancing requirements and still having enough visitors. In the summer of 2021, these quarters were allowed to accept visitors without asking them to present a Covid-19 certificate, which contributed to an (almost) unlimited number of visitors, again.

It is important to note that the Covid-19 pandemic was not an obstacle to developing new creative quarters around the city of Riga. Since the beginning of the pandemic in March 2020, two new creative quarters have emerged in the city, and multiple venues have been announced to be at the planning stage. Furthermore, the development tendencies of these quarters suggest that multifunctionality is the future – the pandemic proved that the culture and entertainment sectors alone are not the most reliable sources of income in times of crisis. Therefore, venues that consist of leisure activities combined with co-working spaces, residential buildings, services, etc. might soon replace the currently well-known creative quarters of Riga.

“My future vision of this place is to make it accessible to everyone. All those quarters – it’s just the first step in developing a site. Later on, the artists disappear, and the real business starts.” – the representative of Creative Quarter 3

Conclusion

The Covid-19 pandemic, an unforeseen event with an immediate global effect, affected cultural and leisure industries all over the world, and Latvia was no exception. The requirements of social distancing, having a Covid-19 certificate and limiting the numbers of visitors to venues imposed a threat to the aforementioned industries. While different cultural venues, entertainment establishments and creative quarters encountered slightly different experiences over the past two years, the general trajectories of their response and coping with the pandemic are neither completely different nor completely the same. While such requirements generally restrict the socialising of individuals – which is one of the main factors in the success of these industries – the evidence from Riga shows that there are certain preconditions for more or less successful operating during the uncertain times that 2020 and 2021 have been.

The findings suggest that, while pandemic has had an impact on everyone, cultural and entertainment venues with large outdoor premises suffered less than venues with limited outdoor space or that were mainly indoors. Furthermore, the restrictions in both the first and the second wave of the pandemic in Latvia had a larger effect on the culture industry than the leisure sector. Certain leisure establishments were able to slightly adjust and continue operating, e.g., the restaurants turned to takeaway or delivery business, yet online concerts and exhibitions that were introduced in the first wave were not in as much demand later on.

The pandemic also revealed that cultural and leisure industries might be unreliable in terms of business during times of crisis. Hence, some of the creative quarters of Riga tried to complement their usually creative activities with various other services, e.g., food delivery, leasing storage space, having a car servicing centre on the premises, etc. This also supports the pattern of development of multifunctional quarters in Riga, where quarters offering multiple experiences – cultural, working, residential, leisure, etc. – might eventually replace the currently well-known bohemian hang-out venues.

Acknowledgement

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Kopsavilkums

Covid-19 pandēmijas ietekme uz kultūras un atpūtas industrijas darbību Rīgā. Pētījuma mērķis ir novērtēt Covid-19 pandēmijas ietekmi uz radošo-kultūras un izklaides-atpūtas industrijas darbību Rīgā. Iedzīvotāju socializēšanās ir viens no galvenajiem faktoriem, kas nodrošina šo industriju veiksmīgu darbību, līdz ar to epidemioloģiskie ierobežojumi apdraudēja to turpmāku darbību. Pētījums veikts,

izmantojot kvalitatīvās izpētes metodes – daļēji strukturētas, padziļinātas intervijas ar Rīgas radošo kvartālu pārstāvjiem. Pētījuma rezultāti parāda, ka sociālās distancēšanās ierobežojumi ietekmēja visu industriju, taču atsevišķu gadījumu piemēri nav ne pilnībā atšķirīgi, ne arī identiski: izšķiroši bijuši konkrēto vietu priekšnosacījumi un raksturs, piemēram, vietas ar plašām ārtelpām spēja veiksmīgāk pielāgoties bieži mainīgajiem nosacījumiem nekā tās, kam bija pieejamas ierobežotas ārtelpas vai pārsvarā tikai iekštelpas. Tāpat pētījuma rezultāti atklāj, ka jaunu pakalpojumu ieviešana līdzās ierastajām kultūras aktivitātēm pandēmijas laikā veicina jaunu, multifunkcionālu kvartālu attīstību Rīgā.

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**IS TRAVELLING CURRENTLY A RISK? THE IMPACT OF COVID-19
AND WAR IN UKRAINE****VAI CEĻOŠANA PAŠLAIK IR RISKANTA? COVID-19 PANDĒMIJAS UN
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Abstract

The aim of the study is to examine how regular travellers' behaviour and views regarding international travel have changed as a result of the Covid-19 pandemics and the war in Ukraine. The study includes three research questions 1) how much is travel missed and how do pandemics affect international travel behaviour? 2) how do regular travellers view the danger associated with pandemics and the war in Ukraine? 3) to what extent are future travels perceived as risky? The research is based on statistical data on outgoing tourism and domestic visitor monitoring data analysis, and interviews with 33 regular Latvian travellers. The interviews were conducted during the first quarter of 2022.

According to the findings, regular travellers currently feel a lack of excitement about planning trips or international travel experiences. Those who frequently travel for business report a lower level of longing for this experience. The habit of travelling locally has increased due to the lack of international alternatives during the pandemic with restrictions on global mobility. Regular travellers accept the inconveniences caused by the Covid-19 restrictions, but they were afraid and applied self-protection strategies, or even refused to travel entirely, during the first month of the war in Ukraine. Finally, regular travellers are not going to refrain from taking multiple journeys overseas or to Western European countries in the next six months but will avoid travels to zones of military conflict.

Keywords: travel, mobility, risk, COVID-19, the war in Ukraine

Introduction

The global pandemic Covid-19, since 2020, and the war in Ukraine in 2022 are the two most notable recent crisis events. War is an exceptional human tragedy, but both events have a significant negative influence on various economic sectors, and on tourism particularly. Initially, according to the World Travel and Tourism Council (WTTC), it was estimated that it would take 10–35 months for the tourism industry to return to pre-crisis numbers (Faus, 2020). However, political conditions have reshuffled the expected return to normal, particularly in Latvia and the whole Baltic region, which shares borders with Russia and Belarus. According to the UN World Tourism Organisation, international tourism resumed its comeback in January 2022, with substantially stronger performance than the poor start in 2021. However, the

Russian invasion of Ukraine adds to the already-existing economic uncertainty, as do various Covid-related travel restrictions. Overall confidence may suffer, impeding the revival of tourism (UNWTO, 2022). Covid-19 has had a multifaceted impact, including economic losses, environmental advantages (through reduced transportation consumption) and effects on health and wellbeing (Yang et al. 2021).

Tourist behaviour is defined as the interaction of internal (motivation, attitudes, beliefs, etc.) and external (environmental) elements (economic environment, security, socio-cultural environment, etc.) (Andrades, Dimanche & Ilkevich 2015). Previous studies have shown that tourist behaviour analysis is crucial for tourism development, since it helps to determine travel motivation, destination selection, evaluation and future travel intentions (Augustine and Balachandran 2021). Travel volumes have reduced globally, and journeys have become less frequent since the start of the pandemic (Abdullah et al. 2020). The epidemic has a detrimental impact on respondents' daily routines, reducing visits to any hospitality or cultural sites and frequently suspending the operation of such places. The epidemic appears to cause fear and uncertainty in various facets of consumers' daily lives, including their travel habits (Kourgiantakis et al. 2021). However, many tourists are looking for alternatives, visiting places in their home countries, and emphasising the safety and cleanliness of destinations, hotels, restaurants and other establishments. People are more anxious about their health and safety before trips (Augustine and Balachandran 2021) – even more so since February 2022 – and physical safety has also come to urgent attention. Tourists prefer expensive accommodation as a proxy for safety, excellent cleanliness standards, and privacy (e.g. in Airbnb accommodation), and have an increased preference for more independent travel arrangements over traditional scheduled travel (Kourgiantakis et al. 2021). In studies published in 2020, it was already estimated that the Covid-19 situation would impact tourists' propensity to travel in groups and their willingness to buy tour packages. Travellers would be more concerned with the cleanliness of airports, public spaces and tourist attractions or services, and the accessibility and quality of treatment at the destination. Health standards and subjective perceptions about the performance of the host countries' health systems influence travellers' decisions. Another projected trend is a decrease in money set aside for vacations. Covid-19 is affecting purchasing power (Chebli et al. 2020). Business travel is increasingly replaced with digital meetings and could stay partially digital in the future, being combined with on-site business events (Bukovska et al. 2021).

Travellers express a desire to focus more on short-distance tourist attractions in the country or neighbouring countries (Eichelberger et al. 2021). This represents a significant shift towards localism in tourism consumption (Kourgiantakis et al. 2021;

Marchezini 2019). Among crucial elements to consider when selecting a holiday destination are a low degree of crowding and sanitary standards. Tourists choose outdoor activities that allow them to engage with nature (Gursoy and Chi 2020).

The goal of this timely study is to examine how travellers' behaviour and views regarding international travel have changed as a result of the Covid-19 pandemics and the war in Ukraine, by answering these key questions: 1) How much is travel missed and how have pandemics affected prior international travelling habits? 2) How do regular travellers view the uncertainties associated with the pandemics and the war in Ukraine? 3) To what extent is future travel perceived as risky?

Data and methods

The study is based on a mixed-method approach. It includes a general overview of the decrease in international travel during Covid-19, monitoring increased domestic travel activities as well as in-depth views from regular travellers. The qualitative part of the study included semi-structured face-to-face or online interviews with 33 regular travellers, which were conducted in the first quarter of 2022. The ages of the interview respondents (19 women and 14 men) in the sample vary from 19 to 58, and most often they prefer travel on leisure trips with friends or family.

Table 1. **Interviewee characteristics**

Variable	Criteria	Number
Gender	Woman	19
	Men	14
Place of residence	Urban	26
	Rural	6
Family status	Married	5
	Unmarried	27

The sampling technique includes a random sample of interviewees. An important limitation for participation was the selection of those who perceive themselves as regular travellers and travel at least three times a year. The interview template consisted of 18 questions. The interviewees were informed about data protection and anonymity procedures and asked to consent to the interview being recorded. The interview length varied from 21 to 30 minutes. The interviews were transcribed and analysed using an Excel spreadsheet. The content analysis allowed us to identify similar and/or contrary views regarding core issues relevant to the research questions. The presented citations illustrated the main trends of travel motivation and behaviour changes, risks associated with the pandemic and war, and future travel

plans. Data obtained from the interviews were placed in the quantitative data frame characterising current travel trends (outgoing and domestic).

Travel decline in Latvia since the Covid-19 pandemic

A decrease in international mobility reducing travel activities because of Covid-19 is evident from the statistics from Riga International Airport (see Figure 1). Curve of increasing passenger numbers fell fourfold in the following year. A slow recovery (+17%) was noticed in 2021, not stabilising the situation much. Recent data indicate that over 220,000 passengers used Riga International Airport in February 2022, representing an increase of ~10% compared to February last year.

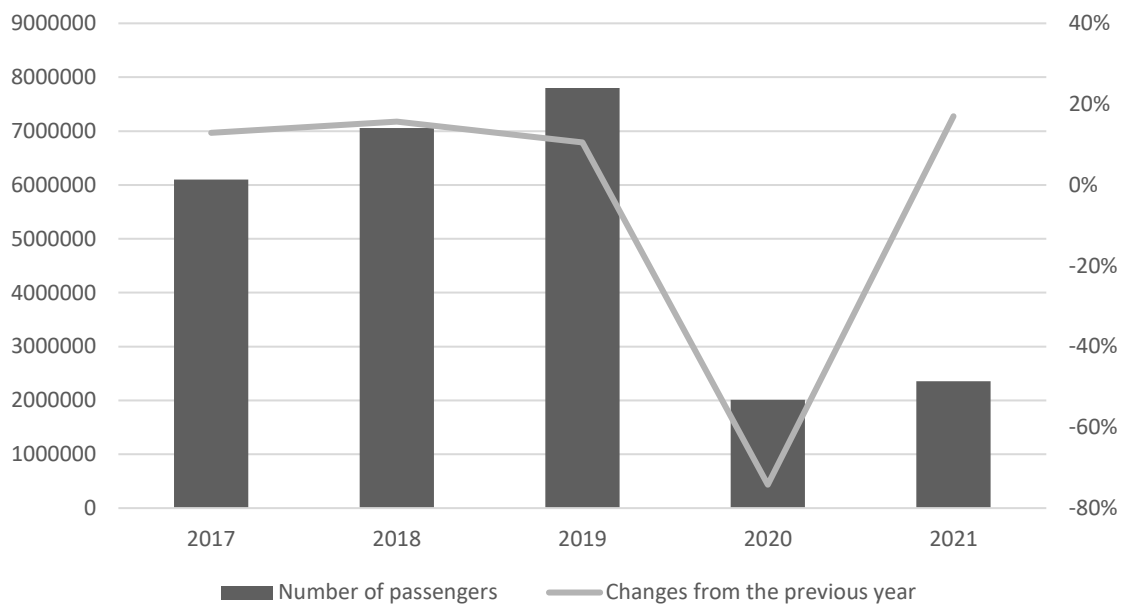


Figure 1. **Riga International Airport passenger turnover and changes from the previous year** (authors’ figure based on Riga International Airport data)

Travel restrictions related to the Russian military invasion in Ukraine concern transfer passengers at Riga International Airport and overall incoming tourism trends in Latvia. In early 2022, there were massively accommodation booking cancellations by regular travellers from Western Europe and Scandinavian countries. The accommodation sector experienced negative trends even though travel restrictions in the two years of the pandemic boosted local nature tourism, producing for many smaller rural tourism accommodations an even bigger turnover than before Covid-19. Large hotels were affected the most. In total, 1.3 million international and local tourists stayed overnight in 2021, which was 10% less than in 2020 and 54% less than in 2019 (CSB 2022).

Russia’s war in Ukraine presents new challenges for the hospitality industry, as tourism ties with Russia are unlikely to resume. The number of Russian tourists in Latvia decreased significantly in previous years – in 2020 by 74%, while last year it was even 93% less than in the year before the pandemic (CSB 2022), and it was similar for outbound travel habits.

Changes in travelling behaviour and longing for travel

An analysis of the results from the interview materials suggests that, in general, the willingness to travel has not changed much (see Table 2), but it has created much more inconvenience due to restrictions (e.g., the wearing of masks, and each country's demands for Covid-19 conditions) and has changed certain decision-making factors. Among respondents, safety has become an increasingly important need during travel and tourism experiences. The war in Ukraine has divided travel attitudes in two ways: either travel attitudes have not changed, or there is now less or no desire to travel because of fears, insecurities, or even feeling guilty for wanting to have fun while people are suffering from war elsewhere. Some choose not to travel to distant places but to closer destination countries or internally. For most, Covid-19 is no longer a concern compared to military action in Ukraine. Some people do not miss travel, but most respondents do indicate a deferred desire for it. The majority (24 respondents) already know where they want to travel in the next six months; some are reviewing provisions for the potential case of a wider war crisis escalation.

Table 2. **Travel behaviour and plans for travel** (based on data from interview material)

Travel behaviour due to COVID-19	Has changed	14
	Has not changed	18
Travel behaviour due to war in Ukraine	Has changed	16
	Has not changed	16
Plans for travel within next 6 months	Intends to travel	24
	No travel plans	8

Since the Covid-19 pandemic every trip has become more memorable and has increased the longing for this experience. In addition to the inconvenience associated with displaying vaccination certificates and complying with new safety standards, the costs of the trips have fluctuated (some providing larger discounts to avoid even greater losses, some compensating for the reduction in visitor numbers by increasing the price). Still, meanwhile, the total number of tourists for international travel has become lower.

"I think a lot more about travelling. In addition, when choosing a destination, I think about the risks of Covid and its effects more. I think which countries would be safe; what the rules and restrictions in place are; which travel routes would be more in nature (fresh air); whether there will be a lot of crowding; whether the route includes popular tourist attraction sites where very large crowds cannot be avoided" (Woman, 1964, regional city)

"Habits have not changed much. During the pandemic I was exploring current restrictions in the destination country. This was done before the pandemic, but during the pandemic, more attention was paid to using masks when visiting public places" (Woman, 1992, Riga)

People feel longing and sadness about the limited opportunities to travel regularly, similar to that indicated in other studies. The reasons for concern are both economic and safety reasons. Perception of personal safety risks seems to be something a person can manage and do some work to prevent. However economic uncertainty in the longer term seems unpredictable and is seen as an obstacle to future travels. International travel is referred to as a reward for hard work.

"I miss it, yes, because it's my main hobby in life, where I spend my money and the way I relax. I'm afraid that my income may be lower and therefore travel less often." (Female, 1991, Riga)

"I do miss travelling. A lot. Because there is a lot of hard work daily, and travelling is a reward for it all" (Woman, 1996, Riga)

As an alternative to international travel, local tourism has developed, and the extent to which local rural and natural resources are used has significantly increased – e.g. on several Latvian nature trails, according to the regular monitoring data based on visitor counter data, the number of visits has increased by up to 10 times; some beach sites were visited during the wintertime with the same intensity as in the high season of summer, although this also increased the environmental load. Some nature sites were continuously visited even after they had been formally closed because of an excessively large anthropogenic load on environment and the entire public nature and recreation system has been put under visitor flow “capacity tests” due to constant demand for long walks outdoors (Klepers and Krumina, forthcoming).

“Considering that travel volume has decreased in the last two years, international travel was replaced by local tourism during the pandemic – I got to know Latvia. I went to places where I had not been before. However, I miss international travel (Man, 1998, Riga)

“No, I don't miss it, there are many other things I can do in my leisure time. I am filling it with things that interest me. I even drive around close surroundings in Latvia. When will there be a calmer time I will think and plan my future travels” (Woman, 1964, Jekabpils)

Few respondents have not noticed any changes in their travel frequency, which depends on their occupation, travel experience, and other factors.

“Yes, I miss it. Before the pandemic, I travelled very often, which I have not been able to do in a pandemic. When I had a trip recently, I felt completely ecstatic because I hadn't been anywhere in a long time” (Woman, 2002, Riga)

Travelling during the pandemic and war in Ukraine

Individual choices vary regarding whether or not to travel during the pandemic and the war. Views vary from acceptance and compliance with inconveniences caused by the Covid-19 restrictions to fear, self-protection strategies and refusal to travel during unsettled times. However, travelling behaviour and destination choices have inevitably changed significantly for travellers from Latvia.

“I have never been afraid of Covid-19. As a doctor, I look at it a little differently. I both got sick and vaccinated myself. I have my own opinion on all of this, but it's something entirely different about the threat of war. This is something completely different and incomparable. I take the threat of war very seriously because if Force Major starts somewhere and it is impossible to get home, atomic bombs are flying somewhere, it is a danger. These are genuine dangers. I am worried about Covid; if suddenly I cannot get home, I would have to stay in quarantine and spend money on rent. Life gets complicated, and money is lost. But in a war situation, money no longer matters.” (Woman, 1996, Riga)

While Covid-19 caused inconvenience and, possibly, unplanned financial losses, the ongoing war significantly changed the geography of travel destinations for Latvians.

"Covid-19 is not a reason for me not to travel. I have been vaccinated, so my fear of getting sick is minimal, but the war situation in Ukraine is a significant reason for me to choose to stay at home or travel very close to the northern borders of Ukraine" (Woman, 2002, Riga)

They try to protect themselves, for example, by not going to risky places:

"I am not afraid of getting Covid-19 because safety measures are in place, such as wearing masks, vaccinations, etc. The war does not scare me because I feel safe in my country – Latvia – and we are in NATO. I do not travel to places of war or high risk." (Man, 1999, Carnikava)

"The desire to see new places is much greater than the fear of getting Covid because I understand that we can't always influence where we catch the virus; even if we are cautious, there is a risk. But I do not feel the threat of war, only extreme empathy and compassion for those currently experiencing it, but I do not feel threatened myself, at least for now." (Woman, 2003, Talsi)

More categorical views on travel were observed in the interviews of seven respondents. They expressed that they categorically do not travel during periods of uncertainty and unforeseen circumstances:

"We did not travel during the pandemic. We did not want to endanger our health. There is no point in travelling if you can get sick during the trip and miss everything. It is not worth challenging your destiny!" (Man, 1963, Madona)

"The threat posed by the war does not allow us to think about travel because the future seems too unpredictable at the moment" (Man, 1987, Riga)

Travel plans for the near future

Interview material suggests three main trends regarding international trips in near future. Those whose employment involves regular business trips are sure about their future travels despite research predicting that some business trips will be replaced by online meetings in the future. Most regular travellers (22 respondents) also plan to travel in the current political and economic situation and are ready to accept potential risks. There are specific plans for some future trips within the following six months. They have particular and already planned leisure trips to Western European, Asian or other destinations overseas.

"I plan to visit countries with mountains because I like an active lifestyle and regularly on my holidays go out of town to the nearest mountains. I would also like to visit the Netherlands, Norway (especially the fjords), and I want to travel to a more distant corner of the Earth, for example, New Zealand, but this is only at the level of ideas." (Women, 1992, Riga)

Despite those who remained frequent travellers going on either business or leisure trips, numerous travellers from Latvia refrain from travelling. Among those not planning to travel within the next six months, the main concern relates to an escalation connected to the situation in Ukraine.

"There are no further specific plans because the situation in Ukraine has now stifled the desire to take risks, both with money and with other things. And if the situation changes radically, there will be no travelling at all." (Woman, 1996, Riga)

"There is a lot to plan for, but the current circumstances, situation and general mood do not lead to grandiose plans. I'm likely to be more open to a variety of nearby and safer destinations." (Woman, 1964, Jekabpils)

Conclusions

According to the findings, regular travellers lack excitement in planning trips and actual international travel experience. Those who frequently travel for business report a lesser level of longing for this experience. Based on the study results, there is passion and hope that tourism will recover faster because most respondents in this study have planned when and where they will travel immediately – 0-6 months – after the Covid-19 pandemic ends. Moreover, regular travellers are not refraining from taking multiple journeys in the next six months but would certainly avoid travelling to military conflict zones.

Travellers' opinions vary regarding Covid-19 and the risks of the war in Ukraine. Overall, the period since restricted travel and the risk of infection has made travellers get used to this. However, in the case of the war in Ukraine, travels toward the EU external border are limited, and the level of danger and unpredictability is much higher. This study has been able to reflect a period of significant negative events that since the beginning of 2020 have massively affected the tourism industry and travellers' tolerance towards risk and travel plans. This research does not include any specific analysis of support trips to/from Ukraine, but further studies would be vital.

The sample analysed was too small to draw any quantitative conclusions about the travel differences between various lifestyle segments or demographics.

As a response to the limitation of international travel, local nature tourism has substantiated its position as the most popular attraction with significant levels of safety, cleanliness and beauty to fulfil tourist demand, and confirms the study assumptions made by Wachyuni and Kusumaningrum at the very beginning of the pandemic. During the pandemic, nature tourism has increased enormously, providing benefits for mental and physical health, but also creating a more significant anthropogenic load on vulnerable nature sites. Despite the critical role tourism plays in satisfying the needs of self-improvement in humans' lives, in a crisis, "tourism is neither a priority nor a necessity" (Baba et al. 2020). In 2022, travellers' behaviour patterns and desire for international mobility have not changed dramatically; but due to the pandemic and war the number of actual trips has decreased, with travel plans postponed for a later date. Reasonable risk-taking is justified by the satisfaction and reward international travel ensures.

Acknowledgment

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Kopsavilkums

Pētījuma mērķis ir noskaidrot, kā COVID-19 pandēmijas un Ukrainas kara ietekmē mainījies ierastā ceļotāju uzvedība un domas par starptautiskajiem ceļojumiem. Darbā izvirzīti trīs pētnieciskie jautājumi: 1) kā pandēmija ir ietekmējusi regulāro ceļotāju starptautiskos ceļošanas paradumus un vai ceļošanas pietrūkst; 2) kā regulārie ceļotāji raugās uz briesmām, kas saistītas ar pandēmiju un karu Ukrainā? 3) cik lielā mērā nākotnes ceļojumi tiek uztverti kā riskanti? Pētījuma pamatā ir intervijas ar 33 regulāriem Latvijas ceļotājiem, pieejamiem statistikas datiem, un apmeklētāju uzskaites datiem Latvijā. Intervijas veiktas 2022. gada pirmajā ceturksnī.

Kā liecina rezultāti, pastāvīgajiem ceļotājiem ilgojas pēc ceļojumu plānošanas, kā arī viņiem pietrūkst reālās starptautiskās ceļojumu pieredzes, kas savukārt neattiecas uz tiem, kuri regulāri dodas komandējumos. Pandēmijas periodā ir palielinājusies aktivitāte vietējā tūrisma jomā, kas ir alternatīva starptautiskai ceļošanai, īpaši palielinoties pieprasījumam pēc dabas tūrisma vietām. Regulārie ceļotāji samierinās ar neērtībām, ko rada COVID-19 ierobežojumi, taču viņi baidās un izmanto paš aizsardzības stratēģiju vai pat atsakās ceļot militārā iebrukuma laikā Ukrainā. Visbeidzot, regulārie ceļotāji, lai gan apstākļi nav skaidri un pastāv risks, turpmāko sešu mēnešu laikā plāno doties ārvalstu braucienos uz Rietumeiropas valstīm vai citviet pasaulē, taču atsakās no iespējas doties uz valstīm, kas iesaistītas militārajā konfliktā.

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**DEMOGRAPHIC CHANGES AND MIGRATION IN LAU 2
REGIONS OF LITHUANIA IN 2001–2018****DEMOGRĀFISKĀS PĀRMAIŅAS UN MIGRĀCIJA LIETUVAS LAU 2
REĢIONOS NO 2001. LĪDZ 2018. GADAM****Viktorija Baranauskiene, Donatas Burneika**Department of Regional and Urban Studies,
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baranauskiene.viktorija@gmail.com, donatas.geo@gmail.com**Abstract**

Depopulation processes started to intensify in Lithuanian peripheral areas in 2004, when Lithuania joined the EU, and increasing emigration was the main factor behind these processes. This paper analyses the main differences between migration processes at LAU 2 level in 2001 and 2018 in relation to the changing demographic structure of the population inside the country. Analysis of data revealed that migration processes played little role in the redistribution of the population at the beginning of the century; however, the intensification of migration at the end of the 2010s resulted in redistribution of Lithuanian residents towards major metropolitan regions. A rapid increase in the share of residents in three metropolitan regions was followed by a decrease in the population in distant peripheries. A decrease in the size of the population was also followed by ageing processes in those areas.

Keywords: emigration, depopulation, periphery, metropolitan regions, Lithuania, eldership (LAU 2 region)

Introduction

Over recent decades Lithuania, like other CEE countries, has experienced profound changes in its population geography, which resulted in spatial transformation of the whole society. The major trends in the Baltic states are related to the polarisation of spatial development both within these countries and at the EU level (Åberg 2005; Stanilov 2007a, 2007b; Berzins & Zvidrins 2001; Burneika et al. 2013, 2017; Cirtautas 2013; Ubarevičienė 2018a, 2018b; Baranauskienė 2019, 2021; Ubarevičienė & Burneika 2019). Emigration from peripheral areas towards the metropolitan centres and abroad was the main process reshaping Lithuania's urban system; therefore there were a lot of studies analysing trends of migration from and inside Lithuania (Rakauskienė & Ranceva 2012; Ubarevičienė 2016; Shor & Burneika 2017; Ubarevičienė 2018a; Pociūtė-Sereikienė 2019). There are also studies that reveal post-accession migration from the Baltic states (Krisjane et al. 2013), the mobility of young people in the EU (Krisjane et al. 2018), and emigration and remittances pattern analysis in lagging-behind regions of the Baltics (Kozlovs 2019),

among others. Though emigration to foreign countries was the major cause of shrinking population across the country, the internal migration flows made the decisive impact on the transformation of Lithuanian residential structure (Ubarevičienė 2018a). Like in most CEE and Baltic countries, the growth of the metropolitan (primarily the capital) regions, manifested by fast suburbanisation, was the most evident process (Krišjāne & Bērziņš 2012). These processes were unsurprisingly followed by the depopulation of the peripheries. Though emigration trends at the municipal level are pretty obvious, the micro-scale trends remain uncertain so far. The main aim of this paper is to establish major spatial changes in migration processes at the local (LAU 2) level in 2001 and 2019.

As with all social processes, emigration can be explained either based on preferences of social agents (people) or by structural factors (social structure) or by their mutual interaction (structuration). The human decisions to emigrate can be rational, caused by, for instance, objective differences in wages or employment possibilities, as rational choice approach (Buchanan & Tullock 1962), the new economics of labour migration (Castles & Miller 2003) or dual labour market theories predict (Massey et al. 1993; Brettell & Hollified 2000). These decisions also can be based on subjective images, such as “distant metropolis is never perceived in perfect material measures” (Ley 1979). The polarisation of development and related migrations are often related to the structural factors, such as the nature of the present capitalistic economy or neoliberal economic policy (Hadjimichalis & Hudson 2014; Lang et al. 2015). Emigration processes can also be perceived as a continuation of the urbanisation processes which were sustained in the Soviet era, when one-fifth of the labour force was employed in agriculture. All these and many other theories can help us to understand the ongoing processes, but the main task of this paper is only to reveal the major spatial changes of migration at the very local level, because only this scale can illustrate the details of transformation of the Lithuanian urban system.

Data and methods

This research is based on the quantitative analysis of secondary data and uses mathematical statistical as well as cartographic analytical methods and the GIS. The analysis is based on the detailed 2001 and 2018 data on the declared place of residence obtained from the State Enterprise Centre of Registers, as well as the data on arrivals and departures officially declared by residents (for the identification of immigration to and emigration from LAU 2 regions) and the age structure of the population (for the identification of the share of the population under 15 years of age). The research aims to reveal the impact of migration processes in the smallest administrative areas of the country (seniūnija – an eldership or LAU 2 region) in 2001 and 2018. It should also be

noted that the declared arrivals and departures analysed do not necessarily reveal the exact movement of population, because residents moving to other areas often do not declare changes in their place of residence. The available data do not allow us to accurately estimate the number of migrants or the exact changes in population number, but it should be sufficient for the revelation of general trends of migrations and their spatial differences in different regions of the country.

The analysis of changes in population size, as well as the declared arrivals and departures, is conducted at the most detailed territorial level of an eldership (LAU 2 level). According to the data of the Lithuanian State Enterprise Centre of Registers, on 1 January 2001, 3,071,103 residents were registered in the population register, while on 1 January 2018 there were 3,010,564 residents (the data also includes the registered residents in the territories of municipalities, without specifying the specific place of residence). This study analyses only the data in which the specific place of residence has been indicated by the declarers; therefore, a smaller population was selected for analysis (3,071,089 residents as of 1 January 2001 and 3,009,259 residents as of 1 January 2018).

A total of 524 territories (elderships) were examined in the analysis of the population changes from 2001 to 2018, as well as the arrivals and departures (net migration) officially declared by the residents in 2001 and 2018. In total, there are 556 administrative units in Lithuania that match the eldership level (LAU 2 level), but this paper uses the administrative territorial division which was updated by UAB HNT-Baltic on 25 August 2018, according to 2015 data of the State Enterprise Centre of Registers. The layer used is adapted according to the data of the population register obtained from the State Enterprise Centre of Registers on 20 February 2019. As a very few cities have more than one eldership, we did not analyse inner-city changes. Some elderships consist of both central municipal city and surrounding suburban-rural areas (Anykščiai, Kupiškis, Širvintos), and in such cases the situation in the city eldership can be more positive, as population growth is concentrated in mostly in suburban areas of all cities.

Results

Demographic changes in LAU 2 regions (seniūnija) in 2001–2018

The previous studies have already revealed the main trends of changes in redistribution of population inside Lithuania, but most of them were based on the data of population censuses of 2001 and 2011 (Ubarevičienė 2018a) or made at the municipal level (Burneika and Pocius 2019). The analysis of the population changes based on the data of from the State Register reveals that the number of residents who have declared their place of residence in a particular municipality decreased only by

2% in 2001–2018 (Table 1). The overall demographic changes look very limited, though this can be related also to the changing system of declaration of place of residence. The most evident demographic change of 2018 comparing to 2001 is related to intensification of migration processes. The yearly migration flows in all LAU 2 regions (*seniūnija*) increased by more than three times in 2018.

Table 1. **Indicators of population change in Lithuania in 2001 and 2018** (authors' elaboration based on data of the State Enterprise Centre of Registers)

	Population (inhab.)	Number of births	Number of deaths	Natural population change (per 1000 inhab.)	Number of arrivals/immigrants	Number of departures / emigrants	Net yearly migration (per 1000 inhab.)
2001	3,071,089	30,612	38,607	-2.6	33,438	48,981	-5.1
2018	3,009,259	28,041	38,571	-3.5	140,651	125,442	5.1

The fairly stable population size in the country as a whole, however, hides pretty major changes at the local level. The changes in the number of inhabitants in LAU 2 regions were extremely polarised, because regions surrounding the three metropolitan centres were the major hotspots of population growth. The population number was growing only in two cities (Vilnius and Jonava), but suburbanisation was evident even around small urban centres. More distant areas were losing population at a different pace, but the majority of non-suburban LAU 2 regions lost more than one-fifth of their population during this period, while suburban areas were growing fast. The visual analysis of the map (Figure 1) clearly reveals that the depopulation trends are strongly related to the location factors. The fastest depopulation was evident in those regions which are the most distant from the three major cities: Vilnius, Kaunas and Klaipėda. Other cities have very limited spatial impact on the depopulation trends.

