QUALITY OF LIFE DEPENDENCE ON PUBLIC TRANSPORT ACCESSIBILITY

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ABSTRACT

Purpose. *Article present the survey on dependency of quality-of-life indicators with transport accessibility. Specific focus is on rural areas. There was hypothesis to prove, that inhabitants of low population density rural areas are facing poor quality-of-life.*

Design/Methodology/Approach. *A representative survey of the population was chosen as the research method. The study area was divided into transport districts, and the representativeness of the survey was ensured in each transport district. Transport districts are divided according to the criterion of travel time and public transport supply. The survey included questions that allowed checking whether and which quality of life parameters correlate with the quality of public services.*

Findings and implications. *The research found that public transport accessibility is closely related with such attributes as education, employment rate and closely related to such attributes of life quality as change of clothes more often or having the proper shoes more often as well as having Internet access.*

Limitations. *The study was conducted in just one country with a very high level of car ownership, which is still growing. Another limitation is that the public transport supply in this country is insufficient due to historical reasons. For a long time, public transport was unsubsidized or weakly subsidized in this country.*

Originality. *The originality of the paper is based on a representative survey conducted by the authors, the results of which linked quality of life indicators with public transport availability indicators. The originality of the work is based on a representative survey conducted by the authors, the results of which linked quality of life indicators with public transport availability indicators.*

1. INTRODUCTION

Many of European Countries are facing urbanisation process which leads towards inequalities in quality of life. Largely populated cities with high density suburban areas are growing fast accompanied by development of infrastructure and public services. However, a region and especially rural areas have a serious issue with declining of population. Low density of population is facing a scarce of available public funding due to insufficient number of local tax payers. As an example, is Lithuania, where capital city Vilnius is growing since 2005, since EU access of the country, however the population of rest of the country continuously declining due to domestic and foreign emigration. Foreign emigration is caused by economical reason in many of 2005 EU new commers. However, it is important to emphasize, that majority so called labour emigrants are formerly residents of poor regions, low density regional towns and rural areas. Domestic migration has very similar patterns, when inhabitant of working age are leaving low density towns, villages and rural areas for large cities and suburbs.

The issue of increasing inequality between large cities and their metropolitan areas and regions was on political agenda during 2014-2020. Efforts to reallocate public funds in favour of regions with rural areas and declining population region was taken place in National funding as well as in EU funding in Lithuania. One of the current streams of politicians is to improve the public transport accessibility in regions, as there is the hypothesis, that poor mobility and public transport accessibility and access are causing inhabitants behaviour to leave rural areas for major cities. The aim of the article is to present survey results and to verify mentioned hypothesis. Such comprehensive survey is never was done for Lithuania and shall support politicians' decisions on reorganization of public transport services at National level. Survey was carried out in 2019 with methodological part and finished in 2020, with the gathering answers and operating with results. One of the boundaries of survey was Covid19 possible impact on perceptions of respondents, but it was tackled by formulating question to avoid influence of lock down.

2. LITERATURE REVIEW

Issues with quality of life and public services depending of living area are object of research for many years. Those are coming very similar both in European Union and in United States. Bieri and Dawkins (2016) have proved that US Federal housing subsidies are allocated without regard to spatial differences in the cost of living or quality of life and these subsidies are significantly related to metropolitan quality-of-life differentials. Household transportation expenditures, and this is particularly pronounced for low-income households.

In Gerber et all (2017) is argued in the life-oriented approach that travel behavior affects life choice and vice versa with resulting impacts on quality of life. Authors conducted in depth analysis of interdependences between daily mobility and life event (relocation) and their relationship and show how life events first, encourage travel behavior changes, especially mode choice, and second, improve or decrease people's quality of life.

Insufficient rural area population for profit oriented regular transport services and scarcity of public funding for those services, led over the past decade, considerable decline in rural buses. Between 2010 and 2016, funding for buses in Wales fell by 20% (Joseph, 2016). Cut routes and timetables can disproportionately affect rural areas, where there are few alternative options. Higher levels of car ownership in rural compared to urban Wales (Systra 2018) suggest that most rural dwellers depend on driving. However, both older and younger people are less likely to have access to a car (Powell et al. 2018) Ð and more likely to need to get to distant schools and health services. Research argued that accessibility poses particular challenges, especially for those with physical disabilities.

Correlation between public transport accessibility and indicators of quality of life are also found beyond EU, UK and US. Those are significant in other regions of the world. Transportation is one of the key indicators used to measure the Quality of Life of people especially those living in the urban area is proved by Othman at all (2021). Many aspects of transportation are very significant as they have the power to directly influence our way of life in search for a better Quality of Life is justified by research conducted in Malaysia.