The general spatial trends in population redistribution were quite similar in all the Baltic states, though there was only one major growth pole in Latvia (Ubarevičienė 2018b; Kūle et al. 2011; Plüschke-Altöf et al. 2020). Though the recent coronavirus crisis has made an impact on population mobility, we do not currently have any data giving reason to expect major changes in the monitored processes. Such a forecast can also be supported by another consequence of emigration. Previous studies (Ubarevičienė et al. 2016) have revealed that migration is selective and therefore changes in population number are followed by changes in social structure. Based on the data of the State Register, we have analysed the changes of the demographic structure in LAU 2 regions and our results confirm these statements (Figure 2). The visual analysis of the mapped changes of the share of younger population group shows

a growing share of younger people around the metropolitan centres. This also means that in the nearest future natural demographic changes will make a stronger impact on the spatial changes in the number of residents, which so far have been determined mostly by migration processes. The most radical increase of younger people was evident in the suburban zone of Vilnius, while changes in the number of residents were quite similar in other metropolitan areas. Apparently, the centralisation of the country is proceeding faster than data on population numbers shows. Though the fastest ageing was monitored mostly in those areas which were losing population most rapidly, there were also other regions where demographic changes were quite positive (i.e. the northern municipalities of Biržai, Rokiškis and the central municipalities of Ukmergė and Kėdainiai). These exceptional positive cases could be related to a different age composition of migrants but we don't have data to confirm this hypothesis.

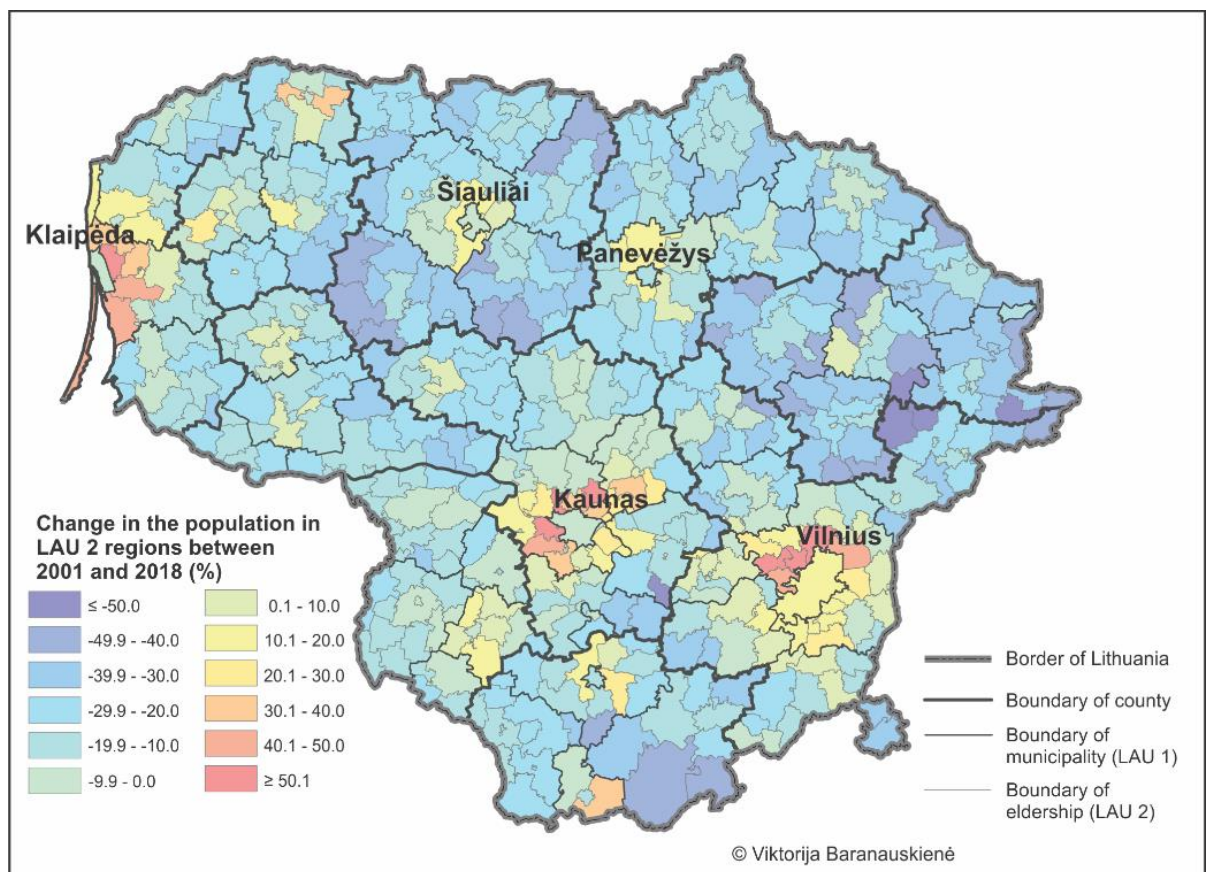


Figure 1. **Change in the population in LAU 2 regions between 2001 and 2018** (author's figure based on data of the State Enterprise Centre of Registers)

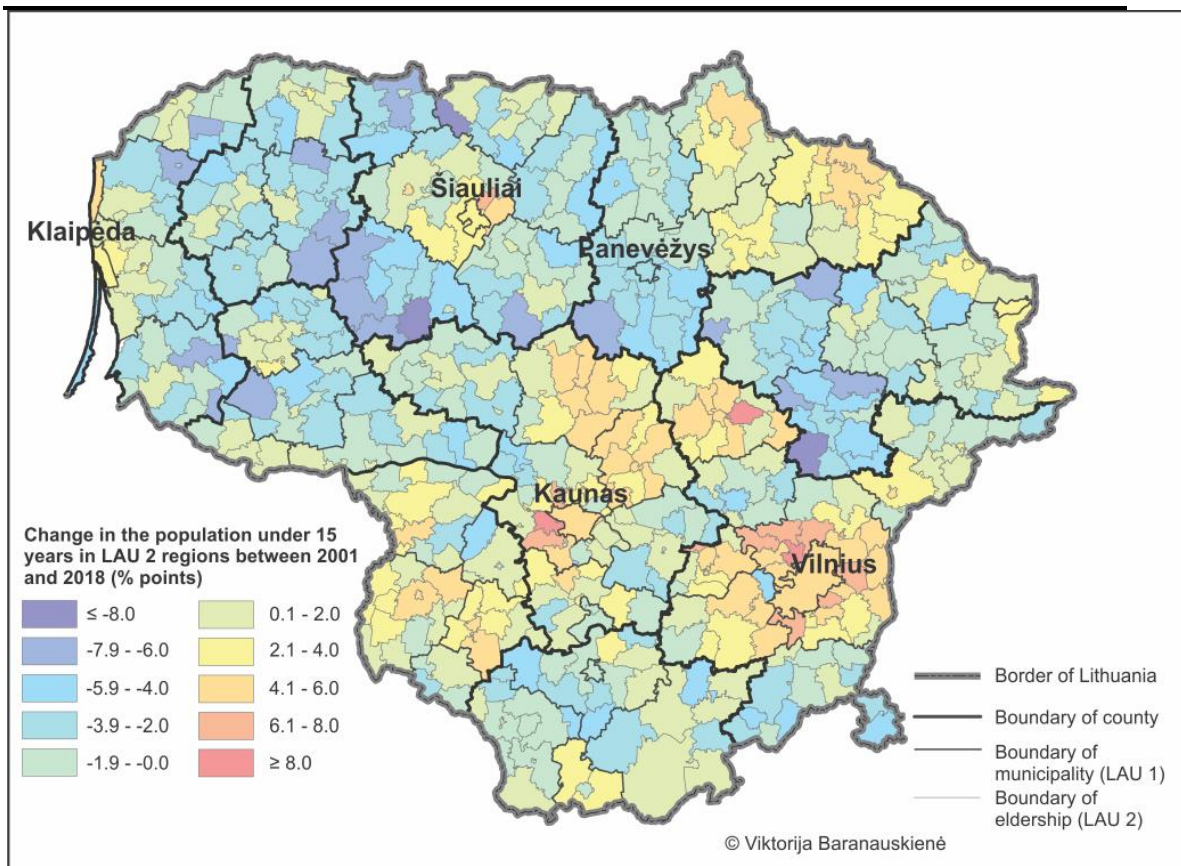


Figure 2. **Change in the share of population under 15 years of age in 2001 and 2018**
(author’s figure based on data of the State Enterprise Centre of Registers)

Immigration and emigration

The analysis of migration data of 2001 and 2018 showed that the migration processes of the population in the country were uneven. The previous analysis of migration indicators data made by Baranauskienė (2021) revealed that in 2001, when Lithuania was not yet an EU member, migration processes were not intensive. Arrivals and departures made a very limited impact on the number of the population: 1.1% and 1.6% of the total population respectively. The share of immigrants increased to 4.7% and emigrants to 4.2% from the total number of the population in 2018. The intensifying immigration and emigration from LAU 2 regions was caused both by internal and international mobility. Emigration was the dominant process back in 2001 and throughout the whole period as the previous research illustrated (Shor & Burneika 2017). In 2018 immigration to LAU 2 regions became more numerous than emigration, which corresponds to the general trends of changing international migration flows in Lithuania.

Though population mobility at the beginning of the 21st century was very low, some spatial differences were evident already. The immigration flows to LAU 2 regions varied from 0.2% to 7.3%, and immigration flows from 1.1% to 6.8% of the

total population. The most extreme cases could be also related to the changes in the administrative system near Visaginas, but otherwise the most intensive immigration was already being observed in the suburban areas of the three biggest cities in 2001. In 2018, immigration flows varied from 1.2% to 26.5%, while emigration varied from 1.4% to 13.0%. Immigration, which was generally more spatially diversified than emigration, intensified in the surroundings of smaller cities as well. As a result of the changing migration flows, the map illustrating net migration in 2018 is much more polarised than the one for 2001 (Figure 3). The maps illustrate deviations in net migration per 1,000 inhabitants in LAU 2 regions in 2001 and 2018. Migration processes played a minor role in population change in 2001 when deviations from the national average were minimal. Migration became a decisive factor in 2018, when the country was divided quite sharply into growing and declining regions.

The intensification of migration processes can partly be explained by growing international mobility in the borderless EU, but the actual spatial pattern of these processes can only be related to changing internal migration according to the centre-periphery dimension. As foreign emigration from cities was more numerous than emigration from less urbanised municipalities throughout the 21st century, the total net migration to cities was generally negative or close to zero. The formerly rural suburbs around the municipal centres and especially the cities of Vilnius, Kaunas and Klaipėda were the main winners in this game. Unsurprisingly, the most negative migration trends were evident in the most distant municipalities, which corresponds to the trends in population change (Figure 1). The most negative trends in 2018 were observed in those regions located the furthest from the three growth poles. The border regions with Kaliningrad oblast (Russia) and Latvia are the most typical examples of such areas. The observed situation once again confirms the hypothesis that migration has so far played the decisive role in determining the trends of population change in most Lithuanian regions.

The analysis also suggests that the country is experiencing fast urbanisation, even though Statistics Lithuania provides data on the stability of the urban–rural population during the last few decades (Lietuvos statistikos departamentas 2021). The only reason for this stability is related to the fact that suburbanisation is taking place in formerly rural areas, while the territorial administrative system has been “frozen” for more than two decades.

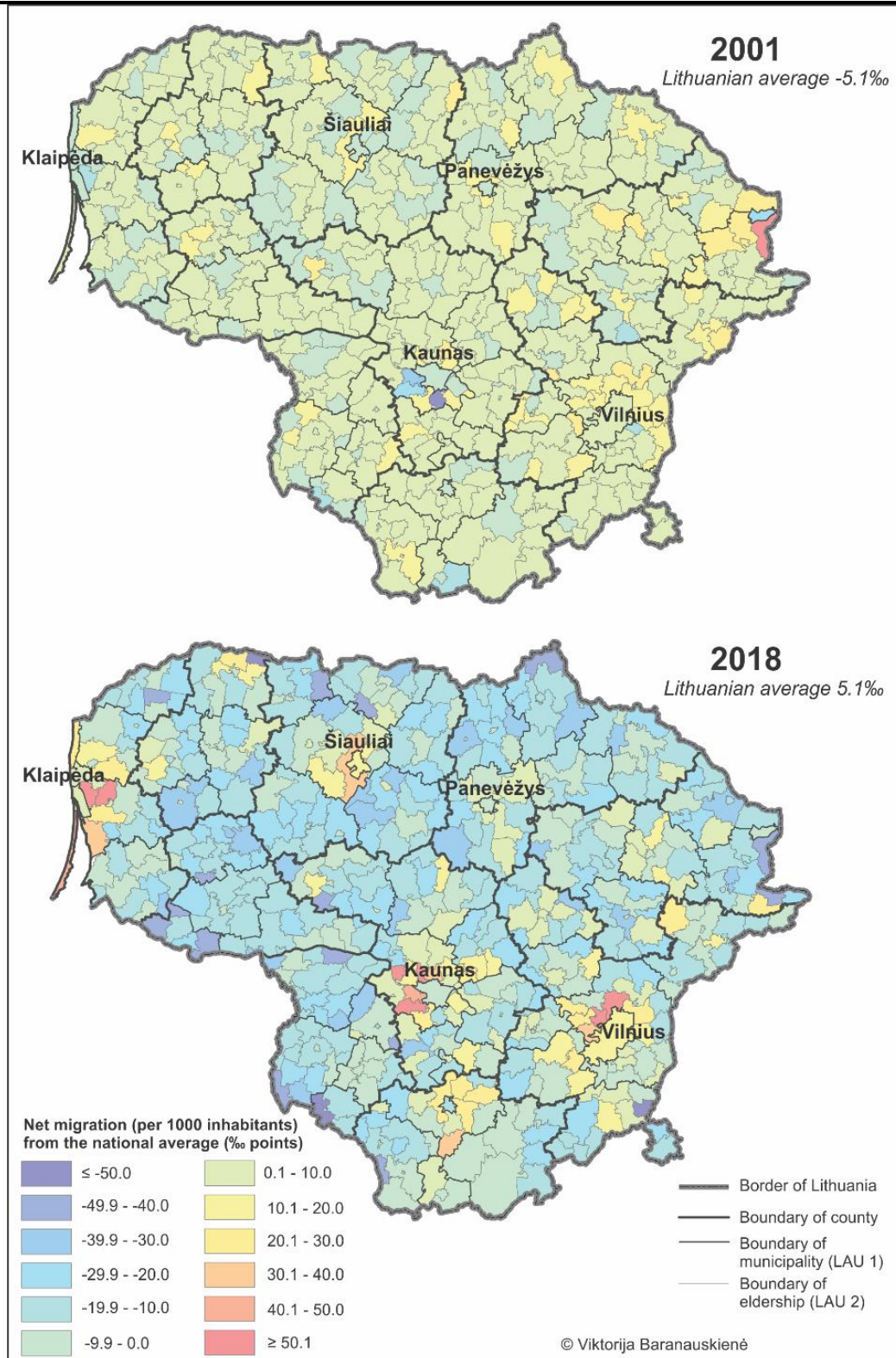


Figure 3. Net migration (per 1000 inhabitants) compared to the national average in LAU 2 regions in 2001 and 2018 (author's figure calculations based on data of the State Enterprise Centre of Registers)

Conclusions

Although migration processes intensified only in the 21st century, they had become a decisive factor in the transformation of the Lithuanian settlement system. Migration processes have changed the age structure in different regions, so the natural population change will tend to frame these changes in the future. As a consequence, the development of the country is ever more polarised. On the other hand, the migration processes in 2018 still show that Lithuania retains its multipolar development character, though Vilnius is playing a more and more important role.

The growth potential of the three metropolitan centres can be felt beyond their direct suburbs, but the most distant parts of the country are losing population very fast. Net migration in the majority of peripheral areas is still very negative even when the country has a positive net balance in international migration flows. This is especially evident in the western parts of the country, which used to have a younger and more mobile population. As a consequence, the decrease in younger groups here is extremely fast. The growing immigration from other countries will hardly make a noticeable impact on the development of the peripheral regions, as cities attract most of those immigrants.

The analysis of local migration trends reveals that low-level differences in migrations are quite visible. The migration trends can be highly polarised both in the whole country and within one small municipality. Our results suggest that the geographical location of any particular LAU 2 region is the most important factor in migration trends in 2018 and this is in line with the findings of previous studies (Ubarevičienė 2016). Such a situation suggests that migration processes and population change in a particular locality can depend more on its place in the Lithuanian settlement system than on the socio-economic situation in a particular municipality. The socio-economic situation in a municipality is at least to some degree the result of its location.

The statistical invisibility of the actual urbanisation of the country means that the formal territorial administrative division of Lithuania reflect settlement systems which existed at the end of the last century. Effective planning and governing of the trans-municipal urban systems is impossible without reforms to its administration.

Kopsavilkums

Depopulācijas procesi Lietuvas perifērajos rajonos sāka pastiprināties 2004. gadā, kad Lietuva iestājās ES, un pieaugošā emigrācija bija galvenais šo procesu faktors. Šajā rakstā analizētas galvenās atšķirības starp migrācijas procesiem LAU 2 līmenī 2001. un 2018. gadā saistībā ar mainīgo iedzīvotāju demogrāfisko struktūru valstī. Datu analīze atklāja, ka migrācijas procesiem bija maza nozīme iedzīvotāju pārdalē gadsimta sākumā; tomēr migrācijas pastiprināšanās 21. gadsimta pirmās desmitgades beigās izraisīja Lietuvas iedzīvotāju pārdali uz lielākajiem lielpilsētu reģioniem. Straujš

iedzīvotāju skaita palielinājums trīs lielpilsētu reģionos ~~sekoja~~ noteica iedzīvotāju skaita samazināšanos attālās perifērijās. Iedzīvotāju skaita samazināšanās šajās teritorijās izraisīja arī novecošanās procesu.

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MINORITY ETHNIC GROUPS IN THE LARGEST CITIES OF LATVIA**MAZĀKUMTAUTĪBU ĢEOGRĀFIJA LATVIJAS LIELAJĀS PILSĒTĀS****Maris Berzins, Magnuss Spude**

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Abstract

Spatial segregation of minority ethnic groups is a returning issue in public and political debates across many parts of the world. The degree of spatial concentration and segregation of ethnic minorities in European cities is well documented. However, despite Latvia's diverse migration history and relatively high minority population, particularly in the largest cities, these issues have received scant attention. This study examines the residential patterns of minority ethnic groups, presenting data on the levels and dynamics of urban residential segregation. The study includes five ethnic minorities: Russians, Belarusians, Ukrainians, Poles, and other ethnicities. We adopted a widely used methodology to examine changes in ethnic residential segregation between 2000 and 2019. The information comes from the 2000 census and the population register. We are confident in stating that overall ethnic residential segregation levels do not appear to be increasing. However, there are some differences not only between ethnic groups in the same city, but also between similar groups in different cities. Furthermore, demographic change reinforces both minority representation in established residential patterns and ethnic segregation in urban Latvia as a whole. Certain characteristics of the Latvian context, such as the dominance of owner-occupied dwellings and relatively low residential mobility, may explain the findings.

Keywords: urban segregation, ethnic minorities, population geography, index of segregation

Introduction

The increasing ethnic diversity of European societies has generated an important academic debate regarding the integration of migrant communities into host societies (Benassi et al. 2022). Although large-scale immigration in Latvia has been over for at least three decades, its impact is still reflected in the ethnic composition of the population, which is also unevenly distributed across the country. Thus, patterns of segregation are the outcome of the complex interplay of individual, institutional and structural factors, as well as historical place specific legacies (Boterman et al. 2018). There is the wide array of dimensions that segregation studies deal with, and a variety of social interactions and inter-ethnic encounters in numerous domains (van Ham and Tammaru 2016). The ethnic geography of cities has attracted much scholarly attention

for almost a century, much of it focusing on the extent to which members of individual ethnic groups are concentrated in particular parts of the urban fabric. Globally, previous studies confirmed the relatively low levels of segregation in European cities compared to those in the US (van Ham et al. 2021). Although a great deal of work has been done by geographers on the residential segregation of ethnic groups within cities, covering a wide range of places and contexts, relatively little of this has been explicitly and rigorously comparative at the national level. Most of the previous studies focus on large metropolises, and there are comparatively few studies of segregation at the national level addressing urban segregation in second-tier cities (Marcinićzak et al. 2012; Šimon et al. 2021). Besides, ethnic segregation still remains a modestly studied aspect of urban segregation in post-socialist cities (Ladányi and Szélényi 2001; Gentile and Tammaru 2006; Hess et al. 2012). This study aims to evaluate ethnic geographies in the nine largest cities of Latvia using individual-level geo-references compatible data that explicitly allow comparative studies.

Most recently, the impact of the COVID-19 pandemic cannot be underestimated in analysing the residential patterns of ethnic minorities. The COVID-19 pandemic has massively affected the lives of people around the world for more than two years now. Same as the COVID-19 pandemic is not shared equally across geographic areas, so many other important urban social phenomena, including segregation, gentrification, and inequalities in ethnicity, wealth and income reveal spatial disparities (Zhai et al. 2021). Recent studies suggest that the burden of COVID-19 morbidity may be hardest felt in disadvantaged and segregated places and could reinforce the existing ethnic inequalities (Berkowitz et al. 2021; Yang et al. 2021). The available data do not allow us to analyse changes and geographic differences in the health outcomes of ethnic minorities in Latvia. However, the findings of this study offer empirical knowledge on the residential patterns of ethnic minorities and can also provide useful insights into public health behaviour.

In the following, we first present a brief description of ethnic minority formation in Latvia. The next section outlines the data and methods. This is followed by a descriptive analysis of the segregation levels and residential concentrations of minority ethnic groups in the nine largest cities of Latvia. The last part concludes this work with key findings.

Overrepresentation of minority ethnic groups in urban Latvia

This study investigates the minority ethnic groups in urban Latvia, and therefore this section describes the key points of ethnic minority formation and residential patterns. Latvia is an ethnically diverse country with more than 160 different ethnicities that could be found among the inhabitants of the country. However, the

ethnic composition was significantly affected by the Soviet-era migration, urbanisation, and industrialisation policies. Latvia was part of the Soviet Union between 1944 and 1991, and during this period experienced large-scale immigration, mainly from Russia. During the 1970s and 1980s the share of Belarusian and Ukrainian immigrants increased (Monden and Smits 2005). Ethnicity in the former Soviet Union, was an additional element of urbanisation and socio-spatial differentiation. Immigration was part of a deliberate political and ideological agenda used to disperse predominately Russian-speaking workforce through 'organized channels' of migration (Lindemann 2013). The related processes of immigration and industrialisation, and the central allocation of housing, led to overrepresentation of minority ethnic groups in the urban areas (Gentile and Sjöberg 2010). In addition, large prefabricated high-rise housing estates in the major cities were the main place of residence for ethnic minorities (Kährlik and Tammaru 2010; Hess and Tammaru 2019). The societal changes and economic reforms in the 1990s have placed ethnic minorities in a new situation that substantially alters inherited patterns of labour market and housing segmentation from the Soviet period (Hess et al. 2012). Therefore, Latvia with sizable ethnic minority population, where the large-scale immigration stopped more than three decades ago, provide an interesting starting point for studies of ethnic segregation. Nevertheless, until the present-day rare studies exist on residential patterns of ethnic minority groups in Latvia (Krišjāne et al. 2016; Bērziņš et al. 2021). In 2019 ethnic minorities form considerable share (about 38%) of the Latvian population.

We restrict our description of minority ethnicities in urban Latvia to the five largest groups: Russians, Belarusians, Ukrainians, Poles, and others (including those who have not indicated their ethnicity). The main ethnic groups are strongly concentrated in the nine largest cities of Latvia housing almost 52% of the country's nearly 2 million inhabitants and 76% of the urban population. In population census of 2000, in response to a question on which ethnic group they identified with, 42% of residents in the nine largest cities of Latvia defined themselves as Latvians and the same share of residents self-reported to be Russians. The share of Latvians had increased over the next two decades, whereas most of the minority ethnic group proportions decreased (Figure 1). However, it should be noted that all the largest cities and the main ethnic groups that live there have experienced a decline in population. The only exception is other ethnicities. An increase in the share of this group's population may be explained by the growing number of individuals who do not want to declare their ethnic origin or identify themselves with one or the other ethnic group. Another explanation in this regard is the positive international net migration rate of

some new immigrant groups indicating an increase in the share among other ethnicities.

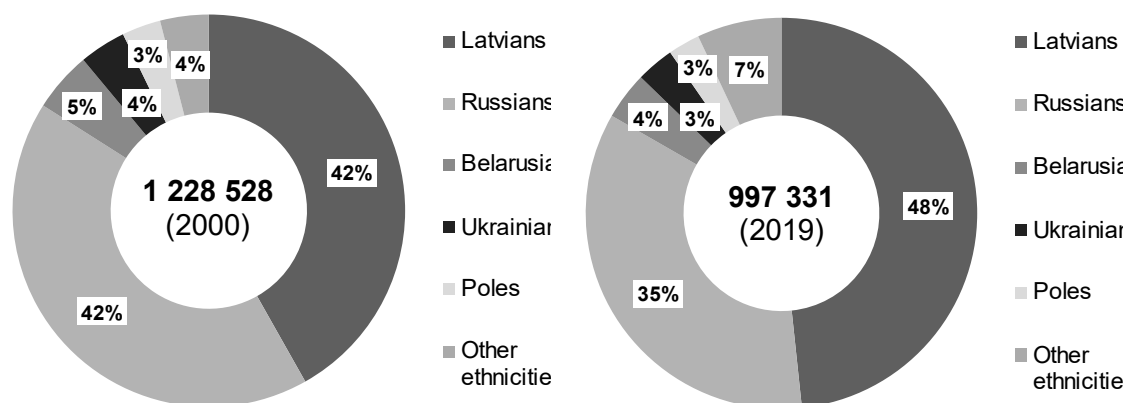


Figure 1. The ethnic composition of the residents in the nine largest cities (authors' figure based on data from Central Statistical Bureau of Latvia)

Table 1 uses the above indicated 5 separate categories of minority ethnic groups and Latvians that allow a reasonably clear picture of the changes over the past two decades. Among the ethnic minorities considered, all groups show a decline in population. Moreover, compared to Latvians, the population shrinkage of minority ethnic groups is more pronounced. The only group showing small increase is the other ethnicities. While slightly more than a half of the Latvia's population live in the nine largest cities, more than 70% Russians and Ukrainians, and more than 60% Belarusians and Poles do so (Table 1). Meanwhile, the share of Latvians living in largest cities is less than half of the total population of this ethnic group.

Table 1. The population of main ethnic groups in the nine largest cities, 2000 and 2019 (authors' elaboration based on the data from Central Statistical Bureau of Latvia)

Ethnic group	Population in the 9 largest cities			% living in the 9 largest cities per ethnic group	
	2000	2019	% change	2000	2019
Latvians	513,873	482,150	-6.2	37.5	40.3
Russians	518,306	349,352	-32.6	73.7	73.0
Belarusians	60,814	39,298	-35.4	62.6	64.0
Ukrainians	47,212	31,306	-33.7	74.2	72.7
Poles	39,314	26,262	-33.2	66.1	67.6
Other ethnicities	49,009	68,963	+28.9	59.0	68.0
Total	1,228,528	997,331	-18.8	51.7	51.9

Since the 2000, the significance of the nine largest cities has slightly increased for the Belarusians, Poles, and other ethnicities. For the largest ethnic minority group – Russians, the significance of the nine largest cities has slightly declined. The decrease also applies for Ukrainians. With respect to urban concentration, it can be seen from Table 1 that Russians, Ukrainians, Poles, and other ethnicities are more strongly attracted to the largest cities than are the members of Latvians and Belarusians. Regarding the other ethnicities, it should be emphasised that the new immigrant groups are more frequently settling in the largest cities, and therefore an increase in the share of this group has been evident over the past decades.

Measuring segregation: data and methods

Applications and tools to assess residential segregation should be adapted to the objectives, scales and spatial units of analysis (Petrović et al. 2018). There is extensive literature on the measurement of ethnic residential segregation, with a substantial number of separate indices representing one or more segregation dimensions and providing one-number summaries (i.e. global indices) for the whole study area (Massey and Denton, 1988). Residential segregation usually is conceptualised as the degree of spatial separation between two or more population groups in a given context (Yao et al. 2019). These indices are easy to interpret and investigate segregation dimensions, allowing for comparative analysis across the urban system (Reardon et al. 2008). However, these indices are typically descriptive and do not capture complex residential patterns across analysed groups (de Bézenac et al. 2021). Thus, segregation measurements must be seen within a broader social and historical context, reflecting past dependencies and politics of space.

The data used in this contribution are based on the census (2000) and population register (2019). Both data sets are provided by the Central Statistical Bureau of Latvia, ensuring appropriate anonymization of the individual-level geo-referenced data. In 2000, the population census was collected using a survey. Data on minority ethnic groups for 2019 was drawn from the population register. This census and register data contain highly accurate demographic information and are compatible with the adopted spatial scale. As mentioned, the provided data on minority ethnic groups distinguish ethnicity based on the self-selection of individuals.

For analysing residential patterns of minority ethnic groups in the largest cities of Latvia, we focus on the Segregation Index (SI) because that is the most frequently used nationally and facilitates comparative urban analysis (Bolt et al. 2008; Boterman 2020). For each of the main minority ethnic groups the SI of that group is calculated compared to all other ethnicities grouped together. The SI for these groups is

calculated per each analyzed city. Indexes were calculated for both years 2000 and 2019. The SI was calculated as (Massey and Denton 1988):

$$SI = \frac{1}{2} \sum_{i=1}^n \left| \left(\frac{x_i}{X} \right) - \left(\frac{t_i - x_i}{T - X} \right) \right| \times 100 \quad (1)$$

where x_i is the number of ethnic group in spatial unit i ; X is the size of the ethnic group; t_i is the total number of people in spatial unit i and T is the total population in a city. The SI compares the distribution of ethnic group with the remainder of the population. The SI ranges from 0 to 100, with 0 indicating non-segregation and 100 indicating complete segregation. The SI approach is insensitive to the spatial arrangement of population and ignores the fact that segregation is not uniform within a given city.

In urban analytics, spatial data visualisation is important to communicate results effectively. The great majority of segregation studies rely on a single scale using pre-defined administrative or statistical units such as neighbourhoods, census tracts, and wards. However, administrative units are criticised because their territorial size and spatial configuration will vary from city to city (in more densely populated areas, spatial units are generally smaller) (Johnston et al. 2016; Marcińczak et al. 2021). Proximity is another important aspect as not all residents who share the same residential area, irrespective of their location within a spatial unit, are equally proximate to each other. Thus, irregularly shaped polygons and large differences in the sizes of administrative units being mapped can introduce misrepresentation. To address this issue, methods have been developed to distort the shape and size of areas by turning irregular polygons (such as neighbourhoods) into regular or hexagonal grids (Imeraj et al. 2018). It should be acknowledged that the socio-spatial division of cities can vary across scales, as the magnitude of segregation generally decreases with the growing size of analysed residential areas (either in terms of population or spatial unit) (Reardon et al. 2008). Empirical studies of ethnic segregation reveal that levels of residential segregation can also differ by ethnic group, where segregation levels change little by scale for one group while others show a significant drop at the same scale (Catney 2018).

The increased availability of grid data has stimulated the development in analysing urban segregation and allows for comparisons across different spatial scales by varying the number of units, size, or distance radius. Moreover, in the case of Latvia, publicly available spatial data on population are mostly at the municipal level. Therefore, in our case, we provide new evidence on the residential patterns of minority ethnic groups in Latvia through regular hexagon grid

coverage. Moreover, the data used are comparable across the analysed cities and between both years. The final dataset represents a spatially fine-grained hexagon grid of a 16-ha size with estimated population counts of main ethnic groups. To visualise the uneven geographical distribution of minority ethnic groups across the studied cities, we employ the Location Quotient (LQ), which is a valuable way to quantify the concentration of minority ethnic groups within particular cities and present the intra-urban differences comparing at the neighbourhood level. LQ is defined as (Brown and Chung 2006):

$$LQ = \left(\frac{x_i}{t_i} \right) / \left(\frac{X}{T} \right) \quad (2)$$

where, x_i and t_i are the population of ethnic group X and total population in spatial unit i ; X and T are the population of ethnic group X and the total population of the city as a whole. $LQ = 1$ indicates that the proportion of the minority ethnic group in the spatial unit is the same as that of the city as whole; $LQ > 1$ indicates a higher level of concentration in the spatial unit than in the city as a whole; $LQ < 1$ indicates a lower level of concentration in the spatial unit than in the city as a whole

Finally, the location of the nine largest cities in Latvia is shown in the figure 2. As shown in the figure, the analysed cities are situated in all regions of the country. In 2019, their populations range from 22 000 in the smallest city (Jekabpils) to 630 000 in the capital Riga. It should be noted here that the settlement system of Latvia is highly monocentric, with the primacy of the capital city being about 7 times larger than the second largest city (Daugavpils). Among the second-tier cities, the population is more evenly distributed. Four second-tier cities have populations of more than 50 000, while the other four have populations ranging from 22 to 34 thousand. Minorities make up 80% of the population in Daugavpils and 15% in Valmiera, which is located in the Vidzeme region and has the lowest overall share of minority ethnic groups. Of course, the case of Daugavpils city differs greatly from that of other urban areas with a lower proportion of ethnic minorities.

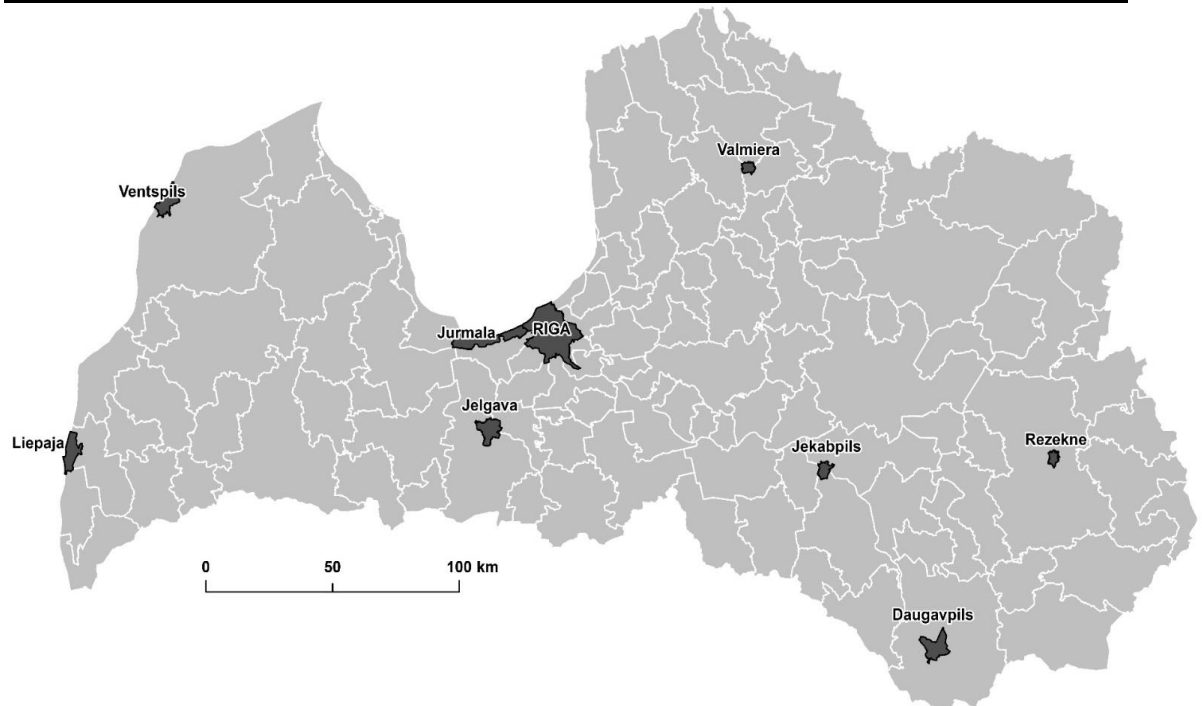


Figure 2. **The location of the nine largest cities in Latvia** (authors' figure based on spatial data from SIA Envirotech)

Results: urban segregation of ethnic minorities

The empirical sections of this study consist of two parts. First, we analyse the segregation levels of the main minority ethnic groups in the total population of each studied city. Second, we present geographies of minority ethnic groups based on the analysis of location quotients. Answering the research question how ethnic segregation in the nine largest cities can be characterised, an important first observation is that the segregation of the ethnic minority groups distinguished takes no extreme forms (Figure 3). Separation of some major ethnic groups is certainly present, while the overall levels according to segregation index are generally low all across the studied cities. The segregation index does not take account of the spatial relationship between the hexagon bins and the level to which these units adjoin one another does not have any influence on the magnitude of the segregation index. The calculated values of a segregation index can be interpreted as the percentage of an ethnic group that would have to move out to obtain an even distribution over the spatial unit proportionate to that of the rest of the population. Comparison of the segregation index between years and between cities reveals a completely consistent pattern with respect to the differences between the five ethnic groups (Figure 3). Segregation of minority ethnic groups is comparatively stronger in the following second-tier cities of Ventspils, Liepaja, Jūrmala, and Valmiera. Meanwhile, the level of ethnic segregation is comparatively lower in the capital city of Riga and in the two largest cities of

Daugavpils and Rezekne in the most Eastern part of the country (Latgale region), with a high share of ethnic minorities. It is also clear that in general Ukrainians, Belarusians, and other ethnicities as a single group display a slightly stronger segregation than other minority ethnic groups, such as Russians and Poles. However, the level of ethnic segregation varies between the different groups in the studied cities although in most cases the differences are not substantial.

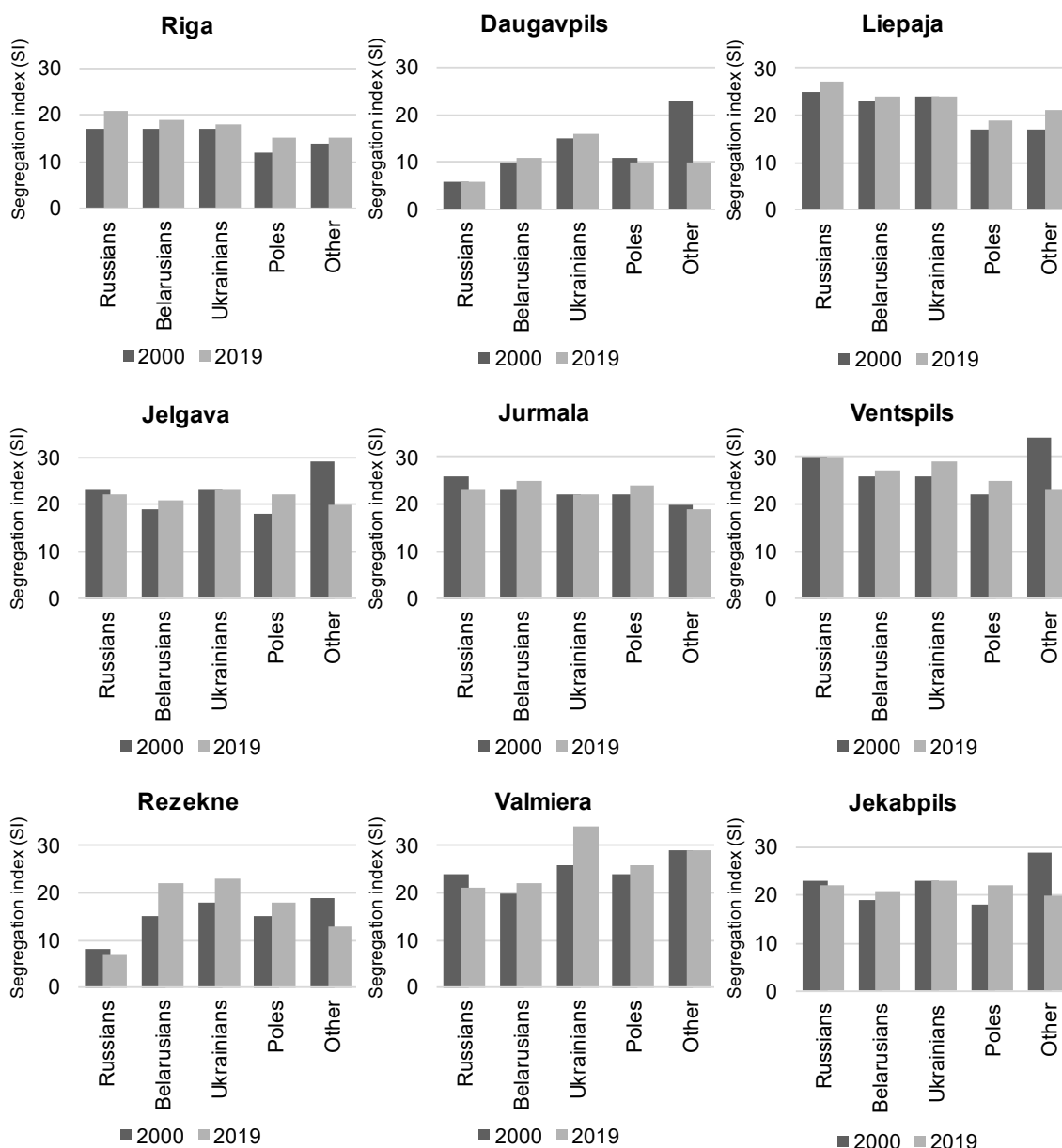


Figure 3. Segregation index of minority ethnic groups in the nine largest cities (authors' figure based on data from Central Statistical Bureau of Latvia)

Looking at both years for which data were available (2000 and 2019), the most striking fact is that the segregation of ethnic minority groups in studied cities has

remained stable over time. Apparently, it is not the case that the minority ethnic groups spread over the analysed cities to an increasing extent. Only in the capital city of Riga and, to a lesser extent, in Liepaja and Valmiera were some signs of a slight increase in the segregation of all the analysed minority ethnic groups. In the other largest cities, there is evidence of reasonably stable levels of ethnic segregation. The only exception, where some cities have seen the most profound changes, are other ethnicities. Therefore, there would be a need for further detailed analysis of the ethnic groups whose populations have changed most rapidly because of demographic change and/or international net migration.

Results: geographies of ethnic minorities

Segregation is inherently geographical and ethnic groups generally form distinct patterns of over- and under-representation across residential space. The resulting urban mosaic is often described with different terms of spatial expression and related processes – ethnic enclave, ghetto, gated community, gentrified community etc. (Brown and Chung 2006). First, we focus on the location quotients measured as mean values for each minority ethnic group per city (Figure 4).

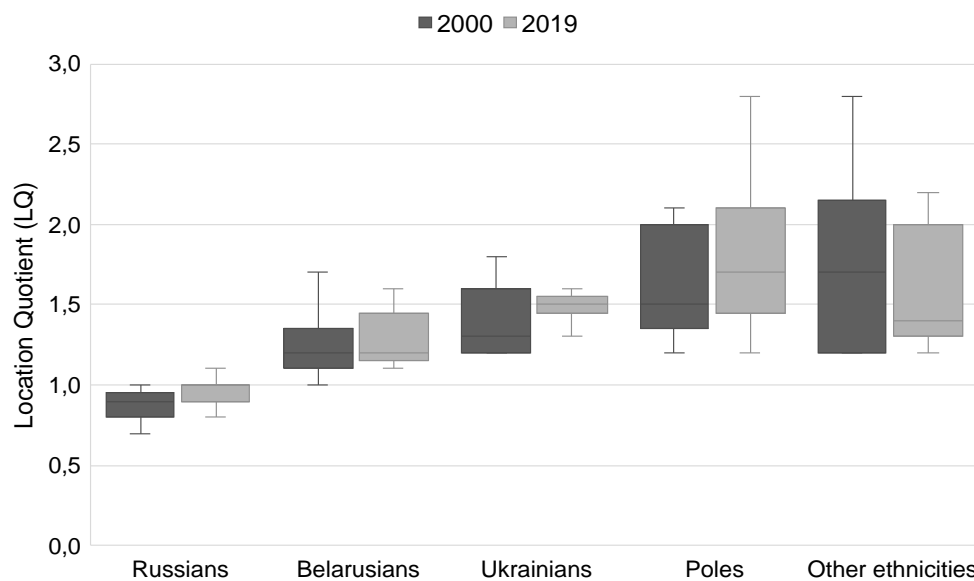


Figure 4. **Box plots of the mean LQ values per each city for minority ethnic groups** (authors’ figure based on data from Central Statistical Bureau of Latvia)

The interpretation of mean values of the LQ in box plots for minority ethnic groups across the studied cities leads to a conclusion that the highest levels of residential concentrations are calculated for the smallest ethnic groups in terms of population size – Poles, Ukrainians, and other ethnicities. Similarly, the range of

variation in estimated mean LQ values between the cities is highest for Poles and other ethnicities. The lowest residential concentrations were found for Russians, the largest ethnic minority in Latvia. For some minority ethnic groups, such as Russians, Belarusians and Poles, the levels of residential concentration have slightly increased over the past two decades. In general, the observed changes are very small, which means that the residential patterns of minority ethnic groups are relatively stable over time.

The remainder of this section maps the landscape of minority ethnic groups in the selected cities or examples of the case studies. First, the second largest city of Daugavpils, where ethnic minorities make up nearly 80% of the city's population. The city is located in the eastern part of the country and is ethnically diverse, and apart from the largest minority of Russians, it is home to significant numbers of Belarusians, Poles and Lithuanians of Latvia.

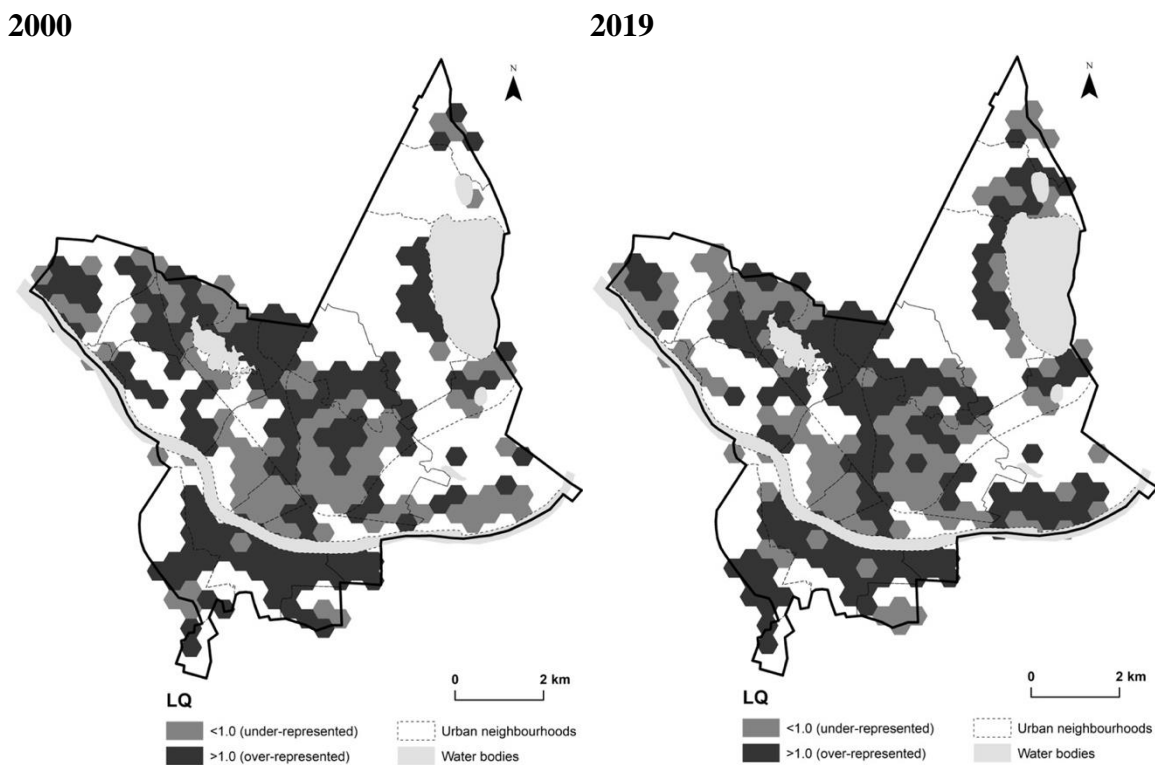


Figure 5. LQ maps for the ethnic minorities in Daugavpils, 2000 and 2019 (authors' figure based on data from Central Statistical Bureau of Latvia)

The location patterns of all ethnic minorities reveal a relatively even distribution across all urban neighbourhoods with a lower presence in the historic city centre or inner-city areas (Figure 5). Minority ethnic groups are over-represented in the Soviet-era housing estates. Comparing LQ results, there are persistent patterns, as residential concentrations of minority ethnic groups in the urban neighbourhoods have not

changed much over the studied period. Here it would be essential to look at the age structure of minority ethnic groups and rates of residential mobility to grasp this persistent trend.

The next city discussed is Ventspils, which, unlike Daugavpils, is located on the Western coast of the Baltic Sea and can be described as Latvia's most ethnically segregated city. The port and railways played an important role in the city's economy, and the urban morphology was influenced by Soviet industrialisation and subsequent labour immigration. The city has neighbourhoods where residential development has been linked to port, railway and industrial development and where minority ethnic groups are still highly concentrated and over-represented, as confirmed by the following LQ maps (Figure 6). Similarly to the case of Daugavpils, there have been no significant changes in the residential concentration of ethnic minorities in Ventspils. The following maps show some clustering of minority ethnic groups in the Northern part of the city. In the case of Daugavpils and Ventspils, the marked decrease in the levels of segregation index for other ethnicities has not affected the residential concentration of all minority ethnic groups when aggregated.

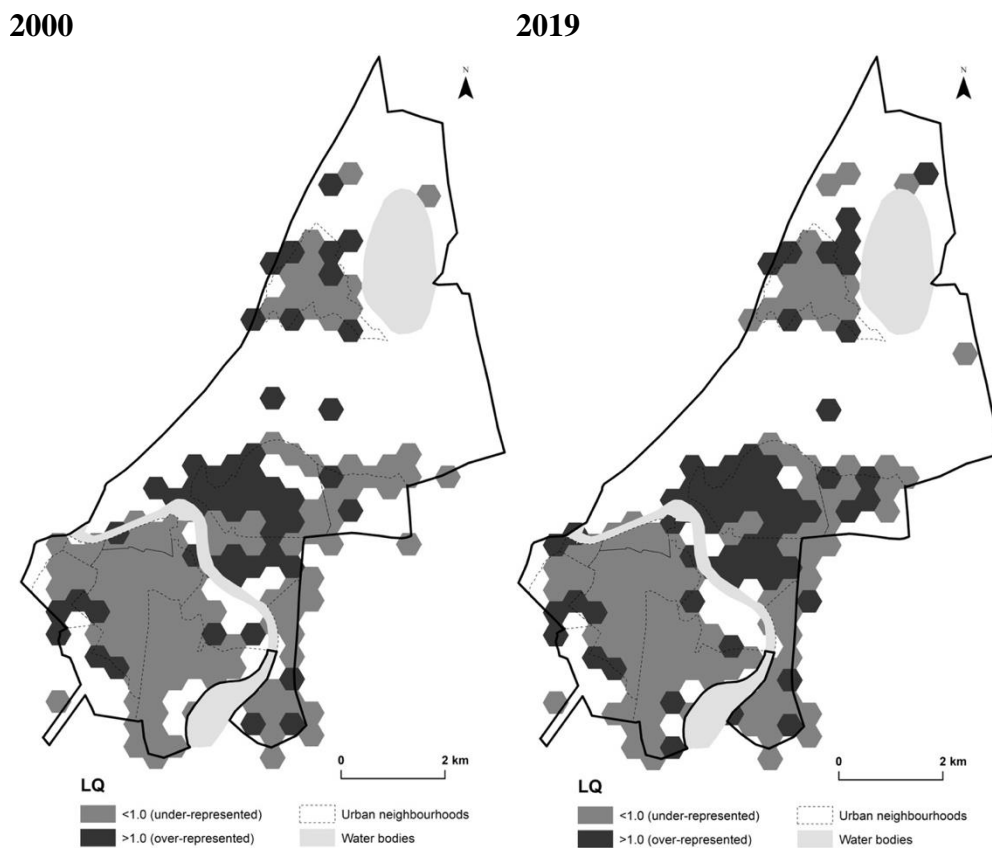
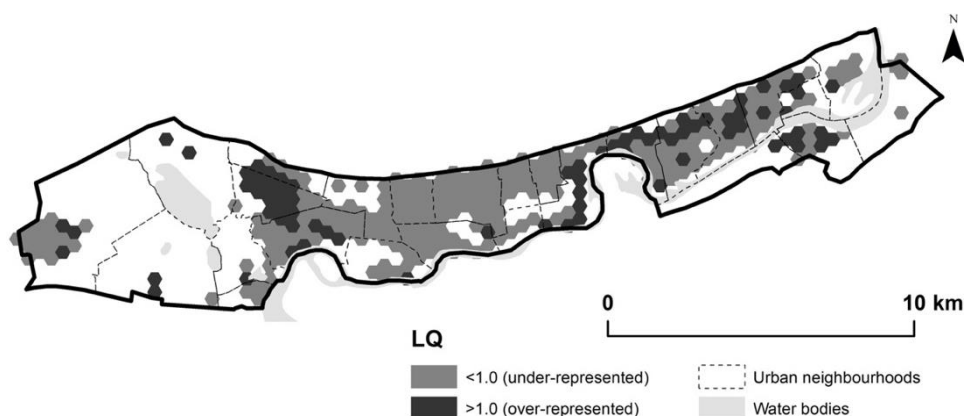


Figure 6. LQ maps for the ethnic minorities in Ventspils, 2000 and 2019 (authors' figure based on data from Central Statistical Bureau of Latvia)

Finally, the Latvian resort city of Jūrmala is analysed (Figure 7). In contrast to the two cities discussed previously, opposite processes have coincided: a slight spatial dispersion of ethnic minorities outside the concentration areas in the largest housing estate in the Western part of the city (Kauguri neighbourhood); and a slight increase in concentration in the residential areas of private houses, villas, and luxury apartments in the eastern part of the city (closer to Riga). This means that there is a housing segmentation among minority ethnic groups. In the case of Jūrmala, the concentration of ethnic minorities in Soviet-era large-scale housing estates is not a straightforward pattern. Jūrmala holds a unique position in the Latvian housing market, which was formerly influenced by the issuing of temporary residence permits to residents of foreign countries, particularly those of Russia, Belarus, and Ukraine, as well as Central Asian nations. This has also impacted the ethnic geographies of the city and must be considered. For future research, additional in-depth investigation is required here.

2000



2019

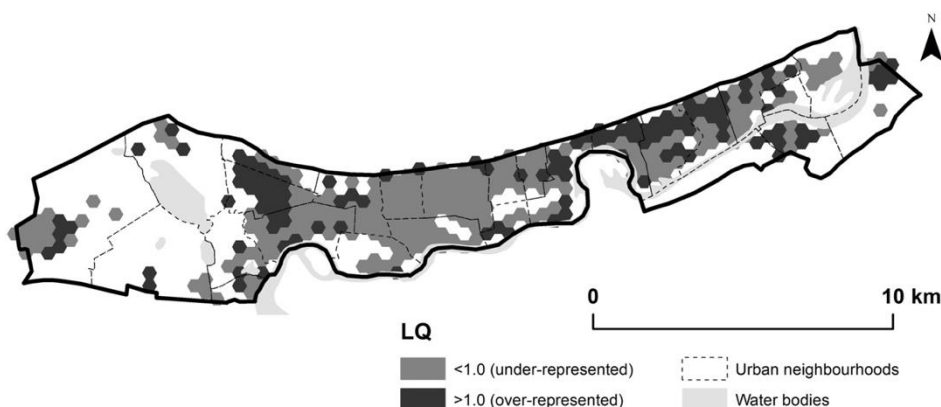


Figure 7. LQ maps for the ethnic minorities in Jūrmala, 2000 and 2019 (authors' figure based on data from Central Statistical Bureau of Latvia)

In future research, it is worthwhile to map the distribution of specific ethnic groups in Latvia's largest cities across urban neighbourhoods. However, it would also be beneficial to overlook the segregation dimension, which depicts the level of ethnic segregation between pairs of ethnic groups.

Conclusion

This study takes a geographic and comparative approach to compare and describe the unequal distribution of minority ethnic groups over urban neighbourhoods in the nine largest cities of Latvia. The study contributes to the understanding of the patterns of ethnic residential segregation that have developed over time because of various historical events and urban transformations. We also wanted to find out whether and what changes have taken place in the more recent period of less than 20 years since 2000. Geo-referenced grid data of census and population register were used to compute aggregated measures of segregation and spatial concentration. In this way the paper addressed the current concerns on social cohesion and fragmentation in urban areas related to increasing diversity of European populations. The main findings of this study draw attention in using of easily interpretable and comparative segregation measures that account for complex geographies and increasingly diversifying urban populations. By means of two widely used measures of segregation, this paper documents in detail and for the first time the current level of minority ethnic segregation and residential concentration in the nine largest cities of Latvia as well as the main trends over the last two decades.

According to earlier studies of the Chicago School of urban sociology, such as the seminal contributions of Robert Park and Ernest Burgess (e.g. Park 1915) claims that the segregation of ethnic groups should decline the longer they stay in the receiving society. Moreover, many former immigrants manage in the course of time to improve their status through social mobility. Thus, bearing in mind the ideas of the Chicago School and knowing that most ethnic minorities in Latvia have lived for a long time and for several generations, a decline in segregation in the nine largest cities ought to be evident. However, segregation levels for the main ethnic minority groups in the largest cities of Latvia have been remarkably stable over the past 20 years. The analysed measures of segregation and spatial concentration conceal powerful persistence in the distribution of ethnic minority groups in Latvia. In all the studied cities, ethnic minority groups have penetrated the urban neighbourhoods of the Soviet-era housing estates. Ethnic residential segregation occurs throughout urban Latvia, but its levels and patterns of residential concentration largely vary – by ethnic group, by the relative size of that ethnic group in the city being studied, by the size of that city, by its ethnic diversity, and by its location. The overall conclusion from the overlooked

variances is that segregation levels have slightly declined for the largest ethnic minority group – Russians. In contrast, most other ethnic minority groups in Latvia over the 20-year period became a bit more separated. The comparative urban analyses of ethnic residential segregation reported here have provided evidence regarding the level of segregation of the four main ethnic groups in the nine largest cities at the beginning of the twenty-first century. For all four, segregation levels and residential concentrations were expected to be highest in the capital city of Riga where the ethnic groups were most numerous. However, the level of segregation and residential concentration of minority ethnic groups in Latvia's most populous city of Riga is lower compared to almost all second-tier cities, with Ventspils and Liepāja (in the Western part of the country) having the highest indices, while the ethnically diverse Latgale region (Daugavpils and Rēzekne in the East) had lower indices, as ethnic minorities make up a clear majority of the urban population there.

Acknowledgement

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Kopsavilkums

Daudzviet pasaulē un Eiropā mazākumtautību izvietojumam un dzīvesvietu izvēlei tiek pievērsta pastiprināta uzmanība, jo tas ir aktuāls sociālo nevienlīdzību un polarizāciju ietekmējošs faktors, kā arī cieši saistīts ar starpvalstu migrācijas aktuālajām tendencēm. Eiropā ir plaši pētīti mazākumtautību izvietojuma un telpiskās nošķiršanās jautājumi, bet Latvijā tiem tikpat kā nav pievērsta uzmanība. Tas ir nedaudz pārsteidzoši, ņemot vērā salīdzinoši lielo un etniski daudzveidīgo mazākumtautību iedzīvotāju skaitu. Pilsētnieku vidū mazākumtautības veido lielu iedzīvotāju īpatsvaru, kas gan ir visai atšķirīgs, salīdzinot rakstā aplūkotās deviņas Latvijas lielpilsētas. Šis pētījums aplūko mazākumtautību izvietojuma iezīmes un nošķiršanās pakāpi lielajās pilsētās dzīvojošo vidū, kā arī sniedz atbildi par notikušajām izmaiņām kopš 2000. gada. Pētījumā analizētas četras lielākās mazākumtautības Latvijā: krievi, baltkrievi, ukraiņi, ukraiņi, poļi un citas mazākumtautības. Darbam izmantoti gan 2000. gada tautskaites dati, gan 2019. gada iedzīvotāju reģistra dati par mazākumtautībām. Iegūtie rezultāti parāda aplūkoto tautību nošķiršanās pakāpi un ģeogrāfiskā izvietojuma raksturu Rīgā, Daugavpilī, Liepājā, Jelgavā, Jūrmalā, Ventspilī, Rēzeknē, Valmierā un Jēkabpilī.

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**RESIDENTIAL SATISFACTION AND THE FACTORS
AFFECTING IT IN A SECOND-TIER CITY****DZĪVESVIETAS PIEVILCĪBA UN TO IEKTEMĒJOŠIE FAKTORI OTRĀ
LĪMEŅA PILSĒTĀ****Līga Feldmane**

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Abstract

Studies of residential satisfaction can help to investigate and improve the emotional state of society and overall satisfaction with life, which is especially important in the wake of the Covid-19 pandemic. This research is based on the population survey in one of the second-tier cities of Latvia, Jelgava, with the aim of investigating the main factors that impact residential satisfaction in a second-tier city. Based on the characteristics of the residential satisfaction assessment of the urban environment in the study, the factors of the urban environment that affect the residential satisfaction assessment by the city's population are identified, of which the most important factor is the quality of the environment and personal safety. The study reveals that residential satisfaction is impacted by various demographic, socio-economic, housing and migration characteristics of the population.

Keywords: residential satisfaction, second-tier city, spatial differences

Introduction

One of the aspects influencing quality of life is place of residence. Its importance has been highlighted in particular in the wake of the Covid-19 pandemic, when people had limited travel opportunities and a large amount of time was spent at their place of residence. Several recent studies have already highlighted that the Covid-19 pandemic has influenced daily habits and subjective wellbeing (Krisjane et al. 2020; Berina et al. 2021). Therefore, studies of residential satisfaction can contribute in the field how to improve the emotional state of society and overall satisfaction with life. Residential satisfaction is a multidimensional construct due to the fact that its precise meaning depends on the time, place and purpose of the assessment, and on the value system of the assessor. In geography, residential satisfaction is associated with an assessment of an individual's place of residence and viewed as an accurate guide to what the respondents feel about their residence (Parkes et al. 2002).

Exploring residential satisfaction in urban environments is an interdisciplinary topic addressed from the second half of the 20th century onwards by researchers representing various specialisations. Previous studies have considered a wide range of

attributes shaping residential satisfaction, starting with a psychological assessment of the individual and ending with the geographical location of the place of residence (Amerigo and Aragonés 1997). Although in general researchers are mainly interested in large cities because various social processes tend to be more visible there, second-tier cities are also becoming increasingly prominent in research (Hanak et al., 2015; Barreira et al., 2019).

According to initial research in this field (e.g. Galster, 1985), residential satisfaction is influenced simultaneously by a complex set of indicators: characteristics of both the area around the place of residence and the population. It is important to investigate the factors that affect residential satisfaction because it contributes to understanding the characteristics of the urban environment that should be improved to make it attractive. While research at the beginning of the 21st century (e.g., McCrea et al., 2005) primarily linked the attractiveness of urban space to economic factors such as job opportunities, living costs and urban services, currently researchers emphasise that the quality of the environment will in the future play an increasingly important role in the attractiveness of a residence (Kahrik et al., 2016).

Based on previous studies and the author's interest in this topic, the research questions are stated as follows:

- 1) What attributes and factors characterise residential satisfaction in second-tier cities?
- 2) How do different groups of residents assess residential satisfaction factors?

Data and methods

In order to study residential satisfaction in second-tier cities and to answer the abovementioned research questions, the fourth-biggest city in Latvia, Jelgava, was chosen as a research area. In the city, the quantitative survey, a population questionnaire, was carried out in the period from June 2018 to December 2018. As a result, using the five-point Likert scale system, a total of 961 respondents expressed their assessment of different urban space attributes, such as public transport, healthcare, sports facilities, cultural facilities, condition of streets and buildings, public places (e.g. markets, squares, pedestrian areas), green areas, availability of retail stores, educational institutions, air quality, noise levels, orderliness, safety and job opportunities. In order to establish which factors of urban space influence Jelgava residents' residential satisfaction assessment, factor analysis was primarily chosen, using the principal component analysis, while the Varimax rotation was used for more complete interpretation of factors. In the process, using regression analysis, it was discovered that the inclusion of certain urban space attributes – retail shops, educational institutions, condition of streets and buildings, as well as job opportunities

– was not expedient, as they did not sufficiently explain residential satisfaction regarding Jelgava, and they were therefore excluded from the set of factors. To ascertain the statistical difference of residential satisfaction assessment (factors characterising residential satisfaction) data between four different groups of indicators – demographic indicators, socio-economic indicators, indicators pertaining to migration experience, as well as housing and place attachment – characterising the respondents, the Kruskal-Wallis H Test was applied.

Results

Factor analysis revealed that residential satisfaction assessment in the case of Jelgava is determined by three factors, whose determining attributes explain 59.1% of the information (Table 1).

Table 1. **Factors impacting residential satisfaction** (author's elaboration)

Factor	Explained information, %	Determining attributes	Factor weight of attribute
1. Environmental quality and personal safety	37.8	Noise level	0.834
		Air quality	0.774
		Safety	0.608
		Orderliness	0.609
2. Infrastructure	11.1	Public spaces	0.738
		Green areas	0.702
		Cultural facilities	0.662
		Sports facilities	0.609
3. Healthcare and transport	10.2	Public transport	0.773
		Healthcare	0.731

Notes: Analysis of the main components, Varimax rotation

Jelgava residents consider the quality of environment to be the most important factor influencing residential satisfaction. The results are in line with the trend reported in the literature, where it is noted that in residential satisfaction assessments, society is gradually moving from economic to environmental quality indicators. Such results can be explained by the fact that, in contrast to large cities, the availability of infrastructure and services is generally better in second-tier cities, and therefore the quality of the environment in the perception of the inhabitants of these cities pushes the importance of infrastructure availability into the background. Although in the opinion of Jelgava residents, the provision of infrastructure affects overall residential satisfaction to a lesser extent than the quality of the environment and personal safety, such attributes as the availability of cultural and sports facilities have an impact on satisfaction with urban space. In addition, the availability and quality of public transport, similar to the findings of studies on other European cities (Hanak et al. 2015) also has an impact on individuals' satisfaction, but it is relatively small. The

reason for it could be the specifics of a second-tier city – shorter distances in the city and a more compact morphological structure – and therefore the use of public transport is relevant for only a small part of the city’s population.