Sipus and Ambramovic (2017) concluded that the population that migrates from the rural area into the urban center has constantly been in decline, with the trend suggesting the increase of emigration with each year. The significantly inadequate mobility in the researched rural area results from the lack of spatial coverage of 70% of the area by public bus transportation services, with railway transport available only to the inhabitants residing in the vicinity of the railway track. The fact that every other working-age inhabitant possesses a vehicle is not by choice but rather due to the impossibility of using adequate public transportation services. Researchers suggest that the availability of public transportation would contribute to the change of the emigration trends of the rural areas, thus improving the quality of life in the analyzed region.

The newest scientific article advocated the transport on demand as possible solution to ensure economically efficient transportations services in low density rural areas. The role of government is highlighted in (Veeneman and Mulley, 2018) by suggesting multi-level governance in public transport and efficient use of public subsidies. White (2016) also figuring the role of transport on demand role in organisation of public transport in situation, when regular transport is not economically sustainable However he indicated as public transport is highly related

to the basic indicators of quality of life. Public transport from one hand is very closely related with the availability of working places. Scarcity of mobility tend even to higher unemployment rates, lower attendance in social and cultural life of residents of rural areas. There is common to have daily job commuting up to 100-kilometer distance in those countries where is public transport access and services are well organized. However, those countries which have not integrated the rural areas by regular job commuting services to the major hubs of working places, are facing poor living standard and emigration in rural areas.

Diana and Daraio (2013) have reviewed among other things the indicators that have been proposed in the transport economics and engineering scientific literature to assess quality aspects in public transport systems in different countries, both in Europe and overseas. As it is mentioned in Jarzemskis and Jarzemskiene (2017) This review only considers variables and indicators related to physical, or instrumental measures, thus not taking into account other methods that are for example based on individual satisfaction levels, subjective or perceived quality. According to their review, the quality indicators available in the published research in these fields can be grouped as time performance and service coverage indicators. On-time performance that is related to the service reliability. This seems the quality aspects being most considered in the above defined research field, and a lot of indicators have been proposed that are related to this aspect. Service coverage and availability, that identifies to which extent the studied system is available both in spatial and in temporal terms. Spatial and temporal availability can typically be measured through the consideration of the service are on one hand, of the hours of operations on the other. This is also useful to assess the importance and the impact of a service within the whole transport system.

The results of the publications of Bansal et all (2021), Huang et al (2019), Kim et all (2019), Ma et all (2019), Noel et all (2019), Song et all (2020), Wu et all (2021) show different willingness to pay more for environmentally friendly car in China, India, South Korea as well as European Nordic countries.

In summarizing the review of literature, it is important to conclude that it well justified fact that public transport accessibility and perception of quality of life are closely related. However, the prove of those correlation by taking sets of very specific accessibility indicators and quality of life indicators was not obtained during analysis of literature. That was for the authors a scientific challenge to define proper methodological approach and tools to use for proving mentioned correlations. In the next chapter methodology is presented.

3. METHODOLOGY

For the representativeness of regions, the whole territory of Lithuania is divided into non-intersecting parts - layers and a stratified sample with a simple random sample in layers is used. The stratification is based on the aspects of peripherality of the territory and accessibility of the territory by public transport.

Table 1.: Transport accessibility matrix

Transport accessibility	Short distances, high density		Middle distance travel zone		Long distance travel zone (periphery)	
High	1H	„HH" (high-high) clusters are dominating, hot spots of public transport.	2H	Some hot spots of public transport, scarce of statistically valid areas	3H	Hots spots for periphery
Middle	1M	Up to 30 min travel by car from centre of a region, scarce of statistically valid areas or clusters.	2M	30-60 min travel by car from centre of a region; scarce of statistically valid areas or clusters.	3M	More than 60 min travel by car from centre of a region; scarce of statistically valid areas or clusters.
Low	1L	Cold sport, there are number of areas	2L	Cold spots, scarce of statistically valid areas or clusters.	3L	Cold spots, scarce of statistically valid areas or clusters.

Source: Ministry of Interrior of Republic of Lithuania.

Taking into account the data of public transport travel and the territorial division of the Ministry of the Interior and the geographical distribution of the population, the study analyses 4 out of 9 territorial division layers - (1H); (1M / 1L); (2H); (2M / 2L / 3M). All regions in Lithuania were reflected by using ARC GIS tool with precision of transport accessibility by 500 meters.