The three previously detected factors were analysed by different groups characterising the population. The rating of the first factor – **environmental quality and personal safety** – in the city of Jelgava is moderately high, because the average rating given by respondents is 3.69 out of 5. As demonstrated by the Table 2, the demographic indicators characterising the respondents are not decisive in the assessment of this factor, due to the fact that only the age of the respondents has a statistically significant impact.

Among the socio-economic indicators characterising the respondents, occupation, satisfaction with the financial situation and satisfaction with life in general have an impact on the assessment of the quality of the environment and personal safety. This factor was rated significantly higher by persons who were employed, expressed satisfaction with their financial situation and were satisfied with life in general. The results confirms the relationship (Fleuret & Prugneau 2015) that overall subjective satisfaction with life affects satisfaction with different areas of life, including place of residence, as people who are generally satisfied with life tend less frequently to assign negative traits to various spheres of life.

The survey data also shows that residents who have lived in their place of residence for a long time assess the quality of the environment and their personal safety higher than people who have come to their place of residence relatively recently, and this can be explained by an increase in place attachment and acceptance of the environment (Inch & Florek 2010), as well as by the loss of comparative criteria for assessing the residential satisfaction after long-term residence in the same place. Furthermore, the survey indicates a close connection between the future intentions of migration and the assessment of the quality of the environment and personal safety in this city.

The results of the study points out that the indicators characterising housing also have an impact on the assessment of the quality of the environment and personal safety in the city. There is a statistically significantly lower assessment of environmental quality and personal safety among residents living in dormitories. A lower rating was also received from respondents who are tenants compared to those who are owners of their housing, confirming the tendency found in previous studies (Balestra & Sultan 2013) that ownership encourages greater involvement in improving the place of residence, which is thus closely linked to a higher assessment of the environment.

Table 2. Assessment of environmental quality and personal safety (Factor 1) according to the indicators characterising respondents and households (author's elaboration)

		Average value	Kruskal-Wallis value H	df	<i>p</i>
Demographic profile					
Gender	Male	3.71	0.419	1	0.518
	Female	3.68			
Age	18–34	3.65	8.184	2	0.017*
	35–64	3.70			
	65 and above	3.86			
Nationality	Latvian	3.68	0.275	1	0.600
	other	3.71			
Marital status	lives alone	3.70	0.347	1	0.556
	married or in cohabitation	3.67			
Children living in household	yes	3.71	1.169	1	0.280
	no	3.67			
Socio-economic profile					
Education	basic	3.64	3.370	1	0.338
	general secondary	3.63			
	professional secondary education or vocational education	3.67			
	higher	3.74			
	Occupational status	employed			
unemployed	3.68				
studying	3.53				
employed and studying	3.69				
Satisfaction with financial situation	satisfied	3.84	60.220	1	0.000*
	others	3.44			
Overall satisfaction with life	satisfied	3.75	23.387	1	0.000*
	others	3.40			
Migration experience					
Duration of living at the place of residence	recently migrated	3.58	19.446	1	0.000*
	long-term residents	3.77			
Plans regarding migration	plan to move	3.50	16.910	1	0.000*
	others	3.74			
Housing and place attachment					
Type of housing	apartment	3.70	15.056	2	0.001*
	detached house, terraced house	3.76			
	dormitories	3.52			
	Tenure	owned			
rented	3.61				
Place attachment	attached	3.80	67.142	1	0.000*
	others	3.38			

* – statistically significant difference ($p < 0.05$)

The results show that the average rating of Factor 2 – **infrastructure provision** – in Jelgava is 3.83 out of 5, which is the highest rating of any factor. Analysing the assessment of infrastructure provision in terms of respondents' demographic indicators, the results revealed that it is influenced by nationality and the presence of a child in the household. Latvian respondents are more satisfied with the provision of infrastructure in Jelgava, while non-Latvians are more critical of it. The infrastructure of the city is assessed lower by people with a child living in the household, who, compared to childless respondents, give a statistically significantly lower rating to the accessibility of cultural facilities and public spaces. These results are consistent with previous studies (e.g. Balestra & Sultan, 2013) showing that a child's presence in the family increases the demands for certain infrastructural amenities, and for entertainment and recreational opportunities, thus creating a more critical view of urban infrastructure.

Amongst the socio-economic indicators, the assessment of urban infrastructure is influenced by respondents' subjective satisfaction with the financial situation of the household and overall satisfaction with life. Respondents who expressed satisfaction with the financial situation of their household also rated the provision of infrastructure in the city statistically significantly higher. This means that people with higher incomes also have more extensive recreational opportunities in the city, and the results confirms the trend in empirical studies (Boschman 2018; Dekker et al. 2011) that households with a better financial situation and higher income tend to be more satisfied with their place of residence compared to households with a less satisfactory financial situation.

Respondents who stated that they are generally satisfied with life also indicated a higher assessment of the provision of infrastructure in the city, compared to those who were less satisfied with life. Among the group of indicators characterising housing, the only indicator influencing the assessment of Factor 2 is place attachment to Jelgava, because respondents who feel attached to Jelgava assess the infrastructure in the city more highly than those who do not feel a place attachment to it.

According to the results, the residential satisfaction assessment is influenced by the factor of healthcare and transport provision, although less than by the other factors. The respondents' assessment of Factor 3 – **healthcare and transport provision** – was average, and the respondents rated it with an average of 3.12 out of 5. The results did not reveal a correlation in the assessment of Factor 3 between different social groups regarding demographic indicators. Of the socio-economic indicators, subjective satisfaction with the household's financial situation and satisfaction with life in general influence the overall assessment of this factor, confirming the close correlation of these indicators with the assessment of the place of residence and confirming the

previously mentioned observation that overall attitude towards life affects perceptions of different areas of quality of life. Among the set of indicators characterising the migration experience of the respondents, only the respondents' plans to move affected the assessment of Factor 3 – statistically significant differences in the assessment of this factor were observed between respondents who plan to move to another place in the next few years and those who do not plan this or have not yet decided, as the former assessed healthcare and transport provision significantly lower.

Conclusion

The study reveals that residential satisfaction in second-tier cities is determined by a set of urban space attributes and factors such as (1) environmental quality and personal safety, (2) infrastructure (3) healthcare and transport. The research confirms that in Jelgava, similar to current trends in other cities, the most important factor characterising residential satisfaction is the quality of the environment and personal safety.

Differences in the residential satisfaction assessment are significantly influenced by the various indicators characterising individuals or their households, of which the financial situation of the household, overall satisfaction with life, and place attachment were closely correlated to all the factors influencing residential satisfaction. This leads to the conclusion that individuals who are generally more satisfied with life, who have a more favourable household financial situation and who feel attached to the city value the urban environment higher and feel more satisfied with it than those who have a more critical outlook on life, who are in a poor financial situation and do not feel attached to the city.

Taking into account that this population survey was carried out before the Covid-19 pandemic, which could have influenced some aspects of the perception of residence, further expanding the research in the field of residential satisfaction and its impacting factors in second-tier cities in Latvia would be desirable.

Acknowledgment

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Kopsavilkums

Dzīvesvietas pievilcības pētījumi var palīdzēt noskaidrot un uzlabot sabiedrības emocionālo stāvokli un vispārējo apmierinātību ar dzīvi, kas ir īpaši svarīgi Covid-19 pandēmijas apstākļos. Pētījuma pamatā ir iedzīvotāju aptauja vienā no Latvijas otrā līmeņa pilsētām – Jelgavā, noskaidrotu galvenos faktoros, kas

ietekmē apmierinātību ar dzīvesvietu šāda līmeņa pilsētā. Pētījumā, ņemot vērā rādītājus, kas nosaka dzīvesvietas pievilcību, tiek identificēti pilsētvides faktori, kas ietekmē pilsētas iedzīvotāju dzīvesvietas pievilcības novērtējumu, no kuriem svarīgākais faktors ir vides kvalitāte un personiskā drošība. Pētījums atklāj, ka apmierinātību ar dzīvesvietu ietekmē dažādas iedzīvotāju demogrāfiskās, sociāli ekonomiskās, mājokļu un migrācijas aspektus raksturojošas pazīmes.

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**DOES THE COVID-19 PANDEMIC HELP WITH IDENTIFYING
MEASURES TO REDUCE ATMOSPHERIC POLLUTION?****VAI COVID-19 PANDĒMIJA PALĪDZ APZINĀT DARBĪBAS ATMOSFĒRAS
PIESĀRŅOJUMA SAMAZINĀŠANAI?****Iveta Steinberga, Nauris Truhnevics**

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Abstract

This article analyses the variability of gas and aerosol pollution levels in Riga (Latvia) over different periods associated with Covid-19 restrictions. The variability of atmospheric pollution levels is described from a relative point of view; the effects of meteorological parameters were assessed using Pearson's correlation factor and statistical significance. To assess whether changes were statistically relevant during the various assessment periods, the analysis was performed using the ANOVA dispersion test and the post-hoc Tukey test. Major changes have been identified in the case of gaseous atmospheric pollution.

Keywords: air pollution, Covid-19, Riga, gaseous pollutants, particulate matter

Introduction

Various publications and national reports, including digital media, increasingly show information on the reduction of atmospheric pollution due to the limited economic activity imposed by the COVID-19 pandemic restrictions, such as the reduction of nitrogen dioxide (NO₂) concentrations in atmospheric air in Europe, the USA, Malaysia and other countries (Berman & Ebisu 2020; Othman & Latif 2021). The European Environment Agency has also reported that the most significant reduction in air pollution during the Covid-19 pandemic is particularly observed in case of nitrogen dioxide (NO₂) pollution, but other air pollutants have decreased less (EEA 2020).

The global Covid-19 pandemic started in the city of Wuhan in Hubei province in China. The novel Coronavirus (SARS-CoV-2) is an infectious disease affecting the airways and is more contagious than previous strains of the virus (SARS and MERS), with needle-shaped spikes and protein mutations that increase the spread of the virus. Similar local outbreaks with similar symptoms to the new SARS-CoV-2 virus (Platto et al. 2020) were have been detected at the end of 2019 (October–December). In January 2020, the virus became an epidemic in China, after which it spread elsewhere in the world. By 11 March 2020, SARS-CoV-2 had become a global pandemic, and

within a few weeks, the Covid-19 virus had become the most dominant variant of the virus around the world (Platto et al. 2020).

As the virus spread across Europe, in March 2020 most European countries started to introduce economic and movement-restrictive measures to reduce the number of infections. Measures introduced in different countries included partial or total closure of national and international borders, travel restrictions, the closure of educational institutions, restrictions on local mobility and others. These activities, which are intended to limit the spread of the virus, have at the same time significantly reduced the activity of atmospheric pollutants, particularly in the road and aviation sectors. Several researchers have analysed the reduction of direct emissions in the atmosphere (e.g. Guevara et al. 2021), concluding that in 30 countries in Europe (EU-27, the United Kingdom, Norway and Switzerland) the average reduction in NO_x emissions was 33%; in NMVOCs, 8%; and SO_x and PM_{2.5}, 7%. For pollutants as a whole, with the exception of SO_x, 85% of the reduction was attributable to road transport. There is an unclear situation at concentration levels where a reduction in NO_x concentrations is observed in several European cities including Brussels, Madrid, Milan, Paris; statistically significant changes in PM_{2.5} cannot be confirmed in relation to the complex PM_{2.5} formation mechanism (Dobson & Semple 2020; Fu et al. 2020; Kumar et al. 2020; Lee et al. 2020).

In Latvia, there has been a long-term increase in atmospheric pollution in Riga, and effective measures, whose introduction is widely anticipated and problematic, are being sought to improve the situation. In analysing the results of long-term monitoring, it is not possible to unambiguously identify the impacts of individual pollutants, which makes it difficult to assess the effectiveness of measures to reduce atmospheric pollution. In the case of Covid-19, the extent of the effects of the restrictions on mobility on atmospheric pollution can be used as a unique situation in which it can be assessed whether, in the case of Riga, such measures to limit mobility would be effective. The study carried out an analysis of concentrations of pollutants in Riga before the Covid-19 pandemic and during periods of lockdown.

Data and methods

Changes to the structure of air quality data were studied as data changes over specific periods. The following periods for analyses were set, corresponding to specific lockdown periods regulated by legislation in Latvia: (1) 12.03.2019–31.12.2019 (the pre-Covid-19 period); (2) 12.03.2020.– 9.06.2020 (the first Covid-19 lockdown period); (3) 10.06.2020–8.11.2020 (the period between lockdowns); (4) 12.03.2021–30.04.2021 (the second Covid-19 lockdown period). All changes in concentrations of pollutants were analysed, taking into account meteorological

parameters, as their impact on concentrations are well-known. All the data included in the analysis were obtained from the official database operated from the Latvian Environmental, Geology and Meteorology Centre. In the case of gaseous pollutants and meteorological data, hourly values were analysed, while in the case of particle pollution, 24-hour agglomerated data were used. A detailed description of monitoring sites is given in Table 1.

Table 1. Information about monitoring points and gathered data

Monitoring point	Station type	Geographical coordinates	Parameter
Kengarags	City background station	56.935928 N 24.156786 E	SO ₂ , NO ₂ , O ₃ , benzene, toluene
Parks	City background station	56.950606 N 24.115872 E	SO ₂ , NO ₂ , O ₃ , benzene, toluene
Brivibas	Traffic pollution station	56.958914 N 24.125775 E	PM ₁₀
Kronvalda	City background station	56.954847 N 24.104756 E	PM _{2.5} , PM ₁₀
Riga-University	Meteorological station	56.954797 N 24.104686 E	pressure, air temperature, precipitation, wind speed, wind direction

The data analysis was carried out using the the programme JASP 0.14.1.0. The following methods of analysis were applied as part of the work:

- (1) a descriptive statistical analysis to give an idea of the variation of parameters over the periods defined above
- (2) correlations analysis – in order to assess the impact of individual meteorological parameters on concentrations of pollutants, with a view to excluding the effects of these parameters from further analysis
- (3) analysis of dispersions (ANOVA) and post-hoc analysis to compare differences between each Covid-19 period, excluding the effects of statistically relevant meteorological parameters

Results

As a reference period, a sufficiently long period has been selected to reflect the situation of atmospheric pollution before the introduction of the Covid-19 restrictions, it has also been considered to ensure that, as far as possible, data are collected throughout the seasons. It appears that the average and median concentrations of all

observation stations do not exceed the air quality standards, but it is apparent that very high-pollution episodes have also been observed, particularly in the case of particulate pollution (see page Table 2).

Table 2. Overview of pollutant concentrations for pre-Covid-19 period included in data analysis (12.03.2019.–31.12.2019.) (authors' elaboration based on Latvian Environmental, Geology and Meteorology Centre data)

Pollutant, site	Median concentration, ug/m³	Mean concentration, ug/m³	Minimum concentration, ug/m³	Maximum concentration, ug/m³
PM _{2.5} , Kronvalda	9.9	12.018	0.2	67.1
PM ₁₀ , Kronvalda	17.5	20.62	1.1	85.5
PM ₁₀ , Brivibas	34.6	35.756	11	94
SO ₂ , Parks	2.383	2.284	0.279	3.953
NO ₂ , Parks	19.493	20.977	3.463	69.276
O ₃ , Parks	30.237	32.845	3.867	87.237
C ₆ H ₆ , Parks	2.35	2.542	1.102	5.912
Toluene, Parks	7.273	7.641	2.97	14.918
SO ₂ , Kengarags	1.474	1.646	0.763	4.681
NO ₂ , Kengarags	23.843	24.761	3.23	61.717
O ₃ , Kengarags	51.364	53.933	26.535	93.55
C ₆ H ₆ , Kengarags	1.563	1.65	0.68	3.6
Toluene, Kengarags	7.12	7.749	2.502	36.21

Concentrations of substances vary very much over the prescribed periods, depending on the specific pollutants and inherent concentrations in the environment. Therefore, in order to assess the intensity of these changes, the variability of concentrations is described as relative values as a percentage relative to the pre-Covid-19 period; negative values indicate a decrease in concentrations, while positive values indicate an increase in concentrations.

In general, it can be argued that nitrogen dioxide concentrations have decreased during the Covid-19 periods with specified operational and displacement limits, which has contributed to increasing ozone concentrations in the atmosphere as a result of photochemical processes. In the case of sulphur dioxide, the situation is not clear: there was a decrease in concentrations at Parks station and an increase at Kengarags station. A similar situation was observed with toluene and benzene contamination, which could potentially indicate specific, very local sources of pollution. In the case of coarse particulate matter (PM₁₀), atmospheric pollution levels have only increased, while in the case of smaller particulate matter (PM_{2.5}), the situation has improved over

the Covid-19 periods. This reduction of concentrations could be explained by changes in the level of contamination of other concentrations, as part of PM_{2.5} is secondary aerosols produced in response to volatile organic compounds and nitrogen dioxide.

Detailed changes to pollution levels for all substances and all monitoring stations are given in Figure 1.

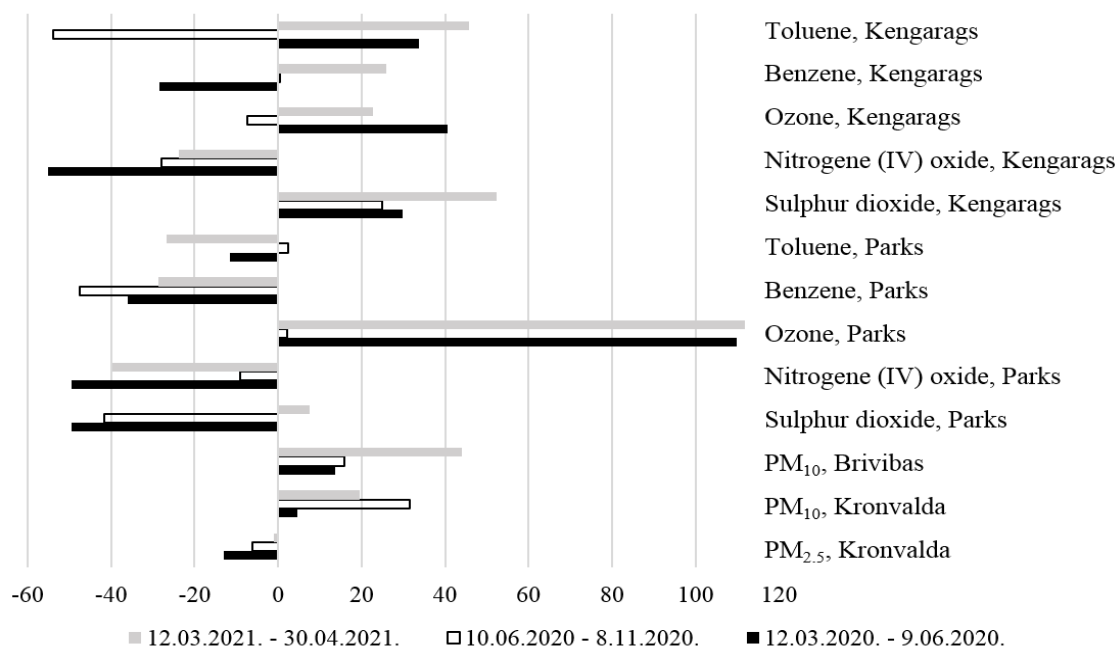


Figure 1. **Relative changes (%) in concentrations; base period is pre-Covid-19 period (12.03.2019. - 31.12.2019.)** (authors' elaboration based on Latvian Environmental, Geology and Meteorology Centre data)

At the Park station there has been found to be a particularly high increase in ozone concentrations, which may initially seem extremely dangerous. However, it should be noted that in urban areas nitrogen dioxide concentrations are close but reversible, related to ozone concentrations. Due to photochemical reactions in the atmosphere, when ozone molecules are split in sunlight, oxygen in the atomic form reacts with nitrogen (II) oxide emitted in the results of incomplete combustion, and a result of this reaction is nitrogen (IV) dioxide. Comparing concentrations between pollutants is difficult not only because of different periods of time but because, as is known, atmospheric pollution is heavily affected by meteorological conditions. Wind speed, wind direction, precipitation, atmospheric temperature and atmospheric pressure are generally considered to be the most significant weather conditions. A correlation analysis has been carried out to assess the magnitude of the effects of particular circumstances, which which eliminates statistical relevance and correlations.

The correlations analysis confirmed that there was a statistically significant correlation between these meteorological parameters and concentrations of pollutants, a factor of Pearson's correlation rates, often with a rather low correlation. The highest correlation rates for Pearson are obtained for wind direction and wind speed, which is why the effects of these parameters on concentrations are excluded in the subsequent analysis.

All set of Pearson correlation coefficients are given in Table 3, and additionally statistically substantial relations were shown.

Table 3. **Pearson correlation coefficients for the whole period analysed** (authors' elaboration based on Latvian Environmental, Geology and Meteorology Centre data)

Variable	Atmospheric pressure	Air temperature	Precipitation	Wind speed	Wind direction
PM _{2.5} Kronvalda	0.20***	0.22***	-0.14**	-0.17***	-0.26***
PM ₁₀ Kronvalda	0.24***	0.22***	-0.17***	-0.14***	-0.25***
PM ₁₀ Brivibas	0.28***	0.13**	-0.19***	-0.25***	
SO ₂ Parks		0.15***			
NO ₂ Parks	0.18***	0.11**		-0.55***	-0.22***
O ₃ Parks	0.17***	-0.35***	-0.18***	0.34***	0.21***
C ₆ H ₆ Parks		0.15***		-0.08*	
Toluene Parks	0.10**	0.32***		-0.16***	-0.10*
SO ₂ Kengarags	0.23***	-0.18***	-0.20***		
NO ₂ Kengarags	0.15***	-0.24***		-0.50***	-0.11*
O ₃ Kengarags	0.21***		-0.15***	0.24***	0.17***
C ₆ H ₆ Kengarags		-0.17***		-0.13*	
Toluene Kengarags	0.13**	-0.76***	-0.10*	0.16***	0.13**

* p < 0.05, ** p < 0.01, *** p < 0.001

An analysis of the variance of ANOVA, completed by the post-hoc Tukey test, has been prepared following the elimination of the impacts of the major meteorological parameters. In the case of particulate matter contamination, statistically significant changes could not be identified during the various periods, even after the effects of meteorological conditions were excluded. However, the situation is different in the case of gaseous contamination (see Figure 2).

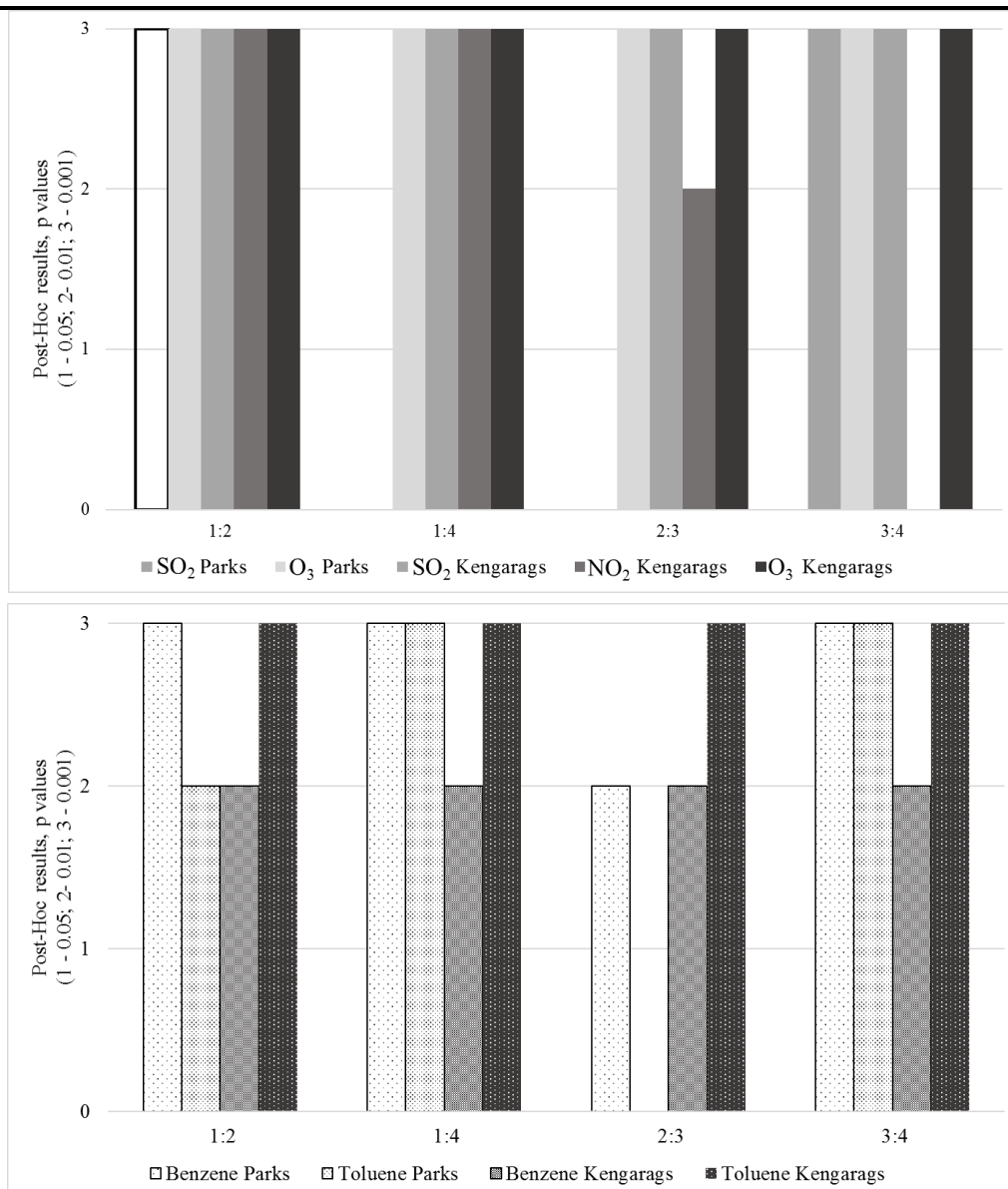


Figure 2. Grouped post-hoc test results for different periods; example of gaseous pollutants (authors' figure based on Latvian Environmental, Geology and Meteorology Centre data)

Conclusions

Although the restrictions on movement and economic activity imposed in Latvia during Covid-19 were not as strict as in other countries, there have been statistically significant changes in the field of atmospheric pollution. The results have shown that this situation can be used to predict how pollution could change if the activity of various sources of pollution was limited. The statistically significant reduction in gaseous concentrations observed unfortunately does not solve the major pollution problem in Riga – the pollution of particulate matter PM₁₀ – but it has indicated that the occurrence of significant amounts of pollution is not confined to transport and

heating pollution. On the other hand, the results of PM_{2.5} have shown that pollution can be reduced by reducing the level of secondary aerosols. Since the reduction of this type of pollution is extremely difficult, the analysis of the results during the above periods indicates that the reduction can be achieved by reducing concentrations of nitrogen dioxide and volatile organic compounds.

Kopsavilkums

Rakstā analizēta gāzveida un aerosolu piesārņojuma līmeņa mainība Rīgā (Latvijā) dažādos ar Covid-19 ierobežojumiem saistītos periodos. Atmosfēras piesārņojuma līmeņa mainība raksturota no relatīvā skatu punkta, meteoroloģisko parametru ietekme novērtēta, izmantojot Pīrsona korelācijas koeficientu un statistisko būtiskumu. Lai novērtētu, vai pārmaiņas dažādos novērtējuma periodos ir statistiski būtiskas, analīze veikta, izmantojot ANOVA dispersijas testu un Poist-Hoc Tukey testu. Būtiskākās pārmaiņas konstatētas gāzveida atmosfēras piesārņojuma gadījumā. Novērotais statistiski būtiskais gāzveida koncentrāciju samazinājums diemžēl neatrisina lielāko piesārņojuma problēmu Rīgā – lielāko cieto daļiņu PM10 piesārņojumu, tomēr tas indikatīvi liecina, ka būtiska piesārņojuma daudzuma rašanās tomēr nav saistīta tikai ar transporta un apkures piesārņojumu. Savukārt iegūtie rezultāti par sīkāko cieto daļiņu PM2.5 koncentrācijas pārmaiņām liecina, ka šo gāzveida piesārņojumu iespējams ierobežot, šādā veidā samazinot sekundāro aerosolu īpatsvaru.

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THE IMPACT OF OUTDOOR SIGNAGE ON THE STREETSCAPES OF OLD RIGA

ĀRTELPAS ZĪMJU IETEKME UZ VECRĪGAS IELU AINAVĀM

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Abstract

Visual pollution caused by insufficiently considered usage of outdoor signage in urban areas can negatively influence the visual quality of public outdoor space. Like other urban areas, Riga is exposed to the risk of this type of visual pollution. As Old Riga is included on the UNESCO World Heritage List, it is important to keep it clean from such contamination. So far, no in-depth research on visual pollution in Old Riga has been carried out. Therefore, the aim of our study was to explore and assess the occurrence and impact of outdoor signage in the main shopping streetscapes of Old Riga. The study was based on spatial preference and observation, street colour photomontages, on sociological investigation methods and on analysis of regulatory and planning documents.

The studies showed that the existing outdoor signage on the facades of the buildings of Old Riga causes visual pollution, which, in its turn, negatively affects the appearance of historical monuments and buildings and lowers the visual quality of public outdoor space. The development of appropriate design guidelines or a design code containing specifications for outdoor signage, windows, facades and their elements and design would promote the development of aesthetically consistent, expressive and high-quality urban space.

Keywords: Old Riga, visual pollution, outdoor signage, streetscapes

Introduction

In recent decades, there has been growing interest in visual pollution and its occurrence in urban areas. This phenomenon has encouraged scholars to study the effect of visual pollution on human perception, psyche and quality of life (Portella 2014). One of the causes of visual pollution is insufficiently considered usage of outdoor signage (e.g. commercial and non-commercial adverts, signboards, LED screens, informative signs) on the facades of buildings in urban areas. Visual pollution can affect humans directly, causing psychological discomfort, and indirectly, leading to economic deterioration of the community or to distraction of attention, like, for instance, eye fatigue in car drivers, lack of productivity, reduction in diversity of views, nervousness, behavioural disorders, pessimism, nausea, loss of vitality and even changes of character (Enache et al. 2012; Yilmaz & Sagsoz 2011). Besides, a visually polluted and degraded environment has reduced economic value (Jana & De

2015). Outdoor signage is a kind of communication between the customer and the salesperson. Lack of outdoor signage may harm the economic and social vitality of the town because signage attracts visitors, customers and investors. Nevertheless, abundant usage of outdoor signage in the historical centres of towns may have negative consequences. Disorganised outdoor signage may annoy people and cause stress, and, in the end, reduce people's ability to understand the messages from businesses (Portella 2014).

Like other urban areas, Riga is exposed to the risk of visual pollution caused by outdoor signage. Elimination of visual pollution is a topical problem for Old Riga, the oldest part of the historical centre of Riga, which has been included on the UNESCO World Heritage List. Its streetscapes are made up of unique architectural monuments and other historical objects of national and local importance. The cultural historical heritage is a unique and non-renewable resource of priceless value. Its sites are an important part of the urban environment. Their occurrence increases spatial value and identity of place (Yilmaz & Sagsoz 2011). In order to preserve them it is necessary to assess the visual impact of outdoor signage upon them. So far, no in-depth studies have been carried out of visual pollution due to outdoor signage in Old Riga and their impact on humans.

The aim of our research was to study and assess the occurrence of commercial outdoor signage in Old Riga and its impact on streetscapes, and to find out visitors' views of them. The survey was carried out in Old Riga from 2018 to 2019, before the Covid-19 pandemic. The obtained results could be used in the development of a unified design code or design guidelines for formatting and distributing signboards, banners and adverts in Old Riga.

In many countries such guidelines successfully regulate the aesthetic quality of urban space. To regulate the aesthetic quality of shop windows, facades and adverts, design codes include many specifications, such as size, proportions, colours, material, details, silhouette, design, etc. Such an approach also requires the involvement and consent of the public (Portella 2014).

Data and methods

In-situ observations and analysis

In-situ observations were made in order to explore the common aesthetics of street space in Old Riga, paying special attention to the occurrence of such outdoor signage as commercial and non-commercial signboards and adverts, their placement and interaction with facades of buildings and their prominence relating to eye level. We took photos of facades of buildings, signboards, adverts and streetscapes. These were processed by Adobe Lightroom CC2017 software and later used for the analysis

and assessment of visual quality of facades and street space and for interviewing visitors to Old Riga.

Colour photomontage of streetscape and analysis

We made colour photomontages of the main shopping streets of Old Riga, namely, Kaļķu, Audēju, Grēcinieku Streets, and put them together in order to compare the facades of buildings (here and further street names are used in their original local spelling). Later they were used for assessment of the streetscapes, focusing on the differences in the height of buildings, roof line, facades and the adequacy of their elements in the common streetscape, and the occurrence of outdoor signage. While creating the photomontage we used a method which shows the facade of the street in one line (Stamps 1993; Stamps, Miller 1993). The photos were processed by Adobe Lightroom CC2017 and Adobe Photoshop CS6 software. Elevation montages were made of both sides of the streets.



Figure 1. **Location of the studied streets** (authors' figure based on Scribblemaps.com online mapping service and OpenStreetMap spatial data)

Analysis of regulatory and development planning documents

In order to define the conditions of good visual quality in the historical centre of Riga, we analysed national laws and regulations, as well as regulations and development planning documents issued by Riga Municipality. They comprise requirements for the maintenance of a good-quality visual environment and

requirements for the distribution of outdoor signboards, direction indicators, building number signs and other signage in the historical centre of Riga.

Structured interview for an expert

To obtain more detailed information about the visual quality of Old Riga and clarify the laws and regulations for the maintenance of the visual environment, a structured face-to-face interview was carried out with an expert on the urban development of Riga. The questions comprised several aspects, namely, the sources of visual pollution in the historical centre of Riga, their impact on the cityscape and the necessity for their prevention, the aesthetic impact of outdoor signage, people's complaints about visual pollution, studies about visual quality in the centre of Riga and the necessity to use standardised signage. Finally, an expert's view was used when composing the questionnaires for interviewing visitors to Riga about the visual quality of the streetscapes.

Survey of questionnaires

We interviewed 135 visitors to Old Riga to find out their views about the occurrence of visual pollution and general assessment of visual quality in Old Riga. A survey was carried out by interviewing the respondents face-to-face and recording their replies in the questionnaire. The respondents were interviewed on the main shopping streets in daylight. The respondents chosen were people of different age groups and different places of residence: 52% were women and 48% men; 48% lived in Riga, 32% elsewhere in Latvia, and 20% were foreigners; 26% were younger than 19, 48.9% were in the age group between 20 and 59, and 24.5% were 60 or above 60.

The questionnaire consisted of four parts. The first part contained general information about the respondent, such as sex, age, place of residence and occupation. The second part contained three multiple choice questions with five possible answers. The respondents had to express their opinion about the appearance of Old Riga streets, the elements that made up their appearance and the amount of outdoor signage in Old Riga streets. In the third part the respondents were asked if they thought that the appearance of Old Riga streets should be improved. The respondents were also asked to assess the pictures of building facades included in the questionnaires with signboards and adverts in shop windows, Picture A showing the facade as it was in real life and Picture B showing an improved facade with a more harmonious advert better fitting into the overall picture (Figure 9). The fourth part of the questionnaire clarified the respondents' attitudes towards outdoor signage and its placement in the historical centre of Riga. The results of the survey were counted manually,

summarised in tables and processed by using MS Excel and SPSS15.1 for Windows software.

Results

Characterisation of the main shopping streets in Old Riga

The analysis of photo collages showed that the streetscapes of shopping streets in Old Riga contained many of historical buildings with signboards and adverts on them. Although most historical buildings are concentrated on Kaļķu Street, they are scattered all over the main shopping streets. They abound in a variety of architectural styles, starting with classicism, neoclassicism, “Bürger Classicism”, and perpendicular Art Nouveau and ending with neo-eclectic and functional styles (Krastiņš S.a). Despite the variety of styles, the buildings form a harmonious ensemble in subdued tones (Figure 2).

Placed among historical buildings, the new ones make a striking contrast with their glass facades. In the facades of the buildings on Audēju Street, due to their similar heights, the roofs form almost a smooth horizontal line, while in Facades A on Audēju Street and Facades B on Grēcinieku Street the roof line is “undulating”. The most impressive part in all the facades is the ground floor shop windows, where signboards and adverts dominate, creating a high risk of visual pollution.



Figure 2. Colour photomontages of the main shopping streetscapes of Old Riga (authors' figure)

Several studies show that people prefer facades consisting of historical buildings. They like streetscapes with well-kept historical buildings (clean and recently repainted). The replacement of old historical buildings by modern ones is mostly evaluated negatively. Radical changes in the height of buildings in old town are also perceived negatively. The physical qualities of outdoor places, such as shapes and colours, create a lasting image of the town in the visitor's mind and cause him/her to remember it as something special and unique (Portella 2014; Lynch 1960), while excessive usage of commercial signboards and adverts can spoil the visual quality of a town. The visual quality of outdoor space determines how people use it and how long they stay in it. Therefore, the commercial character of a city centre greatly influences its functionality from the human point of view (Gehl 2011). People feel better and would rather shop in places with a definite urban environment. They prefer city centres whose urban order differs from other city centres (Sherlock 1991; Mano 1999). The principles of urban design, in turn, can increase the visual quality of the environment and prevent visual pollution, or, by contrast, impair it. Therefore, in the case of Old Riga, it is highly important to consider the implementation of appropriate urban design principles, so that the city does not lose its values in the context of the UNESCO World Heritage List.

In-situ assessment of outdoor signage in the streetscapes of Old Riga

In-situ observations showed that the streetscapes of Old Riga contained outdoor signage of both types - contrasting and not contrasting with the environment. The principal parameters of assessment of signage were their colours and size as compared to the facade on which they were placed, kinds of panels used for adverts and signboards and how much they covered facade design elements.





Figure 3. Signboards on Kaļķu (A-D), Audēju (E), Grēcinieku (F), Vaļņu (G, H) Streets (authors' figure)

Signboards and adverts mostly occurred on the principal shopping streets, namely, Kaļķu, Audēju and Grēcinieku Streets. Most of those placed on panels were obtrusively conspicuous (Figure 3. A-F.). They made a sharp contrast with the colour of the facades. Their size and the covered façade area drew attention to the signboards shading and even concealing elements of the facade. The situation was similar on other streets and squares of Old Riga, for instance, on Vaļņu Street (Figure 3. G, H) as well as on Šķūņu, Skārņu, Teātra, Kungu, Tirgoņu and Mārstaļu Streets, and on Līvu Square.

Adverts and signboards that were environmentally suitable and harmonious with the facades were in a minority. They often alternated with contrasting adverts. Nevertheless, they fitted well into the general composition of the surrounding facades and therefore they were less conspicuous. At the same time, they let the viewer pay greater attention to the facades on which they were placed (Figure 4. A, B).



Figure 4. Examples of the harmonious placements of signboards on Kaļķu (A), Šķūņu (B) and Audeju (C, D) streets (authors' figure)

Still, there were some good examples of harmonious placement of signboards on the facades of buildings in Audēju Street, where the artists had used colours and elements matching those of the buildings (Figure 4. C, D).

An expert in urban development in Riga (Interview 2019) is of the opinion that usage of outdoor signage not contrasting with the environment is highly desirable. It would positively influence the perception and maintenance of historical architecture. Still, much depends on the wishes and tastes of the owner. At the same time, usage of signage not contrasting with the environment may diminish commercial profits for signage installers. Nevertheless, studies prove that introduction of unified design guidelines for displacement of commercial and non-commercial signboards and adverts increase social vitality (Scenic America 1999).

The same can be said about signboards and adverts placed perpendicular to the facades of buildings. Mostly they have active and bright colours. In this context as an environmentally friendly example the building of the shopping centre Galerija Centrs on Vaļņu Street should be mentioned. Here brand signboards of shops are designed in a stylistically unified aesthetic style and placed under the overhang of the building. Thus, they do not disturb the perception of the general streetscape (Figure 5). Though it would be impossible to use this kind of signage placement in all buildings (due to the lack of an overhang), it provides a good example of form and colours for minimal-style design.



Figure 5. **Harmonious solution to the placement of commercial signboards at the shopping centre Galerija Centrs on Vaļņu Street** (authors' figure)

Analysis of existing laws and regulations in Latvia showed that the requirements regulating the placement and design of signage are written in poetic language using subjective terminology. Therefore, their execution is not as effective as desired. The requirements for regulating signage in Old Riga are not objective or exact enough to preserve and display its uniqueness. The development of a unified design code defining the physical properties of signage (proportions, size, colour, material, elements, outline, design and character) in the historical centre of Riga would promote the formation of an aesthetic cityscape and maintenance of historical buildings. It is highly advisable that in the development of the design code public opinion be taken into account. Such approach has been successfully used in several countries, such as, for instance, the USA, France, Germany and Japan (Portella 2014). In some post-socialist countries, due to the lack of laws regulating the disposition and design of signage, there is visual chaos that negatively influences the urban environment (Chmielewski 2020; Voronich 2013). The creation of an aesthetically unattractive

environment is often due to negligence, non-compliance with the law or lack of regulation, excessive advertising or vandalism (Enache et al. 2014).

Visitors’ views on the streetscapes of shopping streets in Old Riga

An analysis of interviews showed that most visitors to Old Riga evaluated the shopping streets as attractive or very attractive (Figure 6). Foreign visitors found them more attractive than local visitors. There were few visitors for whom the streetscape of Old Riga seemed neutral or even ugly.

The interviews also showed that for more than half of them the appearance of historical buildings in the cityscapes of Old Riga was a matter of importance. Almost half of respondents (45.2%) found the presence of signboards in the streetscapes of Old Riga annoying, but 54.8% of visitors did not mind them. A more detailed analysis of responses showed that the latter group were mostly foreign visitors who stayed there briefly (Figure 7).

For inhabitants of Latvia, signboards and adverts cause discomfort and dissatisfaction with public outdoor space. The negative impact of signboards and adverts on the historical monuments and buildings of Old Riga was also demonstrated by the answers of 79% of respondents. They considered that commercial signage spoils the general visual image of Old Riga. The most categorical were respondents in the age group between 20 and 69, who are the most regular active visitors to Old Riga (Figure 8).

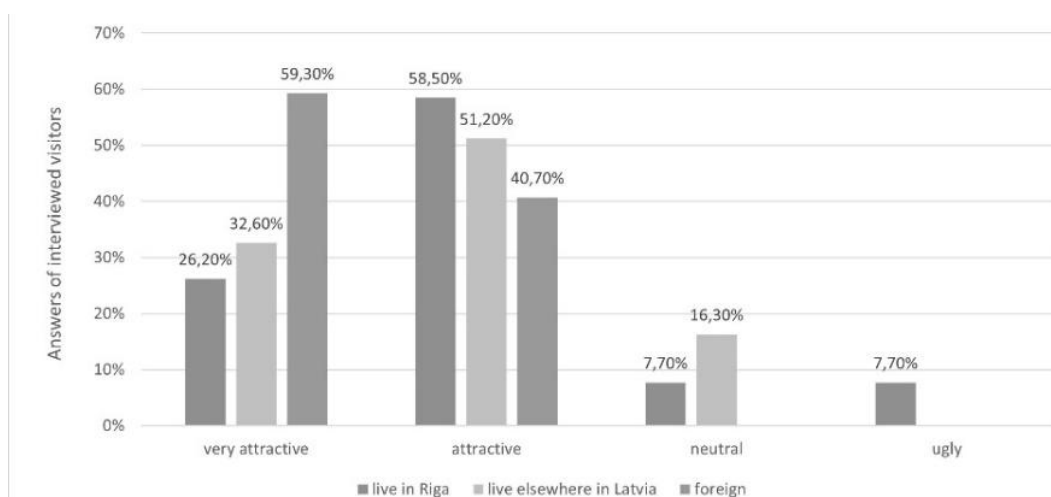


Figure 6. Visitors’ views on the shopping streetscapes according to the place of residence of the respondents (authors’ figure)

Although most of the respondents found the shopping streetscapes of Old Riga attractive or very attractive, 84% thought that their appearance could be improved. The most frequently mentioned suggestions for the improvement of the visual quality of

the streets of Old Riga were the need of renovation of the old facades of buildings and maintenance of historical buildings and limiting of signboards and adverts on historical buildings, raising the quality standards for signboards and diminishing the brightness of shop windows. All in all, 99% of respondents believed that the placement and size of signage should be regulated. Answering the question as to which kind of signage on buildings they preferred (version A – as it is in real life; version B – an improved one matching with façade) (Figure 9), almost 90% of respondents gave preference to the improved variant because, to their mind, it improved the visual quality of the cityscape of Old Riga.

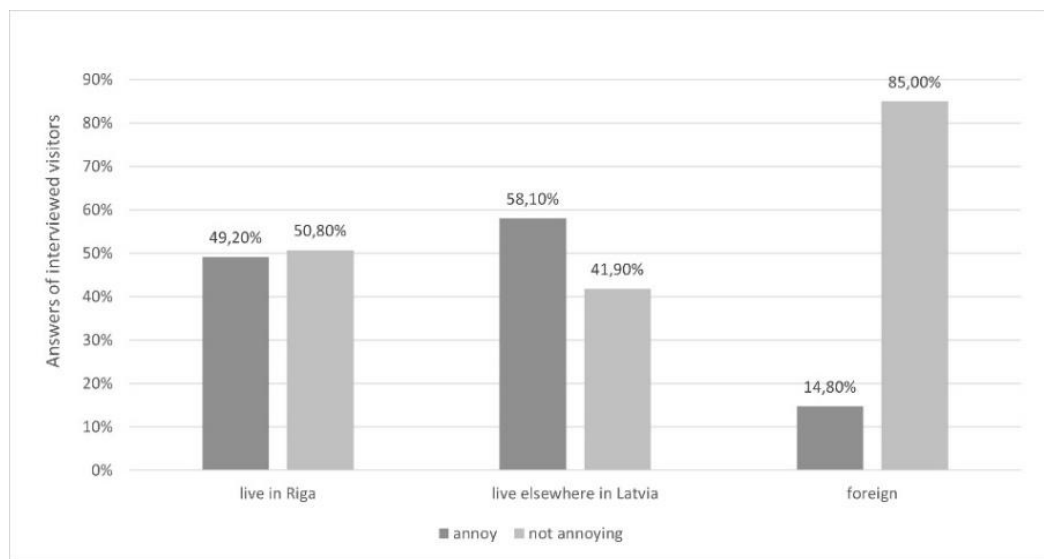


Figure 7. Visitors' views on the presence of signboards in the streetscapes of Old Riga according to the place of residence of the respondents (authors' figure)

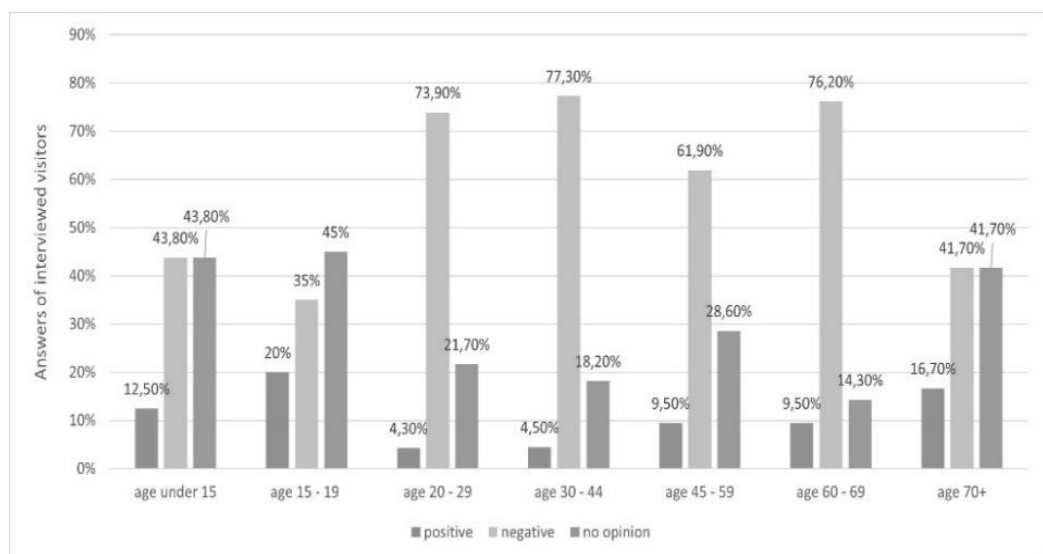


Figure 8. Visitors' views on influence of signboards on visual image of Old Riga according to age groups (authors' figure)

As has been pointed out by Lynch (1960) and Stamps (1999), similarity of assessment and opinions is often found within a particular group of respondents. The most pronounced similarity of opinions was found within specific groups of professionals (architects, town planners and civil engineers) and people without professional experience in the respective field.

A



B





Figure 9. The pictures in Column A show the facades as they are in real life and the pictures in Column B show the facades improved by software with more harmonious signs better fitting into the overall scene (authors' figure)

Yilmaz and Sagsoz (2011) emphasise that the historical centre of the town should be a place whose appearance and quality appeals to people from various urbanised environments. The visual quality of living space influences individuals' quality of life, which, in its turn, influences their behaviour. Such areas are popular places of sojourn, rest and recreation for both local people and tourists. Therefore, it is important to maintain their good visual quality, which could be highly appreciated by people of different ages and cultural backgrounds.

Conclusions

Careless usage of outdoor signage may create visual chaos in urban space and result in visual pollution, thus reducing the quality of the urban landscape. Several pieces of research show that such kind of visual pollution may directly influence the functions of urban space and its users (Portella 2014; Enahce et al. 2012; Yilmaz & Sagsoz 2011). Nevertheless, outdoor signage is an integral part of the urban environment. It has essential functions which make the urban environment socially alive (Portella 2014; Gehl 2011). To reduce visual pollution and its impact on the urban environment and at the same time not to lose its identity and values, it is important for the state and local authorities to implement appropriate outdoor signage management (Portella 2014; Enache et al. 2014).

Our study showed that signboards and adverts on the facades of buildings in Old Riga cause visual pollution and spoil the appearance of historical monuments and buildings, thus diminishing the visual quality of public outdoor areas in Old Riga and making visitors to them feel uncomfortable. Although many visitors find the streetscapes of Old Riga attractive and even very attractive, they would prefer smaller-size adverts. Moreover, their design, proportions and colours should match with the facades on which they are placed. This kind of signage would improve the visual

quality of Old Riga, and visitors would perceive the image of Old Riga better and feel better in Old Riga public outdoor space.

Riga Municipality should raise its requirements on placement of signage and their physical qualities. The development of an objective design code or design guidelines would promote the creation of an aesthetically harmonious high-quality area and encourage maintenance of a historical building site.

Acknowledgement

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Kopsavilkums

Vizuālais piesārņojums, ko rada nepārdomāta ārtelpas zīmju, piemēram, reklāmu un izkārtnu (komerciālo un nekomerciālo zīmju), izmantošana pilsētā, var negatīvi ietekmēt tās publiskās ārtelpas vizuālo kvalitāti. Rīga ir pakļauta šāda veida vizuālā piesārņojuma riskam. Tā kā Vecrīga ir iekļauta UNESCO Pasaules mantojuma sarakstā, tad ir svarīgi to pasargāt no šādas negatīvas ietekmes. Līdz šim vēl nav veikta padziļināta izpēte par šādu vizuālo piesārņojumu Vecrīgā. Šī pētījuma mērķis ir izpētīt un izvērtēt reklāmu un izkārtnu sastopamību un ietekmi Vecrīgas galvenajās iepirkšanās ielās.

Pētījuma pamatā ir aplūkojamās teritorijas klātienē apsekojums, foto uzņēmumu un ielu fotokolāžu analīze, socioloģisko pētījumu metožu lietojums, kā arī attiecīgu normatīvo un plānošanas dokumentu analīze.

Pētījuma rezultāti atklāja, ka uz Vecrīgas ēku fasādēm izvietotās reklāmas un izkārtnes rada vizuālo piesārņojumu, kas, savukārt, negatīvi ietekmē vēsturisko pieminekļu un ēku izskatu, pazemina publiskās ārtelpas un ielu ainavas vizuālo kvalitāti. Estētiski vienotas, izteiksmīgas un augstas kvalitātes pilsētas telpas veidošanos Vecrīgā veicinātu atbilstošu dizaina vadlīniju vai arī dizaina koda izstrāde, kas ietvertu ārtelpas zīmju, logu, fasāžu, to elementu un dizaina specifiskācījas.

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GAISA TEMPERATŪRAS PĀRMAIŅAS LATVIJĀ (1991–2020)**SHIFTS OF THE AIR TEMPERATURE IN LATVIA FROM 1991 TO
2020****Gunta Kalvane, Andis Kalvans, Agrita Briede**

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Abstract

Evidence of the climate changes are evident in all regions of the world. In this study we examine the air temperature variability in Latvia during the last climate normal (1991-2020) in comparison with the previous two climate normals (1971-2000; 1981-2010), as well reference period (1961.-1990) describing seasonal and regional changes. Over last 60-years (1961-2020), the annual mean temperature has increased by 1.2°C across Latvia, with largest increase (0.5°C) between the last two climate normals (1991-2020 and 1981-2010). Across Latvia, winter temperatures have risen more rapidly by around 2°C, while summer temperatures have risen by around 1°C.

The study revealed a shift in climate types: in the western part of the country near Baltic Sea coast, climate zones have changed from boreal (Dfb zone) to temperate (Cfb zone) according to the classification of W. Koppen. In these areas, the coldest month (January or February) has an average air temperature above -3°C. The values of the continentality indices have also changed, with a decrease in the influence of the continentality effect, that is particularly strong in the eastern part of Latvia.

Keywords: annual mean air temperature, seasonality, continentality, climate change

Kopsavilkums

Klimata mainības signāli, atšķiroties to intensitātei, biežumam un sezonālajām izpausmēm, izpaužas visos pasaules reģionos. Pētījumā ir analizēta pēdējā klimatiskās normas perioda (1991–2020) gaisa temperatūras mainība Latvijā, salīdzinot to ar iepriekšējiem diviem klimatiskās normas periodiem (1971–2000 un 1981–2010), kā arī klimatisko references periodu (1961–1990), aprakstot sezonālās un reģionālās pārmaiņas. Latvijas teritorijā 60 gadu laikā (1961–2020) gada vidējā temperatūra ir paaugstinājusies par 1.2°C. Tomēr straujākās pārmaiņas ir novērotas starp pēdējiem diviem klimatiskās normas periodiem (1991–2020 un 1981–2010), kad vidējā temperatūra paaugstinājusies par 0.5°C. Visā Latvijas teritorijā 60 gadu laikā ziemas temperatūra ir paaugstinājusies straujāk, par aptuveni 2°C, savukārt, vasaras mēnešu temperatūra paaugstinājusies aptuveni par 1°C. Pētījumā tika konstatēta klimata tipu pārbīde: valsts rietumu reģionos klimata zonas no boreālās (Dfb zona) ir mainījušas uz temperāto (Cfb zona) tipu pēc V. Kopena klasifikācijas. Šajās teritorijās aukstākā mēneša (janvāris vai februāris) vidējā gaisa temperatūra ir virs -3°C. Samazinājusies arī klimata kontinentalitāte, īpaši valsts austrumos.

Klimatisko normu periodu analīze skaidri parāda klimata pārmaiņu tendences – gaisa temperatūras paaugstināšanos, ļaujot ieraudzīt liela mēroga pārmaiņas uz starpgadu meteoroloģisko apstākļu mainības fona. Klimatiskās normas perioda meteoroloģisko apstākļu analīze veido pamatu adaptācijas

pasākumu plānošanai un izvērtēšanai, gaisa temperatūras mainībai ir būtiska ietekme gan uz lokālo ekonomiku, gan ekosistēmu, gan sociālo vidi.

Ievads

Gaisa temperatūra, salīdzinot pēdējo klimatisko normas periodu (1991–2020) ar pirmsindustriālo periodu, Eiropas teritorijā vidēji ir paaugstinājusies par 1.7–1.9°C, pie tam gaisa temperatūras paaugstināšanās Eiropā ir izteiktāka nekā pasaulē vidēji (attiecīgi pasaulē 0.94–1.03°C) (EEA, 2021). Pēdējais klimatiskās normas periods ir uzskatāms par siltāko periodu meteoroloģisko novērojumu vēsturē gan Eiropā, gan pasaulē globāli.

Likumsakarīgi, ka temperatūras kāpums raksturīgs arī Baltijas jūras reģionam (Jaagus et al., 2014; Tomczyk et al., 2014), pie tam atsevišķos pētījumos minēts, ka Baltijas jūras reģions ir viens no sensitīvākajiem reģioniem attiecībā uz gaisa temperatūras pārmaiņām. Ir secināts, ka gaisa temperatūras paaugstināšanās Baltijas jūras reģionā ir bijusi viena no straujākajām Eiropā (Meier et al., 2021).

Baltijas jūras reģionam ir raksturīga ne tikai gada vidējās temperatūras paaugstināšanās, bet fiksētas arī būtiskas sezonālās pārmaiņas, īpaši ziemas sezonā. Palielinājusies arī diennakts minimālās un diennakts maksimālās temperatūras vērtība.

Baltijas valstu teritorijā gaisa temperatūras raksturu nosaka un ietekmē gan liela mēroga faktori, piemēram, Baltijas jūra, gan lokāla mēroga faktori, piemēram, reljefs, zemes seguma un lietojuma veids, kā arī ūdenstilpju tuvums un lielums (Jaagus et al., 2014). Gan diennakts, gan gada temperatūras gaitai ir vērojamas atšķirības piekrastē un kontinentālajā daļā.

Lokālie un reģionālie pētījumi detalizētāk parāda un raksturo gaisa temperatūras dinamiku un ietekmes raksturu, kas īpaši svarīgi klimata adaptācijas un pielāgošanās mehānismu un scenāriju izstrādē, jo pētījumi liecina, ka temperatūras paaugstināšanās raksturs Baltijas jūras reģionā turpināsies. Atsevišķi modeļi prognozē īpaši izteiktu gaisa temperatūras paaugstināšanos tieši Baltijas jūras reģionā, jo īpaši tā ziemeļu un centrālajā daļā, kas būs īpaši spilgti izteikts ziemas sezonā (EEA, 2021b).

Pētījuma mērķis – raksturot pēdējā klimatiskā normas perioda (1991–2020) gada un sezonālās temperatūras dinamiku/mainību Latvijas teritorijā, salīdzinot novirzes no vidējās vērtības ar citiem klimatiskās normas periodiem, kā arī references periodu, atbildot uz jautājumu, vai pēdējā klimatiskās normas periodā turpinās tikpat izteikta gaisa temperatūras paaugstināšanās? Otrs pētījuma jautājums - vai samazinās kontinentalitātes indekss, vai gaisa temperatūras raksturs zaudē reģionalizāciju? Treškārt, kāds ir gaisa temperatūras reģionālais un sezonālais raksturs, kā arī pārmaiņas.

Dati un metodes

Pētījumā izmantoti E-OBS gridētie meteoroloģiskie dati (Cornes et al., 2018) Latvijas teritorijai ar nominālo izšķirtspēju 0.1°, kas pieejami ES Copernicus programmas Klimata datu servisā. Lietoti arī Latvijas Vides ģeoloģijas un meteoroloģiskā centra (LVĢMC) novērojumu dati (norādot pie attēla), kas pieejami LVĢMC datu arhīvā elektroniskā formā laika periodā no 1961. līdz 2020. gadam.

Dati primāri analizēti Pasaules Meteoroloģiskās organizācijas noteiktā, pēdējā klimatiskās normas perioda – 1991.–2020. gads - griezumā, kā arī salīdzināti ar iepriekšējiem klimatiskās normas periodiem (1971–2000; 1981–2010) un references periodu – 1961. –1990. gads.

Kontinentalitātes indekss aprēķināts, izmantojot Gorczynski formulu (Gorczyński, 1920) - adaptēts no Z. Avotnieces un līdzautoriem (2017), kam pamatā ir gada siltākās (T_{max}) un aukstākās (T_{min}) mēneša vidējās gaisa temperatūras starpība, normalizēta pēc ģeogrāfiskā platuma grāda (Lat):

$$k = 1.7 \frac{T_{max} - T_{min}}{\sin(Lat)} \quad (1)$$

Pētījumā izmantota V. Kopena (W.Köppen) klimata klasifikācija, kuras izstrādes pamatā ir empīriskās attiecības starp klimatu un veģetāciju. Tā izmanto ikmēneša temperatūru un nokrišņus, lai noteiktu dažādu klimata tipu robežas visā pasaulē (Chen & Chen 2013).

Ilgtermiņa tendenču jeb trendu noteikšanai tika izmantots daudzvariāciju, neparametriskais Manna–Kendala tests (Libiseller & Grimvall 2002), kas ļauj noteikt monotona trenda vērtības datu rindām, kas neatbilst normālsadalījumam, kā arī ir relatīvi robusts pret iztrūkstošām un anomālām vērtībām. Manna-Kendala testa pamatā ir tā sauktais rangu jeb pāru princips, pēc kura salīdzina divas novērojumu vērtības. Manna-Kendala testu var izmantot datu rindām, kam ir sezonāls vai sērijveida mainības raksturs, jo tas ļauj aprēķināt testa vērtības katram mēnesim atsevišķi. Pētāmā parametra mainības tendences tika uzskatītas par būtiskām, ja p-vērtība bija mazāka par 0.01, tas ir varbūtība, ka rezultātam ir nejaušs raksturs bija mazāka par 1%. Manna-Kendala trenda testa vērtības un ticamības līmenis aprēķināts ar R pakotni “trend” (Pohlert, 2020).

Meteoroloģiskie un klimatiskie dati analizēti brīvpieejas datu apstrādes un analīzes R vidē (R Core Team, 2021) datu apstrādei, izmantojot “tidyvers ecosystem” pakotnes (Wickham et al., 2019).

Rezultāti

Gada vidējās temperatūras pārmaiņas

Latvijas teritorijas novietojums Baltijas jūras krastā, kā arī viļņotais, paugurainais reljefs un hidroloģiskais tīkls ir noteicis relatīvi nevienlīdzīgo gaisa temperatūras sadalījumu – Baltijas jūras piekrastes teritorijās (jo īpaši teritorijas dienvidrietumos) gada vidējā gaisa temperatūra sasniedz $+8^{\circ}\text{C}$, centrālās un austrumdaļas augstienēs gada vidējā temperatūra ir zemāka par $+6^{\circ}\text{C}$. (1. att.), t.i., gada vidējā temperatūra pakāpeniski samazinās no rietumiem uz austrumiem, t.i., pieaugot kontinentalitātei.

Gada vidējā gaisa temperatūra klimatiskās normas periodā (1991–2020) Latvijas teritorijā ir bijusi 6.88°C , variējot no 7.87°C Liepājā līdz 5.69°C Alūksnē. Kopumā gada vidējā gaisa temperatūra Latvijā variējusi 4 grādu robežās - no 4.99°C (1996) līdz 8.91°C (2020) – attiecīgi 1996. gads ir bijis aukstākais pēdējā references periodā, savukārt 2020. gads – siltākais. Jāpiebilst, ka 2020. gads ir bijis siltākais kopš 1961. gada, aukstākais gads ir bijis 1987. gads, kad gada vidējā temperatūra ir bijusi 3.94°C .

Zīmīgi, ka pēdējā klimatiskās normas periodā ir fiksētas ievērojamas gada vidējās temperatūras pārmaiņas, jo īpaši augstieņu teritorijās. 1981.–2010. gada periodā vidējā temperatūra Baltijas jūras piekrastē bijusi 7.44°C (Liepājas NS dati), savukārt augstienēs 5.25°C (Alūksnes NS dati), gada vidējā temperatūra salīdzinājumā ar pēdējo klimatiskās normas periodu paaugstinājusies par 0.4°C .

Kopumā 60 gadu laikā (kopš 1961. gada) visā Latvijas teritorijā gada vidējā temperatūra ir mainījusies par 1.26°C . References periodā (1961–1990) gada vidējā temperatūra ir bijusi 5.62°C , savukārt, pēdējā klimatiskās normas periodā (1991–2020) – 6.88°C . Zīmīgi, ka lielākās gada vidējās temperatūras pārmaiņas fiksētas starp pēdējo un trešo periodu, attiecīgi gada vidējā temperatūra starp 1981.–2010. un 1991.–2020. gada periodu ir paaugstinājusies par 0.5°C (gada vidējā temperatūra 1981.–2010. gada periodā ir bijusi 6.37°C).