Figure 1: Lithuanian regions and transport clusters according accessibility level
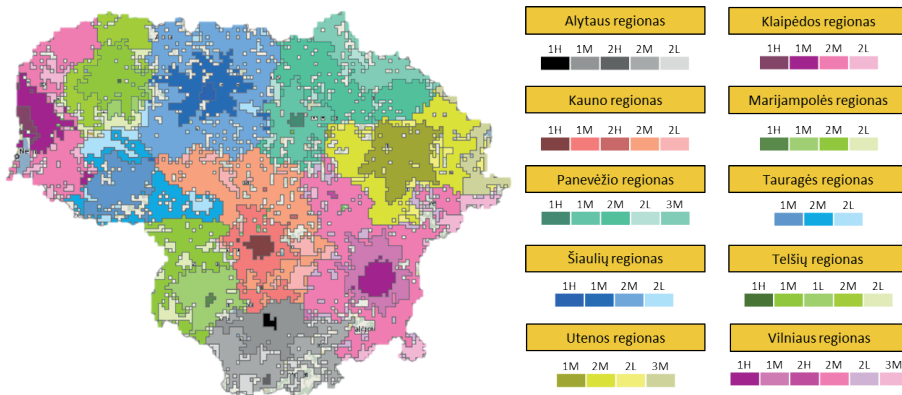
Source: Authors.

To statistically represent all four layers the number of respondents was selected as N=3186. Distribution of respondents along regions is presented in the table below.

Table 2: Number of respondents per region

Region	Number of respondents	Region	Number of respondents
Alytaus	240	Šiaulių	274
Kauno	674	Tauragės	96
Klaipėdos	303	Telšių	141
Marijampolės	156	Utenos	148
Panevėžio	210	Vilniaus	944

Source: Authors.

Analyzing the distribution of respondents according to the level of accessibility of the territory by public transport, it was found that 2160 respondents belong to the high level of accessibility, 919 respondents to the medium level, and 54 respondents to the low level. Assessing the distribution of respondents according to the peripherality of the territory, it was found that 2252 respondents are assigned to the near travel zone, 919 respondents to the middle, and 15 respondents to the distant travel zone.

For data analysis SPSP Statistics was applied. The one-way analysis of variance (ANOVA) is used to determine whether there are any statistically significant differences between the means of two or more independent (unrelated) groups (although you tend to only see it used when there is a minimum of three, rather than two groups).

Survey questionnaire consisted of 65 question which determine the long list of indicators of quality of life to check their interrelations with the layers of transport accessibility.

4. RESULTS

To determine the links and dependencies between the accessibility of public transport and other economic, social, human capital characteristics. a survey conducted by the authors in 2020 was used for the analysis.

Table 3: General economic and public services correlation with public transport accessibility

Transport accessibility	Activity	Unemployment	High Education	Income level	Public services quality	Public transport quality	Affordability of clothes	Affordability of shoes	Internet access
1H	63,2%	4,2%	76,4%	76,0%	4,0	3,9	69,4%	99,4%	68,8%
1M	55,3%	4,9%	66,3%	67,7%	4,0	3,8	66,5%	98,9%	62,8%
1L	100,0%	0,0%	71,4%	85,7%	4,3	3,0	58,1%	100,0%	51,2%
2H	53,8%	4,9%	70,6%	74,4%	4,0	3,9	68,3%	96,7%	64,2%
2M	52,8%	6,4%	57,4%	64,0%	3,9	4,1	60,6%	98,8%	57,5%
2L	51,1%	2,1%	63,8%	72,3%	3,8	3,8	63,7%	98,1%	61,1%
3M	40,0%	0,0%	40,0%	73,3%	3,9	3,2	37,7%	97,1%	44,9%
Correlation	strong	strong	strong	strong	no	no	strong	strong	strong

Source: Authors.

Where a cross-tabulation using the Chi-square criterion, p = 0.000 <0.05, the variables are statistically significantly dependent and a relationship exists. Where the One-way Anova method was used, p = 0.588> 0.05, it was found that there was no statistical significance and no relationship.

The evaluation found that where public transport is more accessible:
- a higher share of the employed population among the total population;
- the share of people with higher and post-secondary education is higher;
- a higher share of people receiving income;
- change of clothes more often;
- having the right shoes more often;
- Having Internet access is more common.

It has also been found that a higher proportion of the unemployed among all people where public transport is less accessible. In summary, the availability of public transport affects employment, unemployment, education, income levels and other aspects such as changing clothes or accessing the internet at home. However, public transport does not affect the totality of the services received or the quality of public transport services.

In summary, the availability of public transport affects employment, unemployment, education, income levels and other aspects such as changing clothes or accessing the internet at home. However, public transport does not affect the totality of the services received or the quality of public transport services.