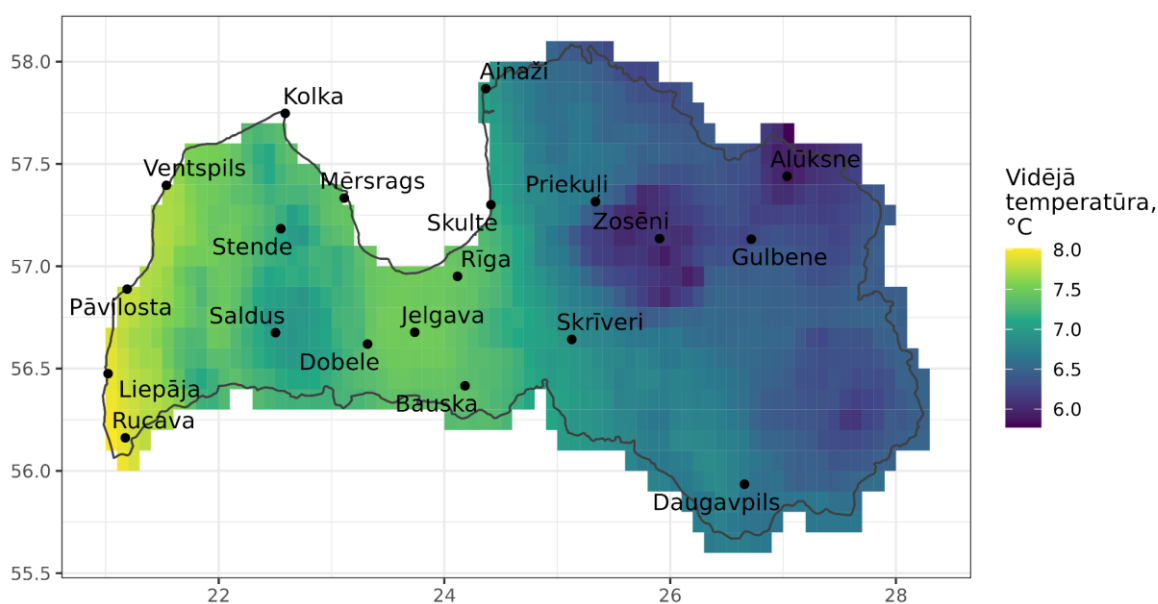
Gada vidējās temperatūras raksturam ir augšupejoša tendence, kas nozīmē, ka Latvijas teritorijā gada vidējā gaisa temperatūra paaugstinās. Ja 20. gs. 70. gados vidējā temperatūra ir bijusi ap 5°C , tad pēdējās desmitgadēs, jau 7°C . 2020. gada vidējā gaisa temperatūra Latvijā bija $+8.9^{\circ}\text{C}$. Augšupejoša gaisa temperatūras tendence ir vērojama visās analizētajās stacijās gan Baltijas jūras piekrastes teritorijās, gan kontinentālajā daļā.

Veiktās Manna-Kendala neparametriskā trenda testa analīzes apliecina minēto, ka gada vidējai temperatūrai ir paaugstināšanās tendence, kas jo īpaši izteikta pēdējā klimatiskās normas periodā (1991–2020). Pēdējā klimatiskās normas periodā piejūras stacijās – Kolkā un Liepājā – taisnes regresijas koeficienta (*slope*) vērtība ir $0.045^{\circ}\text{C/gadā}$, kas ir $0.45^{\circ}\text{C/desmitgadē}$, savukārt kontinentālajā daļā – Daugavpilī –

0.055°C/gadā jeb 0.55°C/desmitgadē. References periodā un pirmajā klimatiskās normas periodā (1971–2000) gada vidējai gaisa temperatūrai ir tendence paaugstināties, savukārt pēdējā klimatiskās normas periodā (1991–2000) trends ir izteikts un statistiski ticams (visās stacijās p-vērtība ir <0.05).

Taisnes regresijas koeficientu (*slope*) vērtību analīze arī parāda gaisa temperatūras pārmaiņu dinamiku, tā, piemēram, Rīgas pilsētā taisnes regresijas koeficienta vērtības references periodā (1961–1990) ir bijušas visaugstākās, taču pēdējā periodā – viszemākās, salīdzinot ar citām meteoroloģiskajām stacijām, attiecīgi 0.04°C/gadā abos periodos. Interesanti, ka Kolkas novērojumu stacijā taisnes regresijas koeficienta vērtības pēdējā klimatiskās normas periodā ir izteiktākas, t.i., lielākas nekā Rīgā.

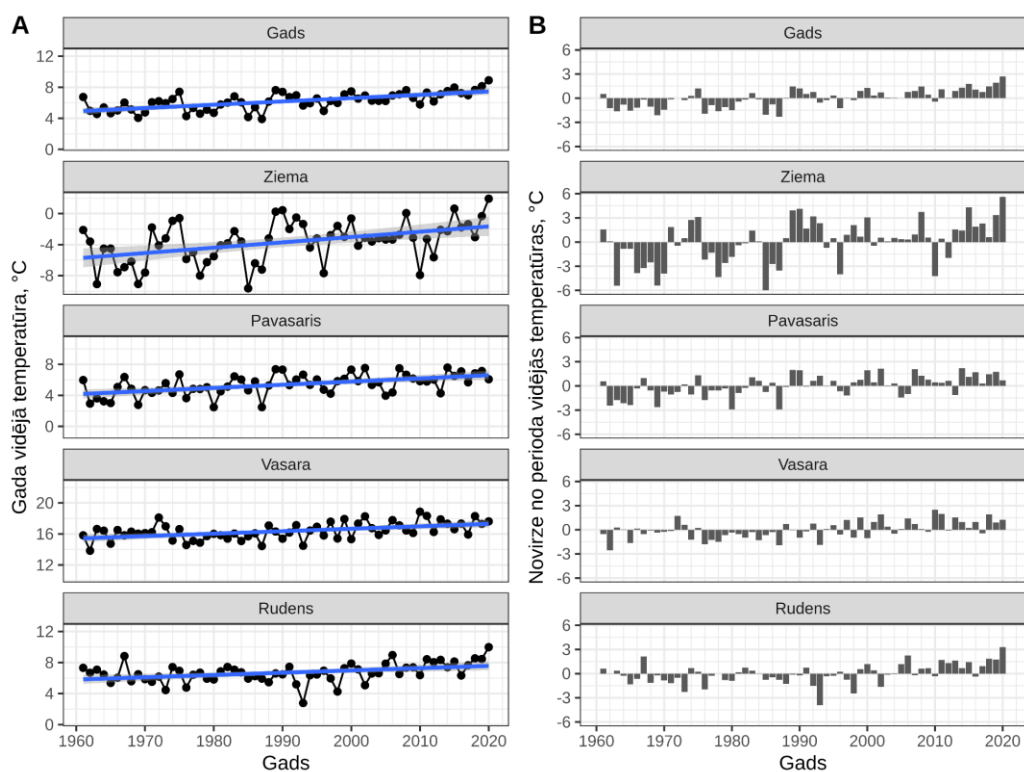
Gaisa temperatūras dinamikā 1989./1990. gads iezīmē lūzumpunktu - ir izteikta gaisa temperatūras kāpuma intensitāte. Pēc šī perioda gaisa temperatūras raksturā parādās pozitīvas novirzes, t.i., novirzes no vidējām ilgtermiņa vērtībām ir pozitīvas – gada vidējā gaisa temperatūra ir bijusi vidēji siltāka nekā pirms šīs perioda. Tā, piemēram, pēdējā desmitgadē (2010–2020) deviņos no desmit gadiem novirze no ilgtermiņa vidējās ir bijusi pozitīva. Līdz 1989./1990.gadam gada vidējās gaisa temperatūras novirzes ir bijušas negatīvas, t.i., gada vidējā temperatūra ir bijusi vidēji zemāka. Šāds sadalījums ir raksturīgs visās analizētajās stacijās. Interesanti, ka tieši pirms 1989./1990.gada Latvijas teritorijā ir fiksēti divi aukstākie gadi (1986. un 1987.gads), kad gaisa temperatūra bijusi vidēji zemāka nekā 1961.–2020. gada periodā.



1. attēls. Gada vidējā temperatūra Latvijā klimatiskās normas 1991.–2020. gada periodā (autoru izveidots, izmantojot E-OBS datus)

Gaisa temperatūras mainība sezonālā griezumā

Pēdējā klimatiskās normas periodā, kā arī ilgtermiņā, ir mainījies ne tikai gada vidējās temperatūras raksturs, bet arī gaisa temperatūras sezonālais sadalījums (2. attēls). Gada vidējā temperatūra Latvijā klimatiskās normas 1991.–2020. gada periodā ir svārstījies 4 grādu amplitūdā (no 5.0°C 1996. gadā līdz 8.9°C 2020. gadā). Savukārt mēnešu griezumā vidējā temperatūra Latvijā variējusi 22.5 grādu amplitūdā: no -3.4°C (februāra vidējā temperatūra visā periodā) līdz 18.1°C (jūlija vidējā temperatūra). Gan aukstākais, gan siltākais perioda mēnesis ir bijis 2010. gadā, attiecīgi janvāris (vidējā temperatūra -14.2°C) un jūlijs (+23.1°C). Savukārt klimatiskās references periodā (1961–1990) aukstākais gada mēnesis Latvijā vidēji bija janvāris ar vidējo gaisa temperatūru -5.8°C, bet pēdējā klimatiskās normas periodā (1991–2020) aukstākais mēnesis bijis februāris ar vidējo gaisa temperatūru -3.4°C, lai gan vidējā janvāra temperatūra šajā periodā ir līdzīga -3.2°C.



2. attēls. Gada un sezonas vidējā temperatūra (A) un novirze no perioda vidējās temperatūras gada un sezonas griezumā (B) Latvijā no 1961. līdz 2020. gadam (autoru izveidots, izmantojot E-OBS datus)

Ziemas mēnešu zemākā temperatūra ir novērota Latvijas austrumu reģionos. References periodā no 1961. līdz 1990. gadam aukstākais mēnesis Alūksnes un Daugavpils meteoroloģiskajās stacijās bija janvāris ar vidējo gaisa temperatūru

attiecīgi -7.6°C un -6.7°C , bet pēdējos gados (1991–2020) aukstākais mēnesis šajās abās stacijās ir februāris, attiecīgi -5.1°C un -4.1°C . Ir vērojama būtiska ziemas mēnešu temperatūras paaugstināšanās. Savukārt piekrastes apgabalos aukstākais mēnesis visā analizētajā periodā ir bijis februāris, kad vidējā gaisa temperatūra no 1961. līdz 1990. gadam Kolkā un Liepājā bija attiecīgi -3.6 un -3.0°C . Pēdējos gados (1991–2020) attiecīgi -1.6°C Kolkas un -1.1°C Liepājas meteoroloģiskajā stacijā. Arī piekrastē ir izteikta zemākās temperatūras paaugstināšanās gada aukstākajā mēnesī, lai gan mazāk izteikta kā austrumu reģionos. Kopumā gada aukstākā mēneša reģionālās pārmaiņas variē $3-4^{\circ}\text{C}$ robežās (3. attēls).

Gada siltākais mēnesis visās novērojumu stacijās ir jūlijs (1. tabula). Periodā no 1961. līdz 1990. gadam jūlija vidējā temperatūra Latvijā bija 16.6°C , bet klimatiskās normas periodā no 1991. līdz 2020. gadam attiecīgi 18.1°C . Jūlija temperatūrai ir relatīvi nelielas reģionālās pārmaiņas – piekrastē, Kolkas un Liepājas stacijās, attiecīgi 16.0°C un 16.4°C references periodā un 17.5°C un 17.9°C 1991.–2020. gada periodā. Latvijas teritorijas kontinentālajā daļā – Alūksnes un Daugavpils stacijās – attiecīgi 16.2°C un 17.0°C references periodā un 17.4°C un 18.1°C 1991.–2020. gada periodā. Jūlija gaisa temperatūras reģionālas atšķirības variē $1-1.5^{\circ}\text{C}$ robežās. Vasarā spilgti iezīmējas Rīgas pilsētas efekts, kad jūlija vidējā temperatūra sasniedz 19.1°C , kas ir par trīs grādiem vairāk kā atklātā Baltijas jūras piekrastes stacijās.

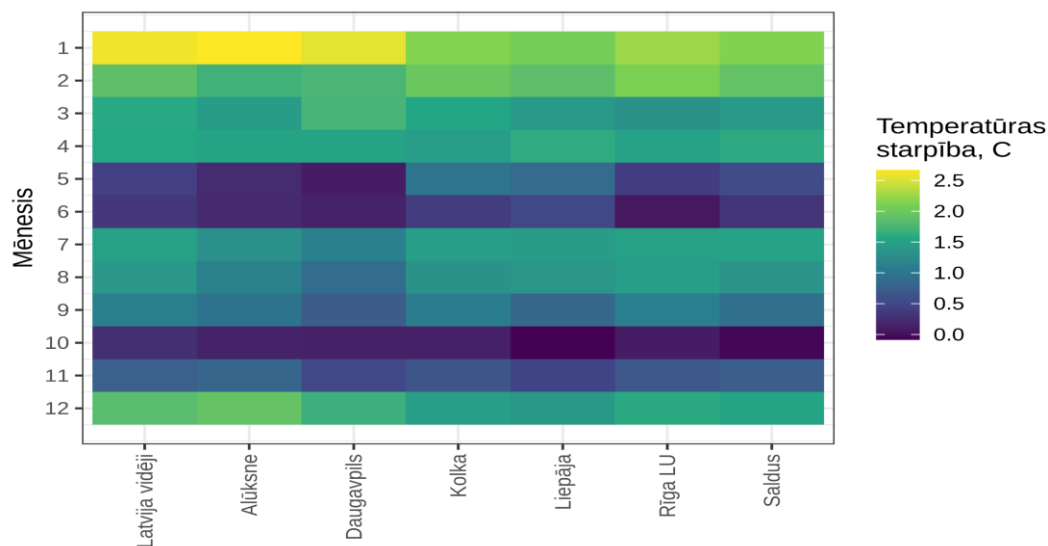
1.tabula. **Mēneša vidējā gaisa temperatūra meteoroloģisko novērojumu stacijās (LVĢMC dati) un Latvijā vidēji klimatiskās normas periodā (1991–2020)** (autoru izveidots, izmantojot E-OBS un LVĢMC datus)

Stacija	Janv.	Feb.	Marts	Apr.	Maijs	Jun.	Jul.	Aug.	Sept.	Okt.	Nov.	Dec.
Alūksne*	-4,9	-5,1	-1,1	5,5	11,3	15	17,4	16,1	11,2	5,3	0,5	-3
Daugavpils*	-4,1	-4,1	-0,1	6,7	12,2	15,9	18,1	16,8	11,9	6,3	1,5	-2,2
Kolka*	-0,8	-1,6	0,5	4,5	9,6	14,3	17,5	17,1	13,2	8,1	3,9	1
Liepāja*	-0,9	-1,1	1,3	6,2	11,2	14,8	17,9	17,7	13,7	8,5	4,2	1,1
Rīga LU*	-2,2	-1,7	1,3	7,3	13	16,9	19,4	18,5	13,5	7,6	2,9	-0,4
Saldus*	-2,7	-2,6	0,4	6,2	11,5	15	17,5	16,7	12,2	6,8	2,4	-0,9
Latvijā vidēji**	-3,2	-3,4	0,1	6,2	11,7	15,5	18,1	17,1	12,4	6,7	2,1	-1,3

* LVĢMC dati ** E-OBS dati

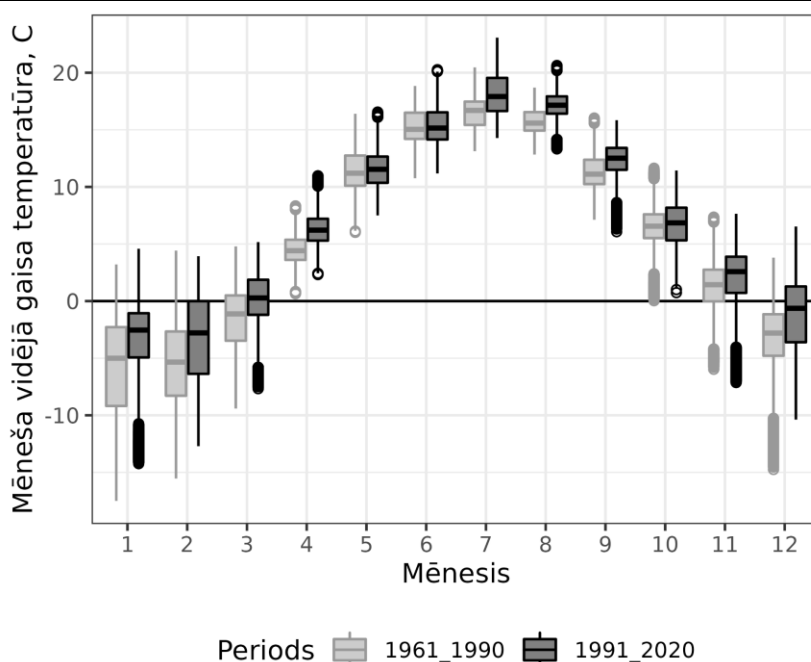
Analizējot datus kalendāro mēnešu griezumā (3. attēls) iezīmējas tendence, ka gaisa temperatūra būtiskāk mainījies ziemas sezonas mēnešos – janvārī, decembrī, arī februārī, turklāt pārmaiņas ir izteiktākas pēdējā klimatiskās normas periodā. Kontinentālajā daļā ziemas gaisa temperatūra ir mainījies visbūtiskāk, vairāk kā 2.5°C robežās, salīdzinot ar references periodu. Zīmīgi, ka oktobrī, kā arī jūnijā gaisa

temperatūras raksturs ir mainījies vismazāk. Arī maija temperatūra, jo īpaši kontinentālajā daļā (Alūksnes, Daugavpils meteoroloģisko novērojumu stacijas) nav būtiski mainījies. Kopumā rudens mēnešos gaisa temperatūras pārmaiņas nav tik izteiktas kā ziemā.

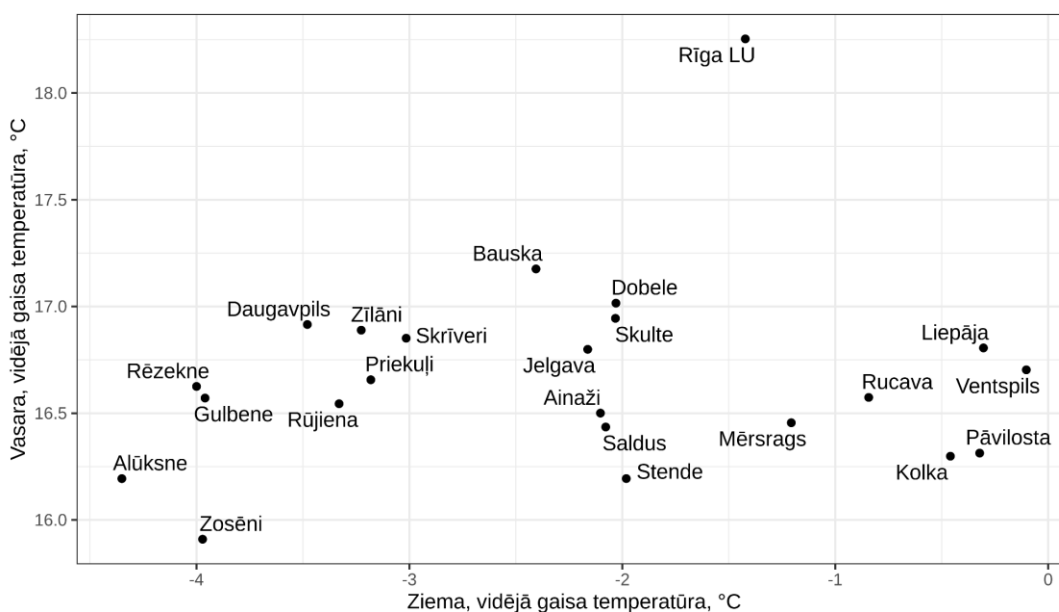


3. attēls. Mēneša vidējās gaisa temperatūras starpība klimatiskās normas periodā (1991–2020), salīdzinot ar references periodu (1961–1990) Latvijā vidēji (E-OBS dati) un meteoroloģisko novērojumu stacijās (LVĢMC dati) (autoru izveidots)

References periodā negatīvas mēneša vidējās temperatūras bijušas četros mēnešos – janvārī, februārī, decembrī, martā, kā arī nereti novembrī, savukārt pēdējā normas periodā – trīs mēnešos, pie tam decembra temperatūra bieži ir ap 0°C, nereti arī pozitīva. Ziemas mēnešos ir vērojamas vislielākās temperatūras amplitūdas jeb vērtību izkliede, piemēram, janvāra vidējā temperatūra pēdējā klimatiskā normas periodā Latvijas teritorijā variējusi aptuveni 20°C robežās (4. attēls). Savukārt vismazākā mēneša vidējās temperatūras izkliede ir augusta mēnesī (4. attēls). Augusta vidējai temperatūrai ir raksturīga vismazākā izkliede, t.i., gaisa temperatūra relatīvi viendabīga. Detalizēts un izvērsts mēnešu klimatiskais raksturojums pieejams LVĢMC Klimata portālā (Klimata portāls, bez datējuma).

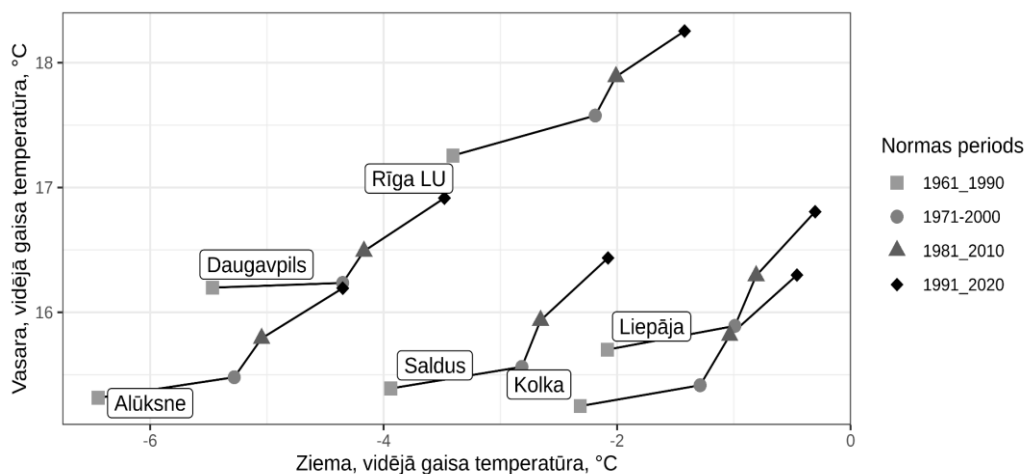


4.attēls. Mēneša vidējās gaisa temperatūras sadalījums un tās robežvērtības Latvijā gada griezumā references periodā no 1961. līdz 1990. gadam un klimatiskās normas periodā no 1991. līdz 2020. gadam (autoru izveidots, izmantojot E-OBS datus, katrai datu šūnai atsevišķi). Kastīte ietver datu punktus starp 25 un 75 procentiles ar atzīmētu mediāno vērtību, nogriežņi sniedz līdz tālākajam datu punktam 1.5 starpkvartiļu ietvaros, punkti parāda pārējās ekstrēmās vērtības



5. attēls. Ziemas (decembris, janvāris, februāris) un vasaras (jūnijs, jūlijs, augusts) vidējā gaisa temperatūra meteoroloģisko novērojumu stacijās klimatiskās normas periodā no 1991. līdz 2020. gadam (autoru izveidots, izmantojot LVĢMC datus) - Datu analīzē, vizuālās uzskatāmības labad, ir izslēgta Rīgas meteoroloģiskā stacija

Ziemā piekrastes stacijās (Ventspils, Pāvilosta, Liepāja, Kolka) gaisa temperatūra svārstās ap 0°C, savukārt, kontinentālajās stacijās (Alūksne, Zosēni, Rēzekne, Gulbene) ap -4°C (5.attēls). Alūksnē un Zosēnos arī vasaras periodā saglabājas zemākā gaisa temperatūra. Maksimālās vērtības savukārt fiksētas Latvijas D un DA stacijās. Nav izteikts nošķīrums – piekrastes kontinentālās stacijas, kā tas raksturīgs ziemas sezonai.



6. attēls. Ziemas (decembris, janvāris, februāris) un vasaras (jūnijs, jūlijs, augusts) vidējā gaisa temperatūra meteoroloģisko novērojumu stacijās klimatiskās normas periodā no 1991. līdz 2020. gadam (autoru izveidots, izmantojot LVĢMC datus)

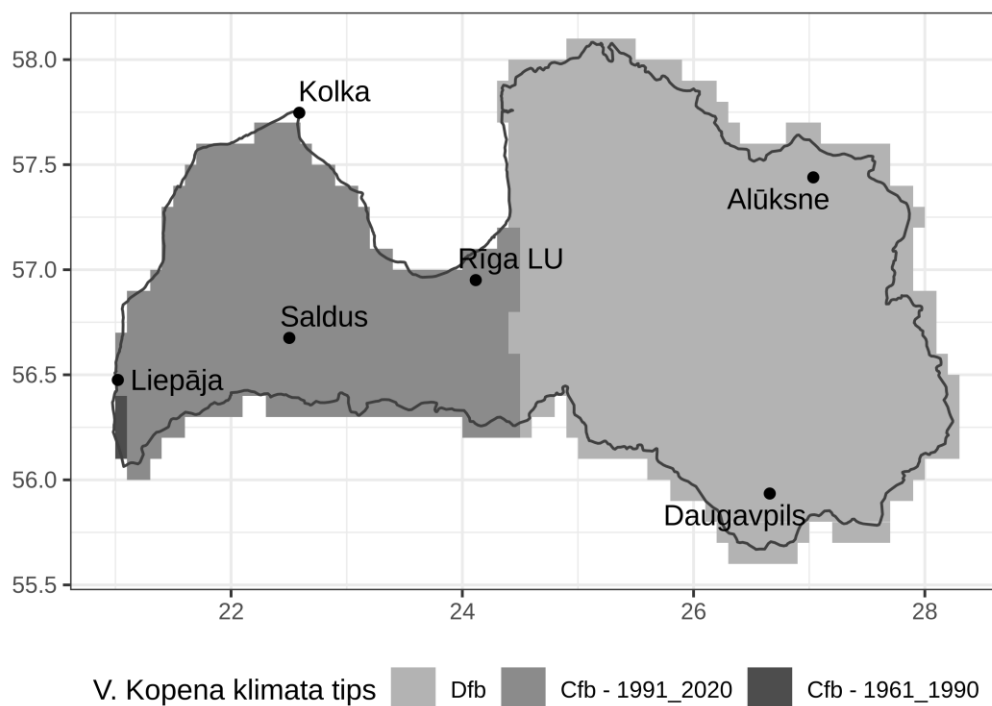
Arī sezonālajā griezumā gaisa temperatūrai ir vērojams “lūzumpunkts” 1989./90.gads, pēc kura dominē pozitīvās novirzes no ilgtermiņa vidējām vērtībām, līdzīgi kā gada vidējai temperatūrai. Izteiktākas pozitīvās novirzes ir ziemas sezonā, mazāk izteiktas – vasarā. Interesanti, ka perioda pēdējos rudenos ir izteiktāka pozitīvā tendence, rudens sezonas temperatūra arī kļūst vidēji augstāka/siltāka nekā periodā vidēji. Gaisa temperatūras paaugstināšanās sezonās atspoguļojas arī reģionālajā griezumā, Alūksnē un Daugavpilī janvārī gaisa temperatūras paaugstināšanās ir bijusi +2.5°C, salīdzinot ar references periodu (3. attēls). Visās analizētajās meteoroloģiskajās stacijās straujākais sezonālās temperatūras kāpums ir bijis tieši pēdējā klimatiskās normas periodā (6. attēls). Gan neparametriskā Manna-Kendala trenda testa analīze, gan regresijas analīze rāda, ka gaisa temperatūras paaugstināšanās ir būtiska un statistiski ticama. Taisnes regresijas koeficients ziemas sezonas pēdējā normas periodā gaisa temperatūrai ir 0.07°C gadā, savukārt vasarā un rudenī - 0.03°C gadā (2. tabula).

2. tabula. Vidējās sezonālās gaisa temperatūras tendences lineārā regresija un Manna-Kendala trenda testa vērtības, 1961. līdz 2020. gada periodā (autoru izveidots, izmantojot E-OBS datus)

<i>Sezona</i>	<i>Taisnes regresijas koeficients (slope) (°C/gads)</i>	<i>Tendence, standartkļūda (°C/gads)</i>	<i>Manna-Kendala trenda tests</i>
Gads	0.04**	0.01	5.50**
Ziema	0.07**	0.02	3.67**
Pavasaris	0.04**	0.01	4.15**
Vasara	0.03**	0.01	3.78**
Rudens	0.03**	0.01	3.53**

** - statistiski nozīmīga vērtība ar ticamību >99%

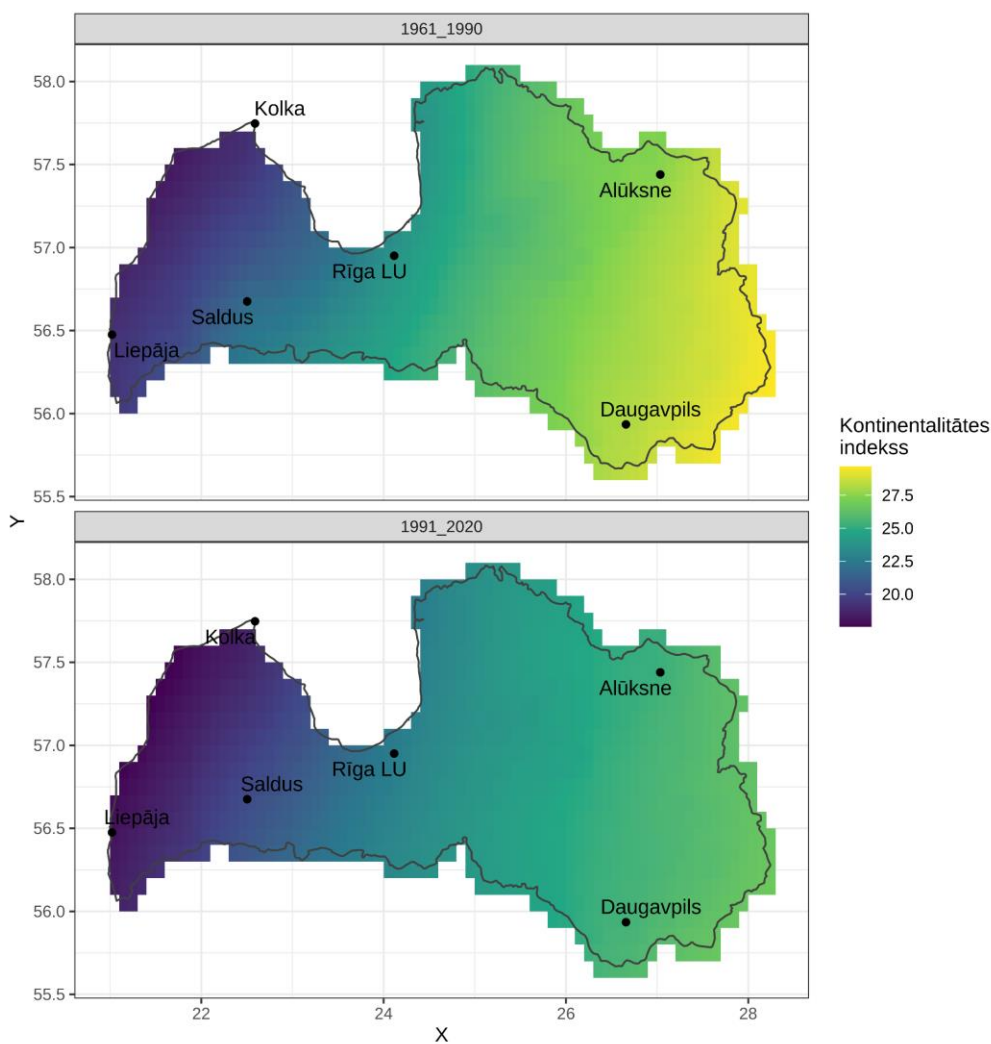
Sezonu kontekstā jāmin klimatisko tipu pārbīde Latvijas teritorijā. Atklātās Baltijas jūras piekrastē un Latvijas vidusdaļā klimata zonas no boreālās-siltas vasaras humīda kontinentālā (Dfb zona pēc V. Koppena klasifikācijas) ir mainījušās uz temperāto-mēreno okeānisko klimatu (Cfb) tipu (7. attēls), ko nosaka gada aukstākā mēneša vidējās gaisa temperatūras paaugstināšanās virs -3°C.



7. attēls. V. Koppena klasifikācijas klimata tipi Latvijā references 1961. līdz 1990. gada periodā un pēdējā klimatiskās normas periodā no 1991. līdz 2020. gadam (autoru izveidots, izmantojot E-OBS datus)

Kontinentalitāte

Baltijas jūrai ir liela ietekme uz termālo režīmu Latvijā, piemēram, atklātās Baltijas jūras piekrastē ziemas temperatūra ir par 3-4°C siltāka nekā kontinentālajās stacijās (5. attēls). Savukārt kontinentālajās stacijās, salīdzinot ar piekrastes stacijām, ir bijusi lielāka gaisa temperatūras paaugstināšanās ziemas mēnešos. Ūdenim piemīt augstāka siltuma kapacitāte, salīdzinot ar sauszemi, tāpēc lieli ūdens objekti – jūras un okeāni – būtiski ietekmē piegulošo teritoriju klimatiskos apstākļus, izlīdzinot gaisa temperatūras sezonālās svārstības. Savukārt reģionos, kuri atrodas tālu no lieliem ūdens objektiem, ir novērojamas ļoti lielas gaisa temperatūras sezonālās svārstības: aukstas ziemas un karstas vasaras. Viens no vienkāršākajiem un bieži lietotajiem ir Gorczyński noteiktais kontinentalitātes indekss (Gorczyński, 1920; Avotniece u.c., 2017), kam pamatā gada siltākā un aukstākā mēneša vidējās gaisa temperatūras starpības izteikšana, ņemot vērā vietas ģeogrāfisko platumu.



8. attēls. Kontinentalitātes indekss pēc Gorczyński, 1920, adaptēts no Avotniece u.c., 2017, references periodā (1961–1991) un klimatiskās normas periodā (1991–2020) (autoru izveidots, izmantojot E-OBS datus)

Kontinentalitātes indeksa analīze liecina, ka klimats visā Latvijas teritorijā kļūst maigāks, L. Gorčinski kontinentalitātes indeksa vērtība samazinās (8. attēls). References periodā (1961–1990) kontinentalitātes indeksa vērtības Latvijas austrumdaļā ir bijušas gandrīz 28% (8. attēls), savukārt pēdējā klimatiskās normas periodā (1991–2020) – mazāk kā 25%, kas var tikt pielīdzināts Latvijas vidusdaļas klimatam references periodā. Kontinentalitātes pārmaiņas galvenokārt saistāmas ar ziemas sezonas gaisa temperatūras paaugstināšanos, kas ir izteiktāka valsts austrumu reģionos.

Kopsavilkums

Kopumā pēdējo sešdesmit gadu laikā (1961–2020) visā Latvijas teritorijā gada vidējā temperatūra ir paaugstinājusies par 1.2°C (no tiem 0.5°C pēdējā klimatiskās normas periodā) ar izteiktākām pārmaiņām augstieņu teritorijās. Temperatūras kāpumam ir sezonāls raksturs. Visbūtiskāk ir mainījusies ziemas sezonas temperatūra, nebūtiskāk – rudens sezonas gaisa temperatūra. Latvijas teritorijā gaisa temperatūra sezonu griezumā var variēt pat 22°C, savukārt gada vidējā gaisa temperatūra – 4°C diapazonā.

Reģionālās atšķirības vairāk izteiktas ziemā, Latvijas rietumu daļā, piekrastē novērotā gaisa temperatūra ir par 3 līdz 4°C augstāka, salīdzinot ar Latvijas austrumu daļu. Savukārt vasarā vēsākie ir ziemeļu reģioni un teritorijas, kas atrodas augstāk virs jūras līmeņa, tomēr vidējā vasaras mēnešu gaisa temperatūras starpība ir tikai aptuveni 1°C. Ziemas sezonā gaisa temperatūras raksturā redzama kontinentalitātes ietekme, savukārt vasaras sezonā Z-D gradients un reljefa ietekme. Izņēmums ir Rīgas aglomerācijas siltuma sala, kur gaisa temperatūra vasaras mēnešos ir par 2-3°C augstāka nekā pārējā teritorijā. Jāteic, ka mainījušās arī kontinentalitātes indeksa vērtības visā Latvijas teritorijā, bet, jo īpaši, austrumu reģionos: klimats kopumā Latvijas teritorijā kļūst izlīdzinātāks un maigāks.

Klimatam kļūstot siltākam, notiek arī klimatisko zonu robežu pārbīde. Klimatiskās references periodā no 1961. līdz 1990. gadam faktiski visu Latvijas teritoriju raksturoja boreālais klimata tips (Dfb zona pēc V. Kopena klimata klasifikācijas), bet pēdējā klimatiskās references periodā Latvijas rietumu un vidusdaļai jau ir raksturīgs temporālais klimata tips (Cfb zona).

Baltijas jūras reģionā gaisa temperatūra paaugstinās straujāk nekā vidēji pasaulē (Christensen et al, 2022; Meier, et al, 2021), ko nosaka atmosfēras cirkulācijas raksturs un teritorijas atrašanās vieta pārejas zonā starp dažādiem klimata tipiem un biomiem. Mūsu pētījums apliecina, ka pēdējā klimatiskās references periodā no 1991. līdz 2020. gadam gaisa temperatūra ir paaugstinājusies vēl straujāk nekā iepriekšējās desmitgadēs.

Pateicības

Izsakām pateicību EU-FP6 projektam UERRA (<http://www.uerra.eu>) par E-OBS datu bāzi un *Copernicus Climate Change Service* un datu devējiem ECA&D projekta ietvaros (<https://www.ecad.eu>).

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**PARASTĀ OŠA (*FRAXINUS EXCELSIOR*) STĀVOKLIS LATVIJĀ
MEŽAUDŽU DESTRUKCIJAS AKTĪVAJĀ FĀZĒ. MEŽA AUGŠANAS
APSTĀKĻI UN KVARTĀRA NOGULUMI**

**SITUATION OF COMMON ASH (*FRAXINUS EXCELSIOR*) IN LATVIA IN
THE ACTIVE PHASE OF STAND DESTRUCTION. FOREST SITE TYPE
AND QUARTERNARY DEPOSITS**

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Abstract

At present, 87.9% of all ash stands in Latvia are found on dry soils, where groundwater does not affect the root system of trees, and 94.3% of ash stands are distributed in eutrophic habitats, saturated with exchange bases and biologically active nitrogen. In Latvia, ash stands are found mainly on the loose sediments of sandy till and clayey till in highland and rise landscapes, as well as on silty glaciolymnic sediments in the lowlands. Sand sediments in the coastal lowlands and riverine landscapes, as well as peat sediments in both highland and lowland landscapes are not suitable for ash forest stands.

Keywords: common ash, Fraxinus Excelsior, quaternary deposits

Kopsavilkums

Pašlaik Latvijā 87,9 % no visām oša audzēm ir sastopamas sausās augtenēs, kur gruntsūdens neietekmē koku sakņu sistēmu, 94,3 % oša audžu ir izplatītas eitrofos biotopos, kas piesātināti ar apmaiņas bāzēm un bioloģiski aktīvo slāpekli. Latvijā oša audzes ir sastopamas galvenokārt uz morēnas mālsmits un smilšmāla irdenajiem nogulumiem augstieņu un pacēlumu ainavzemēs, kā arī uz puteklainajiem glaciolimniskajiem kvartāra nogulumiem zemienēs. Oša audzēm maz piemēroti smilts nogulumi Piejūras zemienē un upju zemju ainavzemēs, kā arī kūdras nogulumi kā augstieņu, tā arī zemieņu ainavzemēs.

Ievads

Latvijā mežaudžu sugu kompozīcija, audžu produktivitāte un izplatība dabas reģionos ir atkarīga galvenokārt no augtenes auglības pakāpes un mitruma apstākļiem jeb edafisko apstākļu fona. Tāpēc vispārīgam oša audžu augšanas apstākļu vērtējumam izmantoti divi edafiskos augšanas apstākļus raksturojoši analīzes veidi.

Veikta oša audžu platību sadalījuma analīze, pirmkārt, pēc meža tipiem, meža tipu dabiskām hidromorfām un cilvēka pārveidotām nosusinātām meža tipu rindām, kā arī pēc meža tipu trofiskām grupām kā ekoloģiski un ģeogrāfiski ļoti ietilpīgās, vides apstākļus atspoguļojošās dimensijās. Otrkārt, ne mazāk nozīmīgs oša augšanu un izplatību determinējošs faktors ir pleistocēna un holocēna irdeno nogulumu, bet

dažviet arī seklo pamatiežu sastāvs, tāpēc meklētas kvantitatīvas sakarības starp oša audžu izplatību un kvartāra nogulumu (dažviet – seklo pamatiežu) litoloģisko dažādību.

Darba mērķis ir noskaidrot oša audžu ekoloģiskās īpatnības Latvijā, ņemot vērā audžu sadalījumu meža tipos un audžu saistību ar kvartāro nogulumu veidu.

Pētījuma objekts un metode

Oša mežaudžu datu kopa. Par oša audžu platību sadalījumu meža tipos 1940. un 1998. gadā MS *Excel* vidē izveidota datu kopa. Kopas sastādīšanā par 1940. gadu izmantoti V. Eihe statistiskie dati (Eihe 1940), par 1998. gadu – Valsts Meža reģistra dati (saglabāti M. Laiviņa privātajā arhīvā), bet par 2018. gadu – GIS vidē sakārtoti Valsts Meža reģistra dati par 2,7 miljoniem meža nogabalu.

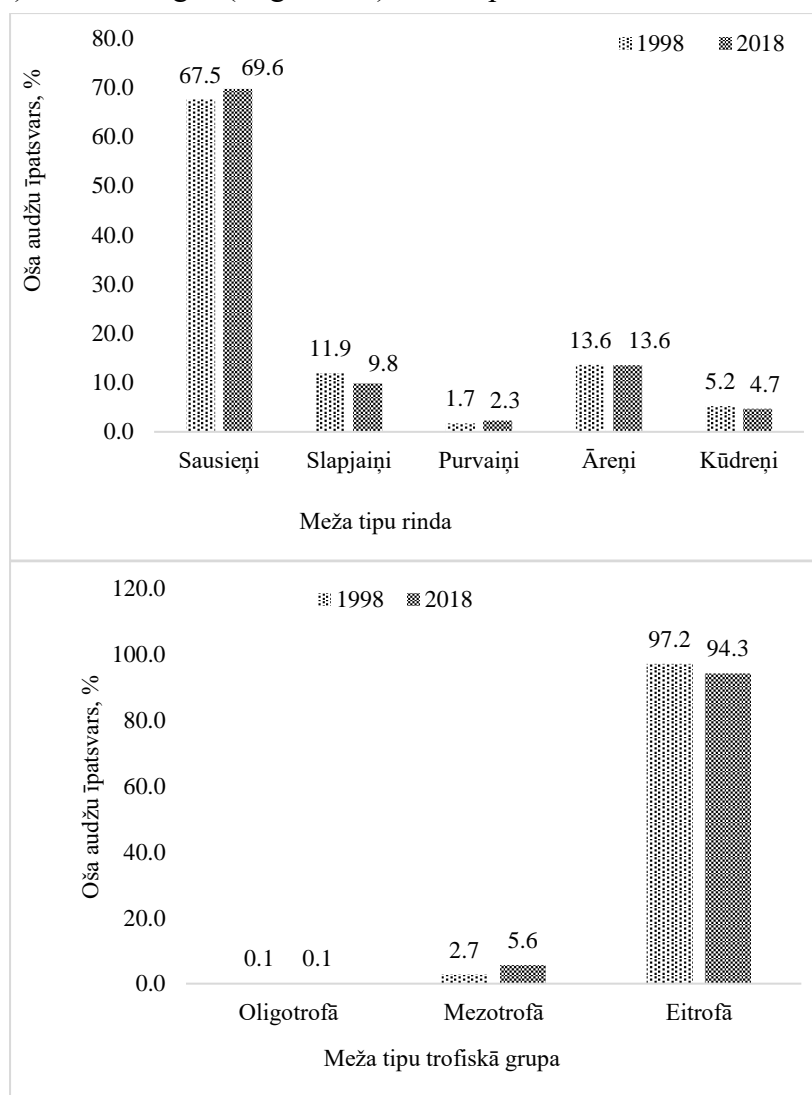
Kvartāra nogulumi. Oša audžu izvietojuma saistībai ar pleistocēna un holocēna irdenajiem nogulumiem, kā arī dažviet ar sekļajiem pamatiežiem, izmantoti Latvijas ģeoloģiskās kartēšanas materiāli – karšu lapas, kas sastādītas no 1997. līdz 2004. gadam mērogā 1 : 50 000 un 1 : 200 000 (Juškēvics un Misāns 1997; Nartišs un Zelčs 2018). Ģeoloģiskajās kartēs identificēti 17 kvartāra nogulumu un pamatiežu sedimentu veidi. Izmantojot 10 × 10 km tīklojumu, katrā kvadrātā (100 km²) noteikta sedimenta veida un oša audžu platība (ha). Analīzē irdeno iežu veidi grupēti septiņās pamatgrupās: granšaina smilts ar oļiem (1), marīnā, eolā un glaciofluviālā smilts (2), smilšmāla un mālsmilts morēna (3), aleirīti, aleirītiska smilts (4), māls (5), kūdra, kūdraina smilts (6) un pamatieži (7).

Datu statistiskā analīze. Oša audžu un kvartāra irdeno nogulumiežu platību sakarību analīzē lietota korelācijas analīze, izmantojot *Data Analysis* statistiskās datu apstrādes programmas MS *Excel* 13.0 vidē (*Pirsona* korelācijas koeficients). Tāpat analīzē izmantots vispārējais lineārais modelis (*Generalized Linear Model*) programmā *SPSS for Windows*, kur aprēķini veikti, izmantojot gammas varbūtības sadalījumu un logaritmisko funkciju. Kā atkarīgo mainīgo analīzē izmanto ošu audžu platību (ha), bet kā faktoriālās pazīmes izmanto ainavzemi un irdeno kvartāra nogulumu platību (ha). Līdzības un atšķirības skaidrošanai starp ainavzemēm pēc kvartāra nogulumu datiem un oša audžu platības (ainavzemju vidējie logaritmētie dati), veikta ainavzemju ordinācija ar galveno komponentu metodi (PCA), izmantota daudzdimensijas datu analīzes programma *PCord 7* (McCune and Grace 2002).

Rezultāti

Audžu sadalījums meža tipos. Analizējot oša audžu saistību ar augtēnes mitruma apstākļiem, redzam, ka gan pirms masveida oša audžu slimošanas 1998. gadā, gan arī pēc 20 gadiem gandrīz septiņdesmit procenti no visām oša audzēm ir

sastopamas sausieņu augtenēs. Mežos mitrās un pārmitrās minerālaugšnes augtenēs (slapjaini) un slapjās kūdras augtenēs (purvaini) oša audžu ir nedaudz virs desmit procentiem, bet nosusinātās augtenēs ar ievērojami uzlabotiem augšanas apstākļiem (āreņi, kūdreņi) – nepilni 20 procenti, redzams, ka meliorētās augtenēs oša audžu īpatsvars ir aptuveni divas reizes lielāks nekā nemeliorētās (1. att.). Vēl izteiktāka ir oša audžu saistība ar augtēnes auglību: audzes sastopamas galvenokārt eitrofās augtenēs, meža tipos ar intensīvu vielas apriti mežaudzē (1998. gadā 97,2 %, bet 2018. gadā 94,3 % audžu ir eitrofās augtenēs). Tikai dažu simtu hektāru platībā (galvenokārt mistrojuma ar citām platlapu sugām) osis sastopams vidēji bagātos (mežotrofos) un nabadzīgos (oligotrofos) meža tipos.



1. attēls. Oša audžu sadalījums meža tipu rindās un meža tipu trofiskajās grupās (autoru izveidots, izmantojot Valsts Meža reģistra datus)

Valsts Meža reģistra 2018. gada dati liecina, ka oša tīraudzes un mistraudzes ir sastopamas 21 meža tipā (oša audzes nav konstatētas tikai viršu ārenī un viršu

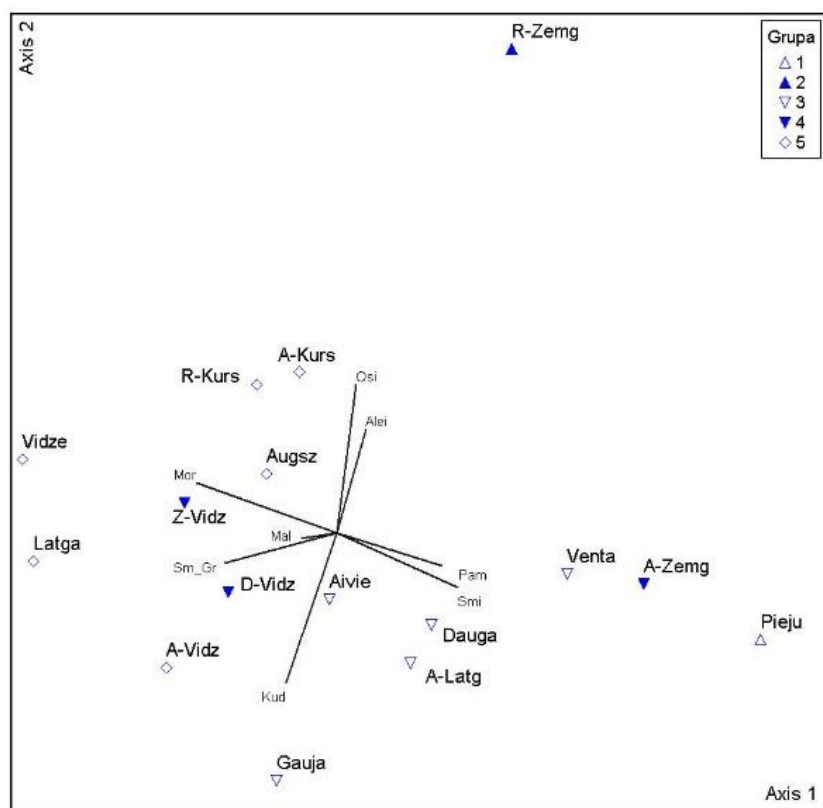
kūdrenī). 1998. gadā oša audzes ir konstatētas 17 meža tipos (tās nav silā, slapajā mētrājā, purvājā, viršu ārenī un kūdrenī, mētru kūdrenī), bet 1940. gadā tās atzīmētas tikai piecos meža tipos. 1998. un 2018. gada mežierīcībā tika izmantota K. Buša meža tipoloģija ar 23 meža tipiēm (Bušs 1976). 1998. gada dati, iespējams, ir saistīti ar nepilnīgi uzkrātajiem taksācijas datiem tā laika Valsts Meža kadastra datubāzē. Savukārt 1940. gada audžu sadalījumam meža tipos pamatā ir 1923. un 1938. gadā pieņemtā tipoloģijas sistēma, kurā ir definēti 13 meža pamattipi (Anon 1938). Lai gan ir atšķirības, pietiekami skaidri redzama oša audžu saistība ar gāršas meža tipu (1. tab.), jo pēc 1940. gada datiem 41,9 % oša audžu sastopamas gāršai līdzīgajā auglīgajā mistrājā, meža tipā, kas mūsdienās ir apvienots ar gāršas tipu.

1. tabula. **Oša audžu īpatsvars (ha, %) eitrofajos meža tipos (1940-2018)** (autoru izveidots, izmantojot Eihe, 1940 un Valsts Meža reģistra datus)

Meža tips / Gads	1940.		1988.		2018.	
	ha	%	ha	%	ha	%
Gārša	946.8	40.1	11373.5	51.9	6126.2	40.3
Mistrājs	989.2	41.9	*	*	*	*
Vēris	37.2	1.6	3244.0	14.8	4084.8	26.9
Damaksnis	*	*	211.8	1.0	367.1	2.4
Slapjā gārša	*	*	2055.4	9.4	927.9	6.1
Slapjais vēris	*	*	601.9	2.7	478.8	3.2
Dumbrājs	380.5	16.1	246.4	1.1	258.4	1.7
Platlapju ārenis	*	*	2783.7	12.7	1975.4	12.9
Platlapju kūdrenis	*	*	1127.4	5.1	674.8	4.4

* – nav datu.

Kvartāra irdeno nogulumu un oša audžu izvietojuma saistība. Ainavzemes atšķiras pēc kvartāra irdeno nogulu sastāva. Ordinējot ainavzemes ar galveno komponentu metodi (PCA) pēc irdeno nogulu sastāva, pirmā galvenā komponente (31,3 % kopējās dispersijas, $p = 0,067$) nošķir Piejūras zemieni ar smilšaino substrāta dominanci (smilts frakcijas korelācija, τ koeficients, ar pirmo asi 0,593) no augstieņu ainavzemēm, kurās izplatīts morēnas materiāls (smilšmāla un mālsmilts frakcijas korelācija -0,831) (2. att.). Augstieņu ainavzemes ordinācijas telpā veido kompakto punktu kopu. Otrā galvenā komponente (28,7 % kopējās dispersijas, $p = 0,001$) ordinācijas telpā izteikti norobežo Rietumzemgales ainavzemi ar lielāku putekļu proporciju irdenajos nogulumos (aleirītu frakcijas korelācija ar otro asi 0,404). Savukārt negatīvas korelācijas otrajai asij ir ar kūdras daudzumu – -0,443, ordinācijas telpā nodalot Aivieksteszemi un Gaujaszemi.



2. attēls. Ainvazemju ordinācija (PCA) pēc kvartāra nogulumu litoloģiskā sastāva un oša audžu (Osi) platības. Ar atšķirīgām zīmēm ordinācijas plaknē parādīta Piejūras zemiene (1), Rietumzemgale (2), upjuzemju (3), pacēlumu (4) un augstieņu (5) ainavzemes (autoru izveidots)

Ainvazeme: Pieju – Piejūras zemiene, R-Zemg – Rietumzemgale, Aivie – Aiviekstes zeme, A-Latg – Austrumlatgale, Gaujas – Gaujaszeme, Dauga – Daugavzeme, Venta – Ventaszeme, A-Zemg – Austrumzemgale, D-Vidz – Dienvidvidzeme, Z-Vidz – Ziemeļvidzeme, A-Kurs – Austrumkursa, R-Kurs – Rietumkursa, Augsz – Augšzeme, A-Vidz – Austrumvidzeme, Vidze – Vidzeme, Latg – Latgale.

Kvartāra sedimenti un pamatieži: Pam – pamatieži, Sm_Gr – granšaina smilts, Smi – smilts, Mor – morēnas smilšmāls, Alei – aleirīts, Mal – māls, Kud – kūdra.

Vispārējā lineārā modeļa analīze atklāj oša audžu statistiski būtisku saistību ar morēnas mālsmilts smilšmāla, aleirīta un smilts nogulumiem. Tāpat ainavzemes statistiski būtiski tiek diferencētas pēc irdeno nogulu sastāva (2. tab.).

2. tabula. Ainavzemes un kvartāra irdeno nogulu ietekmes vērtējums uz Oša audžu platību (GLM analīzes rezultāti, atkarīgais mainīgais – oša audžu platība, ha) (autoru izveidots)

Faktors	F-testa vērtība	Brīvības pakāpe	Būtiskums
Brīvais loceklis	151.156	1	.000
Granšaina smilts	.997	1	.318
Smilts	10.911	1	.001
Morēnas smilšmāls un mālsmilts	89.575	1	.000
Māls	1.423	1	.233
Aleirīts	13.527	1	.000
Kūdra	.097	1	.756
Ainavzeme	242.997	15	.000

Apskatot oša audžu platību dažādās ainavzemēs, redzams, ka audžu izplatība ir tieši saistīta ar smilšmāla un mālsmilts morēnas substrātu (3. tab.). Deviņās ainavzemēs (56 % no ainavzemju skaita) oša audžu platību būtiski ietekmē morēnas nogulumu. Lielāka mālsmilts un smilšmāla nogulu ietekme uz oša audžu izvietojumu ir augstieņu un pacēlumu/nolaidenumu ainavzemju grupā, bet arī Piejūras zemienē, Rietumzemgalē un Ventaszemē ir konstatēta pozitīva sakarība starp oša audzēm un morēnas nogulumiem.

3. tabula. Oša audžu (ha) un kvartāra nogulumiežu un seklo pamatiežu platību (ha) sakarības 10×10 km kvadrātos (Pīrsona korelācijas koeficients r) ainavzemēs (* $p < 0,05$, ** $p < 0,001$) (autoru izveidots)

Ainavzeme (kvadrātu skaits)	Pamatieži	Granšain a smilts	Smilts	Morēnas smilšmāls	Aleirīti	Māls	Kūdra
Piejūras zemiene (99)	0.32**	-0.06	0.00	0.42**	0.09	0.01	0.07
Rietumzemgale (31)	.	0.34	0.09	0.67**	0.04	-0.04	-0.11
Daugavzeme (9)	0.94**	0.28	-0.33	0.54	-0.17	.	-0.37
Ventaszeme (29)	-0.04	0.11	-0.42*	0.48**	0.40*	-0.13	-0.15
Gaujaszeme (40)	0.00	0.08	-0.15	0.17	-0.07	0.95**	-0.14
Austrumlatgale (27)	.	0.46*	-0.07	0.20	0.73**	-0.02	-0.07
Aivieksteszeme (83)	.	0.06	0.17	-0.14	0.09	-0.09	-0.10
Ziemeļvidzeme (58)	.	-0.13	0.02	0.45**	-0.12	0.24	-0.08
Dienvidvidzeme (32)	-0.05	-0.24	-0.34	0.54**	-0.01	-0.11	-0.18
Austrumzemgale (45)	-0.08	0.03	-0.02	0.12	0.06	.	-0.25
Rietumkursa (38)	.	-0.04	-0.39*	0.67**	-0.08	0.21	-0.05
Austrumkursa (66)	0.03	0.04	-0.14	0.43**	-0.28	-0.15	-0.02

Ainavzeme (kvadrātu skaits)	Pamatieži	Granšain a smilts	Smilts	Morēnas smilšmāls	Aleirīti	Māls	Kūdra
Piejūras zemiene (99)	0.32**	-0.06	0.00	0.42**	0.09	0.01	0.07
Vidzemes augstiene (42)	.	-0.20	-0.22	0.19	0.30	0.09	-0.32*
Austrumvidzeme (19)	.	-0.29	0.18	0.59**	0.59**	.	-0.12
Augšzeme (48)	.	0.37**	-0.07	0.52**	-0.17	.	-0.13
Latgales augstiene (72)	.	-0.09	-0.02	0.05	0.24*	-0.13	-0.23*
Latvijā kopā (738)	0.12*	-0.01	-0.08*	0.26*	0.05	0.02	-0.16*

. – nav datu

Aaleirīti (0,1-0,01 mm) un māls (<0,01 mm) oša audžu izvietojumu būtiski ietekmē upjuzemēs (Austrumlatgale, Gaujaszeme, Ventaszeme) un augstienēs (Austrumvidzeme, Latgales augstiene) (3. tab.). Arī Rietumzemgalē saskatāma oša audžu un aleirītisku drupiežu saistība, kas redzama ordinācijas analīzē (2. att.).

Uzmanība jāpievērš oša audžu izvietojuma saistībai arī ar pamatiežiem Daugavas ielejā (dolomītu atsegumi), Piejūras zemiēnē (Slītere, Ķemeri), kā arī oša audžu nesavietojamībai ar organiskajām kūdras nogulām. Vairumā ainavzemju (izņemot Piejūras zemiēni) oša audžu platība negatīvi ir saistīta ar kūdras nogulu platību.

Diskusija

Oša audžu ģeogrāfijas un ekoloģijas īpatnības Latvijā. Tātad Latvijā skaidri iezīmējas oša mežaudžu saistība ar valgām un mēreni mitrām augtenēm – 87,9 % no visām oša audzēm ir sastopamas sausieņu, āreņu un kūdreņu meža tipā, kurā gruntsūdens aktīvi neietekmē koku augšanu. Ņemot vērā oša iecietību arī pret palielinātu augtenes mitrumu, H. Ellenbergs neuzskata osi par drošu augtenes mitruma apstākļu indikatorsugu (Ellenberg et al. 1992; Ellenberg 1996).

Savukārt pēc augtenes auglības oša audžu niša ir trūdaines vāji skābas/neitrālas, ar apmaiņas bāzēm un sevišķi ar bioloģiski aktīvo slāpekli piesātinātas augtenes (Zemīte 1925; Kundziņš 1987; Grime et al. 1988; Ellenberg et al. 1992). Latvijā pašlaik 94,3 % oša audžu ir izplatītas eitrofos augšanas apstākļos. Augtenes trofiskuma labvēlīgo ietekmi uz oša augšanu apstiprina arī morēnas smilšmāla un mālsmilts, kā arī aleirītu pozitīvā saistība ar oša audžu platību vairumā ainavzemju.

Nereti literatūras apskatos tiek uzsvērts, ka oša augšanu labvēlīgi ietekmē augsnes piesātinājums ar kalcija un magnija katjoniem, karbonātsks substrāts. Pētījumos Latvijā konstatēts, ka irdenajos pleistocēna nogulumos Rietumlatvijas augstienēs (Rietum- un Austrumkursas augstiene) ir lielāks kaļķakmens atlūzu saturs, salīdzinot ar Viduslatvijas (liels dolomīta, dolomītmerģeļa, merģeļa atlūzu īpatsvars)

un jo sevišķi ar Austrumlatvijas litoreģiona morēnu nogulumiem, kuros ir liels kristālisko iežu, bet vismazākais kaļķakmens drupiežu daudzums (Lamsters et al. 2018). Arī pozitīvā oša audžu saistība ar devona dolomīta drupiežiem Daugavzemē ($r = 0,94$) un Piejūrā ($r = 0,32$) atspoguļo karbonātiskā substrāta labvēlīgo ietekmi uz oša augšanu. Jāatzīmē gan, ka oša minerālās barošanās pētījumi neparāda pozitīvo saistību starp kalcija un magnija daudzumu augsnē (oša sakņu zonā) un šo katjonu daudzumu oša lapās (Gordon 1964; Čekstere et al. 2013, 2016; Заугольнова 1974). Augu minerālās barošanās pētījumos kā oša augšanu limitējošs faktors pirmām kārtām atklājas slāpekļa saturs augtenē.

Osis izvairās no kūdras augsnēm, visās ainavzemēs saistība starp oša audžu un kūdras substrāta platību ir negatīva (Latvijā $r = -0,16$), purvaiņu rindas meža tipos pašlaik ir sastopamas tikai 2,3 % no visām oša audzēm.

Iespējams, ka pēdējos 20 gados ir kļuvusi plašāka oša audžu augšanas ekoloģiskā niša. Pašlaik oša audzes jau ir sastopamas visu meža tipu trofisko grupu dabiskajās meža tipu rindās – sausieņos, slapjajinos un purvaiņos. Aizvien vairāk eitroficējoties meža augtenēm, palielinās mistraudžu veidošanās tendences, tāpēc arī nabadzīgos augšanas apstākļos (sils, mētrājs, grīnis, purvājs), kā liecina 2018. gada mežierīcības dati, ir sastopamas mistrotas oša audzes (oša īpatsvars koku stāvā 40-69 %), bet dažreiz arī tīraudzes (oša īpatsvars koku stāvā > 70 %), kas liecina par oša atjaunošanās potenciālu dažādos meža tipos, pat arī oša masveida slimošanas laikā.

Oša izplatību ietekmējošie faktori. Nobeigumā jānorāda uz dažām zīmīgām, ar oša audžu stāvokli un dinamiku saistītām sakarībām oša areāla ziemeļu daļā hemiboreālajā zonā, kur atrodas arī Latvija. Pirmkārt, oša vitalitātes palielināšanās 19. gs. sakrīt ar strauju ražošanas attīstību Eiropā, saražotās produkcijas apjoma palielināšanos, minerālmēslu lietošanu zemkopībā, kas ievērojami sekmēja biogēno elementu, sevišķi slāpekļa un fosfora, migrāciju dabas vidē. Otrkārt, pēc Mazā leduslaikmeta (16.-17. gs.) gaisa temperatūra Baltijas jūras reģionā laika periodā no 1871. līdz 2011. gadam ir paaugstinājusies par 0,08°C dekādē, bet Latvijā šajā laikā gada vidējā gaisa temperatūra ir paaugstinājusies par 1,4°C, vidējā minimālā – par 1,9°C, bet vidējā maksimālā – par 1,7°C (Lizuma et al. 2007; Avotniece et al. 2017), kas sekmē oša straujāku izplatību areāla ziemeļu daļā. Treškārt, arī pirms 180 gadiem sākta oša stādījumu veidošana mežaudzēs, kā arī apjomīgā meža meliorācija 20. gs., neapšaubāmi ir sekmējusi oša izplatīšanos.

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**PARASTĀ OŠA (*FRAXINUS EXCELSIOR*) STĀVOKLIS LATVIJĀ
MEŽAUDŽU DESTRUKCIJAS AKTĪVAJĀ FĀZĒ. AUDŽU DINAMIKA
UN IZPLATĪBA PĒDĒJOS 80 GADOS (1940-2020)**

**SITUATION OF COMMON ASH (*FRAXINUS EXCELSIOR*) IN LATVIA OF
THE ACTIVE PHASE OF FOREST DESTRUCTION. FOREST STAND
DYNAMICS AND DISTRIBUTION IN THE LAST 80 YEARS (1940-2020)**

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Abstract

At the beginning of the 19th century, common ash was a rare species in the forests of Latvia. Back then, the first ash plantations were cultivated in Western Latvia (Cīrava), but the attempt was not successful. After that, the ash spread gradually, with a particularly sharp increase during the second half of the 20th century. In 58 years (1940-1998), as a result of intensive natural regeneration and planting efforts, the area of ash stands in forests increased 9.2 times, reaching 0.79% of the forest area, a large proportion of which (62%) was covered by young stands (up to 40 years old). In the first twenty years (2001-2020) of the 21st century, with the onset of the pandemic of fungal pathogen *Hymenoscyphus fraxineus*, the area of ash stands has decreased 1.9 times. During the pandemic, ash young stands and pure ash stands have suffered the greatest loss. Therefore, when growing future ash stands, it is necessary to maintain a balanced age structure of stands and to create ash mixed stands.