Table 4: Satisfaction of life aspects which was found corelated with public transport accessibility

Transport accessibility	Life satisfaction	Satisfaction on financial situation	Job satisfaction	Satisfaction in time spent for hobby	satisfaction by personal connections
1H	6,7	5,5	7,2	6,2	8,0
1M	6,2	5,2	6,9	6,2	7,8
1L	4,4	4,2	6,3	4,7	8,3
2H	6,7	5,4	6,6	6,6	7,7
2M	5,8	4,6	6,7	5,9	7,7
2L	5,8	4,7	6,5	5,9	7,2
3M	5,1	4,2	7,0	6,1	7,6

One-way ANOVA method was used for evaluation, p = 0.000> 0.05. Significant differences were not found between all groups, such as more differences in life satisfaction between 1H, 1L, and 1M, and other groups. It can be said that the evaluation indicators differ depending on the accessibility layer of public transport. In summary, whether satisfaction depends on the stratum is not an option - one can only point out that assessments differ, and why and what factors influence this remains not clear after analysis.

Table 5: Quality of social life aspect which was found corelated with public transport accessibility

Transport accessibility	Leisure activities	Cinema attendance	Attendance cultural objects	Meeting friends and family members	Attendance of live performance	Attendance sport events
1H	36,1%	38,6%	33,9%	69,5%	60,0%	22,0%
1M	24,5%	24,3%	22,7%	69,2%	63,8%	29,6%
1L	11,6%	18,6%	7,0%	74,4%	12,5%	0,0%
2H	39,2%	41,7%	44,2%	76,7%	0,0%	0,0%
2M	24,6%	21,5%	20,8%	70,2%	54,2%	24,2%
2L	19,0%	18,0%	20,9%	73,3%	37,8%	24,3%
3M	18,1%	10,1%	14,5%	67,4%	40,0%	10,0%

A cross-tabulation, Chi-square criterion, p = 0.000 <0.05 was used in the evaluation, so the variables are statistically significantly dependent. It has been found that where public transport is more accessible, participation in leisure activities is higher, visits to cinemas and cultural sites are also more frequent, participation in live performances and sporting events is higher, and meetings with friends and relatives are also more frequent. In summary, the accessibility of public transport affects all aspects analysed.

5. CONCLUSIONS AND INSIGHTS FOR FURTHER SCIENTIFIC DISCUSSION

Transport accessibility is closely related to the such quality-of-life indicators as participation in cultural activity, visiting theatres, sport and culture events. In the areas with better transport accessibility are living people with higher income, higher education and rates of unemployment are lower there.

It is important to mention, that research proved statistically only interdependences between public transport accessibility and identified indictors of quality of life, however results doesn't reflect causality. Still is not enough data to prove if scarcity of public transport is cause of lower quality of life indicators, or if it is consequence of that. There are still theoretical options that impact is in both direction, and causality of such situation could be justified as mutual evolution of both factors. That means that more educated and higher reimbursed inhabitants are moving to the areas, where public transport is more accessible, and in parallel, for those areas where are declining population, politicians are reducing the public transport supply. This mirroring effect causes slowly pattern to the total absence of public transport in particular geographical areas, as it is happening now.

However, finding causality is a challenge for future research. If, however, research proves that access to transportation determines the factors that determine quality of life, then this would be a strong argument for policy makers. Subsidies for the public transport system and the development of infrastructure could raise the parameters of the quality of life of the population, especially in those regions where these indicators are poorer.

One of the research methods could be a longitudinal study, choosing as the research region the one in which interventions in the development of public transport infrastructure and greater subsidization have been carried out. If the results of the study show that the investment led to an increase in quality of life and accessibility to the public transport, then causality could be proven.

It is also important to mention, that results show us, that in areas where is absence of public transport near to 4/5 of populations is using private cars. Research was carried out in Lithuania, where average age of the car is 14,3 year and there are no significant taxes that prevent of spreading automobilization. So, scarcity of public transport is easily replaced by private vehicles, but it could be a matter just in those countries, which has similar low taxation regime for using cars. If country will implement limitation of acquisition and usage of private vehicles by regulatory burdens or emission-based taxation, the presented survey model could show much higher relations between public transport accessibility and quality of life standards. Taxation for using of cars is started in Lithuanian since July 2020, right after the data from the survey was collected. CO_2 tax at EU level since 2023 was announced by the President of European Commission. Conducting a similar study in a country

where the public transport supply is significantly higher would also provide valuable conclusions. It would be especially important to compare the strength of the correlation between the availability of public transport and the quality of life in the case of Lithuania and a country with a larger supply of public transport.

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