Keywords: common ash, *Fraxinus Excelsior*, forest destruction

Kopsavilkums

Parastais osis 19. gs. sākumā Latvijas mežos ir bijusi paretā suga, šajā laikā Rietumlatvijā (Cīrava) ir veidoti pirmie, bet neveiksmīgie, oša stādījumi. Pēc tam osis pamazām ir izplatījies, sevišķi strauji – 20. gs. otrajā pusē. 58 gados (1940–1998), kā intensīvi dabiski atjaunojoties, tā arī stādot, oša audžu platība mežos ir pieaugusi 9,2 reizes, sasniedzot 0,79 % no meža platības, pie tam ir liels oša jaunaudžu (līdz 40 gadu vecas audzes) īpatsvars (62 % no oša audžu platības). 21. gs., sākoties patogēnās sēnes *Hymenoscyphus fraxineus* pandēmijai, divdesmit gados (2001–2020) oša audžu platība ir samazinājusies 1,9 reizes. Pandēmijas laikā visvairāk ir atmirušas oša jaunaudzes un oša tīraudzes. Tāpēc nākotnē, audzējot oša mežaudzes, ir jā saglabā līdzsvarota audžu vecumstruktūra un jāveido oša mistraudzes.

Ievads

Divas pandēmijas dabas un sociālajā vidē. 21. gs. sākumā Latvija ir saskārusies ar divām, vienai pēc otras sekojošām pandēmijām. Pirmā – parastā oša (*Fraxinus excelsior*) audžu masveida kalšana Latvijā un Eiropā visā oša sugas areālā, ko izraisīja patogēna sēne *Hymenoscyphus fraxineus*, otrā – cilvēku masveida slimošana un lielā

mirstība, inficējoties ar mobilo un intensīvi mutējošo vīrusu SARS-CoV-2, kas īsā laikā aptvēra visus kontinentus. Kas kopīgs abiem patogēniem?

Kā sēnes *Hymenoscybus fraxineus*, tā arī vīrusa SARS-CoV-2 izcelsmes reģions ir Austrumāzija; zemeslodes floras un faunas rajonēšanas sistēmā – Austrumāzijas floras un faunas apgabals. Tātad hipotētiski šo patogēnu izcelsmes centrs ir Austrumāzija, no kurienes tie ir sākuši globālu invāziju. Austrumāzijā minēto patogēnu postošā ietekme uz vidi un sabiedrību ir mazāka nekā Eiropā, Ziemeļamerikā un citur.

Hymenoscybus fraxineus saimniekaugs Tālajos Austrumos, Krievijā, Ķīnā, Korejā un Japānā ir Mandžūrijas osis (*Fraxinus mandschurica*), kuram nav novērojami nozīmīgi šīs sēnes kaitējumi kā parastajam osim Eiropā, kur inficēšanās ar šo sēni vairumā gadījumu kokiem ir letāla (Marčiulytienė 2015; Schulz 2017). Parastā oša masveida kalšana, inficējoties ar patogēno sēni, vispirms tika konstatēta Polijā 1992. gadā, pēc tam 20 gados tā aptvēra visu oša areālu Eiropā (Solheim and Hietala 2017). Latvijā pirmie oša kalšanas gadījumi Zemgalē konstatēti 2000. gadā (Liepiņš 2008; Matisone 2020).

Arī cilvēku mirstība, slimojot ar Covid-19, šķiet, ir lielāka Eiropas, Ziemeļ- un Dienvidamerikas valstīs nekā Austrumāzijā – Ķīnā, Korejā, Japānā; hipotētiski Ķīna ir vīrusa izcelsmes centrs (Holmes et al. 2021; Mikltvaits un Vuldrīdžs 2021; Fraiteers et al. 2022). Minētās sakritības – šo (koku un cilvēku) patogēno aģentu kopējie izcelsmes centri, globālās migrācijas intensitāte, negatīvās ietekmes apjoms uz dabas un sociālo vidi, ir pamats raizēm par globalizācijas procesu nozīmi dabas un sabiedrības attīstībā nākotnē.

Oša audžu destrukcija

Pašlaik Latvijas mežos starp vietējo platlapu sugu audzēm izplatītākās ir parastā oša *Fraxinus excelsior* mežaudzes. Latvijā pirmos datus par oša audžu platību valsts mežos 1937. gadā sniedz A. Kundziņš – 1200 ha (Kundziņš 1937). Tomēr V. Eihe savā izcilajā Latvijas meža ģeogrāfijas pētījumā oša audžu platību ir aprēķinājis lielāku – 2373,8 ha platībā (Eihe 1940). 20. gs. otrajā pusē oša audžu platība strauji palielinās, pēc Valsts meža dienesta datiem lielāko platību sasniedzot 1998. gadā – 21905,3 ha, 0,79 % no meža kopplatības. 58 gados oša audžu platība ir palielinājusies aptuveni 9 reizes, vidēji katru gadu aptuveni par 336 ha.

Nākamajos gados, ošiem inficējoties ar patogēno sēni *Hymenoscybus fraxineus*, notiek strauja oša audžu kalšana visā oša areālā Eiropā, arī Latvijā vērojama oša audžu platības samazināšanās (Matisone et al. 2018). Pēc Valsts Meža reģistra datiem oša mežaudžu platība divdesmit gados (2001-2020) ir samazinājusies 1,9 reizes (par 53 %), vidēji gadā par 518 ha. 21. gs. sākumā, pandēmijas pirmajos gados

(2001-2005), mežaudžu destrukcija ir straujā, oša mežaudžu platība samazinās gandrīz divas reizes straujāk (893,3 ha gadā) nekā turpmākajos 5 gadu periodos, kad tā samazinās par 406,4-522,0 ha gadā, arī bojāto oša audžu platību variēšana starp gadiem gadsimta sākumā ir lielāka, nekā turpmākajos periodos.

Tātad oša audzes pēdējos simts gados, salīdzinot ar citām Latvijas mežaudzes veidojošo koku sugu audzēm, ir ļoti dinamiskas. Raksturīgi, ka Latvijā oša audžu platību maiņa nav saistīta ar intensīvu meža izmantošanu (meža atjaunošanas cirtēm, meža stādīšanu u.c. saimnieciskiem pasākumiem), bet gan norisinās nosacīti dabisku faktoru ietekmē. Pēdējos 80 gados oša audžu platības maiņā iezīmējas cikliskuma pazīmes, kas nereti piemīt dzīvo organismu kvantitatīvo parametru maiņai laikā. Tāpēc oša populācijas pētījumi pašlaik ir aktuāli, jo sevišķi, ņemot vērā vides nelīdzsvaroto stāvokli un oša, kā okeāniskas sugas, augšanu Latvijā sava areāla ziemeļaustrumu nomalē.

Pētījumu mērķis ir analizēt oša audžu platību pārmaiņas 20. gs. otrajā pusē un 21. gs. sākumā, kā arī noskaidrot oša audžu reģionālā sadalījuma īpatnības Latvijā.

Pētījuma objekts un metode

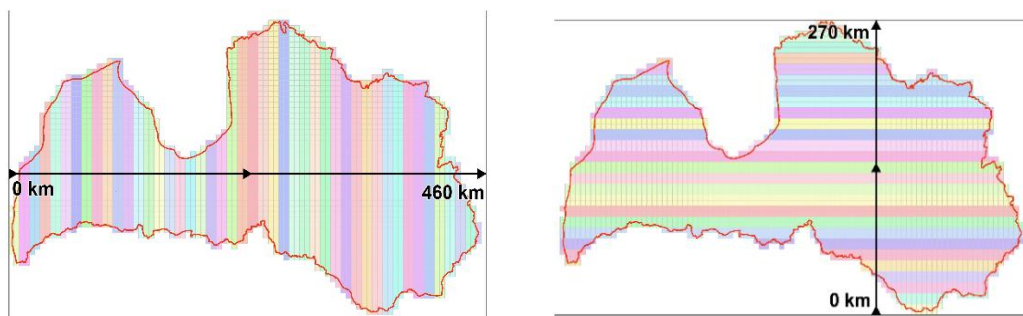
Oša mežaudzes raksturojošā datu kopa

Pētījumā izveidotas oša mežaudžu platību un sugu sastāvu raksturojošas trīs datu kopas 16 ainavzēmēs – par 1940., 1998. un 2018. gadu. Pirmajā – 1940. gada datubāzē MS EXCEL vidē apkopoti V. Eihses (1940) mežu ģeogrāfijas pētījumu dati par valsts un pašvaldību mežiem (par platību 1 457 370 ha jeb 82,5 % no Latvijas mežu kopējās platības). Otrajā – 1998. gada datu kopā MS EXCEL sakārtoti Meža reģistra dati par valsts, pašvaldību un privāto mežu oša audžu sastāvu 582 administratīvajās vienībās (500 pagastos, 26 lauku teritorijās un 56 pilsētās), kas savietoti pēc to piederības ainavzēmēm. Trešajā – 1998. gada datubāzē GIS vidē apkopota VMD Valsts Meža reģistra 2018. gada informācija par 2,7 miljoniem meža nogabalu.

Katrā no trim datu kopām dati sakārtoti, ņemot vērā Latvijas rajonēšanu 16 ainavzēmēs (Ramans 1994), kas ir secīgas un telpiski savietojamas ar G. Ramana ģeogrāfisko reģionu un V. Eihses 47 meža ainavu robežām (Ramans 1935; Eihses 1949). Ticamākai 1940. gada datu salīdzināšanai ar mūsdienu datiem, veiktas nelielas pārmaiņas. V. Eihses Austrumlatvijas VII meža ainava mūsu pētījumā reprezentē Austrumlatvijas ainavzemi K. Ramana 1994. gadā rajonēšanas shēmā, bet Viduslatvijas I un II meža ainava – Austrumzemgales ainavzemi. Savukārt Daugavzemes ainavzemei, ņemot vērā tās lineāro konfigurāciju, atbilstošus 1940. un 1998. gada datus par oša audžu platībām šajā ainavzēmē nebija iespējams novērtēt.

Regulāra tīklojuma sistēma

Oša audžu platību reģionālajā analīzē un kartēšanā izmantots Latvijas teritorijas 10×10 km un 5×5 km tīklojums taisnleņķa koordinātu sistēmā (Laiviņš un Krampis 2004). par pamatu ņemot 5×5 km tīklojumu, Latvija sadalīta 10 km platās joslās rietumu–austrumu virzienā (46 joslas), pirmās slejas sākuma X koordināte – $20^{\circ}56'58.82''$ A garums (LKS-92 sistēmā $X = 310000$), un 10 km platās joslās dienvidu–ziemeļu (28 joslas) virzienā, pirmās slejas sākuma Y koordināte ir $55^{\circ}38'4.80''$ Z platums (LKS-92 sistēmā koordināte $Y = 170000$) (1. att.). Pēc virsas augstuma atšķirībām teritorija diferencēta, sākot no Baltijas jūras līmeņa līdz Latvijas augstākajam punktam – Gaiziņkalna virsotnei 30 augstumjoslās ik pēc 10 m (Krampis 2010). Teritorijas dalījums joslojuma sistēmā (trīsdimensiju ģeogrāfiskajā telpā), dod iespēju veikt oša audžu ģeogrāfiskā izvietojuma gradientanalīzi.



1. attēls. Latvijas teritorijas joslojums rietumu–austrumu un dienvidu–ziemeļu virzienā

Aprēķināta (2018. gada dati) oša tīraudžu (osis 8-10 balles koku stāva formulā) un mistraudžu (4-7 balles) platība (ha) un sastādīta oša audžu izplatības karte. Savukārt meža un oša audžu platības aprēķini katrā elementārajā tīklojuma kvadrātā (25 km^2), 10×10 km platās rietumu–austrumu, dienvidu–ziemeļu un virsas augstumjoslās, ir pamats oša audžu sastopamības kartes, kā arī audžu izplatības gradientu analīzei.

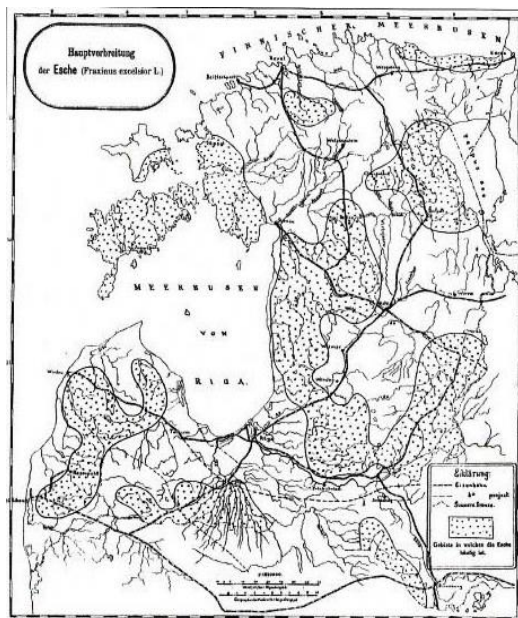
Izmantojot 2018. gada datus, ir sastādītas izplatības kartes kā poligonu veidā, tā arī tīklojuma kvadrātos.

Rezultāti

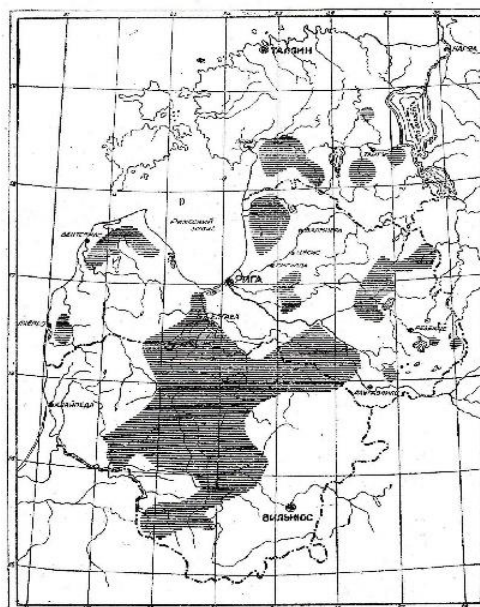
Oša audžu izplatības analīzei izmantotas un rakstā publicētas zinātniskajā literatūrā 20. gs. sākumā un vidū publicētās oša audžu izplatības kartes Baltijā (2., 3. att.), kā arī oriģinālā, I. Krampja sastādītā, audžu izplatības karte 21. gs. sākumā (4. att.). Kartogrāfiskā materiāla salīdzinošā analīze parāda oša audžu mozaīkveida izplatību un visai kompaktu oša masīvu orientāciju virzienā no dienvidiem uz ziemeļiem.

Aprēķinātas oša audžu platības (ha) uz 100 ha meža trīs periodos: 1940. gadā, kad ir publicēti pirmie apkopojšie valsts un Rīgas pilsētai piederošo mežu taksācijas dati, 1998. gadā, kad ir dati par līdz šim zināmo lielāko oša audžu platību, un 2018. gadā, kad ir pagājuši gandrīz 20 gadi kopš intensīvas oša audžu destrukcijas Latvijā. Aprēķinu dati apkopoti 1. tabulā.

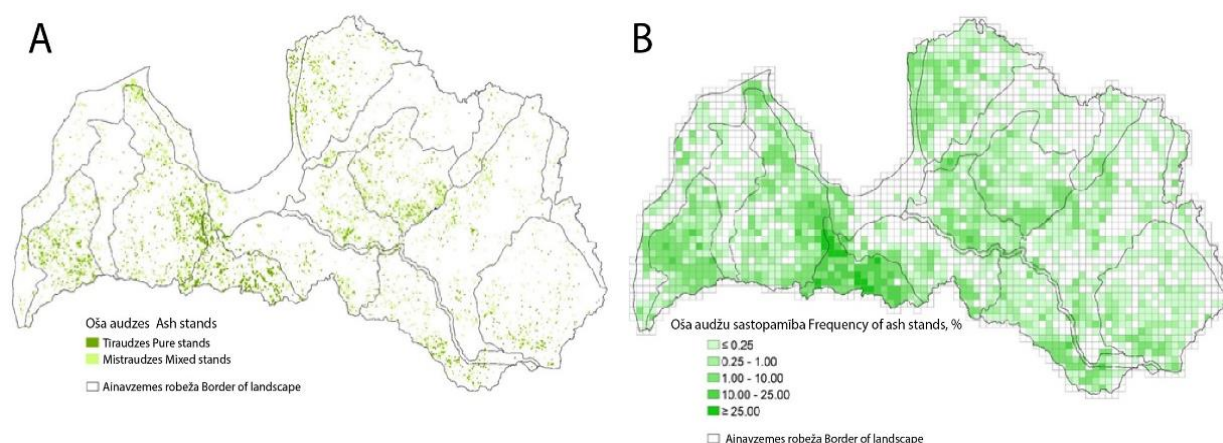
Oša audžu platības pakāpenisku samazināšanos sauszemes iekšienē raksturo audžu sastopamības rietumu-austrumu gradients, $r=0,30$, $p<0,05$ (5. att.). Vēl izteiktāka oša audžu izplatības samazināšanās ir dienvidu–ziemeļu virzienā. (6. att.). Ģeogrāfiskā platuma slejās oša audžu īpatsvars ir svārstīgāks, bet kopējā krituma tendence ir izteiktāka, $r=0,43$, $p<0,05$. Visvairāk oša audzes izvietotas 40-60 m un 80-110 m hipsometriskajos līmeņos, kas atbilst Zemgales līdzenuma un Rietum- un Austrumkursas augstieņu augstumiem (7. att.).



2. attēls. Oša audžu izplatība Kurzemes, Vidzemes un Igaunijas guberņās 20. gs. sākumā (Sivers 1903; Zunde 1999)



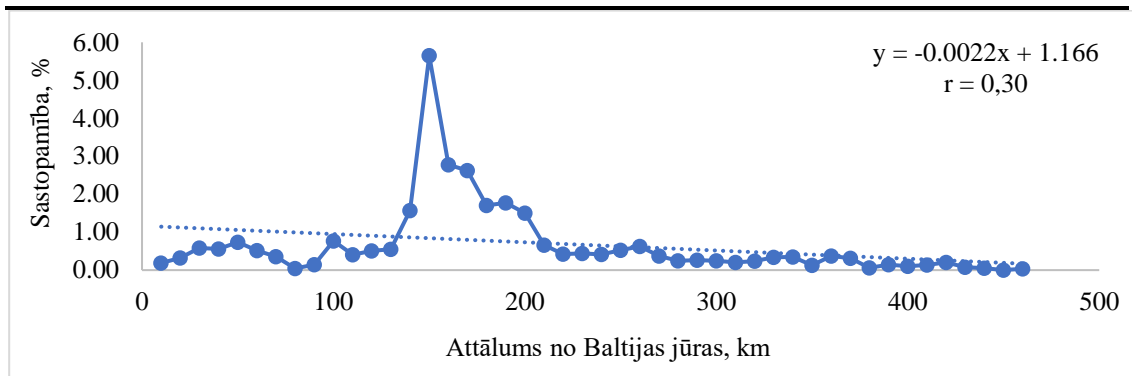
3. attēls. Oša audžu izplatība Lietuvas, Latvijas un Igaunijas padomju republikās 20. gs. vidū (Cakc 1957)



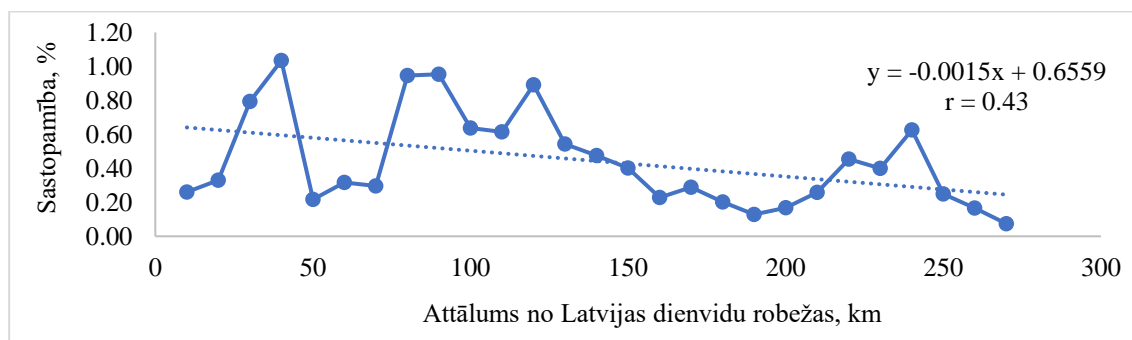
4. attēls. Oša audžu izvietojuma poligoni (A) un sastopamība 5 × 5 km tīklojumā (B) 2018. gadā

1. tabula. Oša audžu platību (ha/100 ha mežu) dinamika ainavzemēs (* – nav datu)
(autoru izveidots)

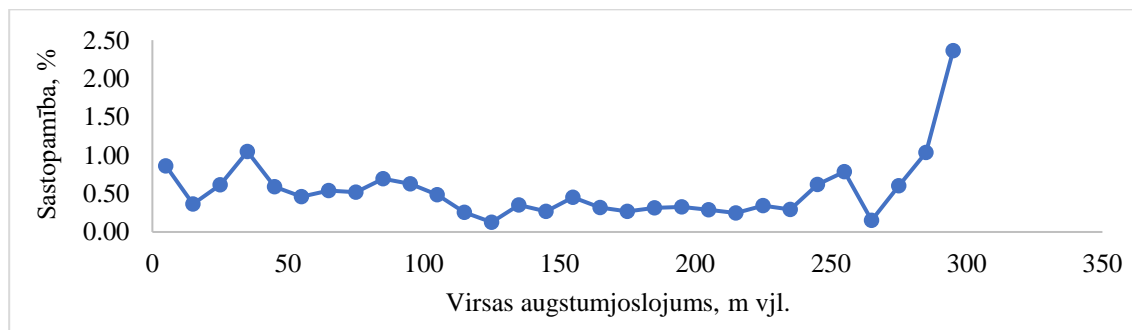
Ainavzeme/Gads		1940.		1998.		2018.	
		ha/100 ha	%	ha/100 ha	%	ha/100 ha	%
I	Piejūra	0.07	8.3	0.27	4.1	0.31	9.5
II	Rietumkursa	0.13	2.6	1.14	6.8	1.16	9.6
III	Ventaszeme	0.00	0.1	0.05	0.3	0.05	0.6
IV	Austrumkursa	0.08	3.9	1.36	16.7	1.03	19.4
IX	Ziemeļvidzeme	0.55	24.5	0.87	10.2	0.40	7.4
V	Rietumzemgale	3.06	30.5	15.56	23.4	9.49	19.1
VI	Austrumzemgale	0.04	1.9	1.17	11.4	0.32	5.3
VII	Augšzeme	0.05	0.6	0.74	6.4	0.38	4.4
VIII	Daugavzeme	*	*	*	*	0.57	0.9
X	Gaujaszeme	0.00	0.0	0.13	0.9	0.14	2.2
XI	Dienvidvidzeme	0.27	9.8	1.19	7.8	0.57	5.9
XII	Austrumvidzeme	0.00	0.0	0.53	2.4	0.10	0.5
XIII	Vidzemes augstiene	0.02	0.6	0.30	3.2	0.44	6.8
XIV	Aiviekstes zeme	0.15	14.8	0.27	3.3	0.17	5.0
XV	Latgales augstiene	0.18	2.5	0.24	2.1	0.19	3.0
XVI	Austrumlatgale	0.00	0.0	0.22	0.8	0.08	0.4
	Latvija kopā	0.16	100.0	0.79	100.0	0.46	100.0



5. attēls. Oša mežaudžu sastopamības rietumu-austrumu gradients (autoru izveidots)



6. attēls. Oša mežaudžu sastopamības dienvidu-ziemeļu gradients (autoru izveidots)



7. attēls. Oša audžu sastopamība augstumjoslās (autoru izveidots)

Diskusija

Izplatība Austrumbaltijā un Latvijā. Latvijas oša audzes atrodas parastā oša *Fraxinus excelsior* areāla ziemeļaustrumu malā: areāla ziemeļu robeža – 63° 40' (A. 1930; Hegi 1975) atrodas aptuveni 650 km uz ziemeļiem, bet austrumu robeža – Volgas augšteces rajons (Заугольнова 1974), aptuveni 700 km uz austrumiem no Latvijas, no nosacītā Latvijas ģeogrāfiskā centra Tīnūžu apkārtnē. Ziemas un pavasara minimālā gaisa temperatūra ir oša izplatību limitējošais faktors areāla ziemeļos un ziemeļaustrumos (Rubner 1934).

Kopumā Baltijā izveidojas kompakta, aptuveni 600 km gara dienvidu-ziemeļu virzienā orientēta oša audžu izplatības josta: Viduslietuvas zemiene (Nevēžis un

Mūsas-Nemunelis līdzenums), Viduslatvijas zemiene (Rietumzemgales, Dienvidvidzemes un Ziemeļvidzemes ainavzemes) un Baltijas jūras piekraste un Monzunda arhipelāga salas Igaunijas rietumos (2., 3. att.). Jau 20. gs. sākumā mežkopis M. Sivers uzsvēra, ka ošis Baltijā ir izplatītākā cieto lapkoku suga un kartē iezīmē šo meridionālo oša izplatības joslu (Sivers 1903), kas sakrīt ar pēdējā kontinentālā ledāja deglaciācijas procesā veidotajām reljefa formām. Arī vēlākos darbos par oša audžu izplatību vienmēr tiek uzsvērtas Zemgales un Ziemeļvidzemes sasaiste (Viduslatvijas zemiene) oša audžu izvietojumā Latvijā (Sakss 1950; Cakc 1957). Augšnes cilmieži šajā joslā pārsvarā ir smilšmāla, aleirīta, māla un morēnas nogulumi, kā arī seklo devona un silūra pamatiežu sadēdējušais materiāls.

Oša audžu izplatībā Latvijā vērojams mozaīkveida raksturs (4. att.). Lielākās platībās oša audzes ir sastopamas Rietumlatvijā, kā arī pret rietumiem eksponētajā Austrumlatvijas daļā – Dienvidvidzemes nolaidenumā, Ziemeļvidzemes un Vidzemes augstienē. Starp Rietumlatvijas reģioniem krasi izceļas Rietumzemgale, kurā jau pagājušā gadsimta pirmajā pusē ir bijusi trešā

daļa (30,1 %) no visu oša audžu kopējās platības – 3,1 ha/100 ha meža zemju (1. tab.). 20. gs. beigās, dažus gadus pirms oša pandēmijas, Rietumzemgalē oša audžu apjoms palielinājās jau līdz 15,6 ha uz 100 ha meža. Rietumzemgalē daudzviet kā dabiski, tā arī ar mērķtiecīgu mežsaimniecisko darbību, bija izveidojušās oša tīraudzes, kas pandēmijas laikā, salīdzinot ar mistraudzēm, cieta visstiprāk. Arī pašlaik šis reģions ir ošu audzēm bagātākais – 19,1 % no oša audžu platības pašlaik ir sastopamas Rietumzemgalē – 9,5 ha uz 100 ha mežu.

Rietumlatvijā oša audzes ir raksturīgas arī augstieņu ainavzemēm – Austrumkursā (sevišķi kontaktjoslā ar Rietumzemgales līdzenumu), Rietumkursā un Ziemeļkursas augstienē. Ievērojami mazāka oša līdzdalība mežaudžu veidošanā raksturīga Latvijas lielo upju – Gaujas, Ventas un Daugavas ieleju mežiem. Tāpat nabadzīga ar oša audzēm ir Latvijas austrumu daļa starp Daugavu dienvidos un Pededzes-Aiviekstes upju sistēmu austrumos – Austrumlatvijas un Austrumlatgales ainavzemes, kā arī Latgales augstiene.

Osis ir silta klimata suga, par to liecina oša audžu izplatība pat tik pēc platības nelielā teritorijā kā Latvija: oša audžu apjoma statistiski būtiska samazināšanās virzienā no Baltijas jūras piekrastes uz iekšzemi, kā arī no dienvidu robežas virzienā uz ziemeļiem. Strauja oša audžu sastopamības palielināšanās redzama pašās augstākajās (>285 m vjl.) virsas augstumjoslās, kas atbilst Vidzemes augstienes Gaiziņkalnam un tam tuvāko lielpauguru grupai. Sarūkot ledājam, Vestienas grēdas vidusdaļā, kur atrodas Gaiziņkalns, bija izveidojies ledāja caurkusuma ezers, kurā ir izgulsnējies līdz pat 28,5 m biezs bezakmens māla slānis (Zelčs 1995; Krievāns un Nartišs 2018), kas ir osim labvēlīgs substrāts, bet Gaiziņkalna stāvajās nogāzēs ir

izveidojušās gravas, kurās auga vitālas oša audzes, pēdējos gados gan tās ir stipri degradējušās.

Vēsturiskas ziņas par osi un oša audžu stādīšanu Latvijā

Pirmās ziņas par parastā oša (*Fraxinus excelsior*) sastopamību Latvijā ir atrodamas jau 18. gs. beigās, 19. gs. sākumā pirmajos apskatos par Latvijas dabu (Hupel 1777; Fischer 1778; Friebe 1805). Šajos darbos minēts, ka osis Baltijas provincēs ir pareta, ne sevišķi bieži sastopama suga ar cietu koksni (izcils materiāls galdniecībā), labs barības augs aitām un kazām (Блументаль 1834; Боде 1838). Savukārt pēc 100 gadiem, 19. gs. beigās un 20. gs. sākumā, Baltijas floras apskatos osim minēta izklaidus izplatība ar būtisku piebildi, ka pēc meža atjaunošanas cirtēm osis tiek arī stādīts (Klinge 1882; Sivers 1903).

Oša un citu platlapu sugu (goba, kļava, dižskābardis, ozols) stādījumi Cīravas muižas zemēs veikti jau 19. gs. pirmajā pusē mežkopja Gāfeldera uzraudzībā. Cīravas meža kultūrās osis ir bijis mazražīgs, 10 gadus veci oša kociņi ir sasnieguši aptuveni metra augstumu, tos stipri ir bojājušas stirnas un zaķi (Боде 1838). Lielākās platībās oša audzes sāka veidot 19. gs. otrajā pusē (1872-1901) un 20. gs. pirmajā pusē (1930-1938). Pēc Otrā pasaules kara Latvijā no šiem stādījumiem bija saglabājušās 20-79 gadus vecas audzes 17,3 ha platībā (Sakss 1958). Visai intensīvi oša stādījumi veidoti arī no 1948. līdz 1990. gadam – 2871 ha (vidēji 68 ha gadā), bet visaktīvāk 1951.-1960. gadā, kad katru gadu ar osi ir apmežoti 155 ha izcirtumu (Grauziņš 1971; Vanags 1995; Liepiņš 2003).

20. gs. vidū Eiropas mērenajā mežu zonā, piemēram, Vācijā, raksturīga ļoti intensīva oša dabiskā atjaunošanās, oša sējeņus zemsedzē dēvēja pat par *nezāli* (Dengler 1944). Latvijā eitrofās augtenēs sējeņu skaits sasniedza 100 un pat 1100 tūkstošus indivīdu uz hektāra (Sakss 1950). Dabiskās atjaunošanās un stādījumu veidošanas rezultātā Latvijā 20. gs. beigās izveidojās oša audžu vecuma disproporcija – ļoti liels oša jaunaudžu (jaunāku par 41 gadu – 62 %), mērens vidēja vecuma (41-80 gadi – 27 %), bet mazs ir pieaugušu un pāraugušu oša audžu (> 80 gadiem – 11 %) apjoms (Vanags 1995).

Pandēmijas mācība

Iespējams, ka lielā atšķirība oša audžu vecuma struktūrā bija viens no galvenajiem iemesliem oša audžu platības straujajai sarukšanai pandēmijas pirmajos gados. Slimības sākumā Latvijā un arī Lietuvā visvairāk slimoja un nokalta jaunie oši, visstraujāk samazinājās tieši oša jaunaudžu platības (Juodvalkis and Vasilauskas 2002; Liepiņš 2008; Laiviņš et al. 2016; Matisone 2020). Noturīgāki pret patogēnu, vismaz pandēmijas pirmajos gados, bija briestaudzes vecuma, kā arī pieaugušas un pāraugušas

oša audzes. Otrs slimības izplatīšanos veicinošs apstākļis bija lielais oša indivīdu skaits paaugā, jaunaudzēs un vidēja vecuma audzēs, kurās saskārās oša vainagi, tā sekmējot patogēnās sēnes pārnesi starp indivīdiem. Tieši oša tīraudžu lielais īpatsvars mežā sekmēja intensīvo oša saslimstību un oša mežaudžu straujo destruktiju. Tāpēc nākotnē, veidojot ilgtspējīgas platlapju audzes, jānodrošina vairāku sugu dalība audzē, jāveido mistraudzes, kurās koku stāvu veidotu vismaz 3-4 sugas (Kundziņš 1937; Mangalis 1988; Rigling et al. 2016; Matisone 2020; Давиденко 2015 u.c.). Mistraudzēm būtu lielāka noturība pret vides nelabvēlīgo ietekmi, daudzveidīgāks audžu sugu sastāvs sekmētu platlapju audžu un kopumā meža masīvu stabilitāti.

Pašlaik katru gadu oša audžu platība Latvijā samazinās vidēji par 400 ha gadā. Neapšaubāmi audžu platība saruks arī turpmākajos gados, veicot meža atjaunošanas cirtes degradētās un pandēmijas laikā novājinātās oša audzēs. Lietuviešu mežkopji prognozē oša audžu samazināšanos līdz pat 2040. gadam (Varnagiryte-Kabašinskiene and Kabašinskas 2014), Latvijā, ņemot vērā oša atjaunošanās potenciālu pandēmijas aktīvajā fāzē (Pušpure et al. 2017; Matisone 2020), oša audžu stabilizācija varētu sākties ievērojami ātrāk.

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