Sustainable City Mobility—Comparison of Actual State in Selected European Countries

Joanna Oleśków-Szłapka, Irena Pawłyszyn, Francesco Facchini, Agnieszka Stachowiak, and Ana Paula Tanajura Ellefsen

Abstract The topic of green mobility is very interesting and indispensable to consider due to European policy and climate changes. Cities are now actively starting to address these issues by implementing a range of different strategies, such as bringing in congestion charges and parking fees to internalise the negative impacts of transport (E. Commission in How can cities address future mobility challenges? 2019), improving and promoting the use of public transport (PT), encouraging non-motorised transport with dedicated pedestrian-bike paths, and restricting the access of certain vehicles to the city centre. The main objective of hereby chapter is to evaluate actual state in terms of green mobility in selected European countries such as Poland, Ukraine, Italy and Norway. Authors endeavor to assess the availability, comfort, technical condition, safety, environmental friendliness, amenities in the cities from the point of view of existing public transport such as trams, buses, urban scooters, city bikes, electric kick scooters, carsharing.

Keywords Green mobility · Sustainable transport · Urban transportation · Mobility solutions · Sustainability

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1 Introduction

City logistics covers all activities in the urban agglomeration supported by modern information systems, which aim to improve the network of goods and information flow. Activities implemented under its assumptions place great emphasis on both the economic and ecological aspects of the expected effects. The tasks of urban logistics include reducing the number of cars on the streets, reducing exhaust emissions or choosing optimal routes and frequencies for public transport, taking into account various social events.

Transportation is one major source accounting for nearly a quarter of Europe's total greenhouse gas emissions and is the main cause of air pollution in cities (E. Commission 2016). Reducing fossil fuel-based travel is therefore crucial for both the local and global climate and has become a major policy objective for national- and city- governments across the globe (Moran et al. 2018).

The importance of green mobility is underscored in the 2030 Agenda for Sustainable Development, the Paris Agreement on Climate Change, and the New Urban Agenda. Green mobility is a broad concept that aims to simplify a diverse set of environmental impacts caused by the transport sector. Many countries are already taking climate change mitigation seriously through transport system improvement. However, climate action in the transport sector still has a long way to go.

Green and sustainable cities present fundamental opportunities to both apply new technologies (such as public transit, district heating, and green building and design) and bring about major lifestyle changes (such as walking, bicycling, and reductions in consumption).

There are, in fact, many different terms used today in discussing efforts to reduce environmental impacts and to live more lightly on the land. Sustainable development, sustainable communities and sustainable cities are a few of these terms (Beathley 2000).

One increasingly popular shared mobility service is bike sharing and such systems have appeared in cities across the world as a green transportation measure (DeMaio 2009; Shaheen et al. 2013; Fishman 2016; Pucher and Buehler 2017; Hamilton and Wichman 2018).

The main objective of hereby chapter is to evaluate actual state in terms of green mobility in selected European countries such as Poland, Ukraine, Italy and Norway. Authors endeavor to assess the availability, comfort, technical condition, safety, environmental friendliness, amenities in the cities from the point of view of existing public transport such as trams, buses, scooters, city bikes, electric kick scooters etc.

Authors compared city mobility in selected European cities such as Poznan (Poland), Bari (Italy), Oslo (Norway) and Lviv (Ukraine) based on primary and secondary sources of data.

The authors of the article conducted research to answer the following research questions:

RQ1: What means of transport are used the most common in analyzed cities?

RQ2: Do the respondents in the analyzed cities use green transport?

RQ3: What factors influence the choice of a particular means of transport?

Poznan is a city located in central-western Poland in the Greater Poland Lakeland, on the Warta River. It is the capital of the Greater Poland Voivodeship and the Poznan County. It is inhabited by 538,6 thousand people, which makes it the sixth largest city in Poland and the fifth largest in terms of population. Collective public transport in Poznan and the Poznan agglomeration is organized by the City Transport Board (ZTM). The main operator in the city and the surrounding area that provides bus and tram transport services is Miejskie Przedsiębiorstwo Komunikacyjne sp.z o.o. (MPK). The rolling stock belonging to MPK consists of 221 tram sets and 311 buses. Currently, the authorities of the city are implementing the "City of Poznan Cycling Program 2017–2022 with a perspective to 2025", which aims to improve the movement of cyclists and increase the interest of residents in the daily use of bicycles. The plan includes, inter alia, the construction of new bicycle routes, Bike & Ride parking lots, the extension of the Wartostrada, as well as education and promotion for conviction to ride a bicycle.

Lviv is a city located in the west of Ukraine. It is an important industrial centre, an air, rail and road hub. Lviv is the seventh largest city in the country (724.713 people) and is considered as a centre of western Ukraine. There are 4 types of public transport in Lviv: tram, trolley bus, bus and small urban buses (so-called marshrutka).[1] In 2017, the number of public transport vehicles was 631, but the strategy of developing city transport by the end of 2020 assumed an increase in the rolling stock to 730 vehicles, which is expected to result in an increase in transport capacity from 127,680 to 196,840 passengers. The bus transport system in Lviv creates 7 radial bus routes and 45 circular routes. Radial routes connect the outskirts of the city with the central ring and are served by buses with high and very high capacity. Circular routes, in turn, connect the city's outskirts. The capacity of buses serving these routes is 35 people. In total, the city supports 575 buses. In addition to bus lines, the city has 11 tram lines and 9 trolleybus lines. The demand for electric transport has increased in recent years. While building the *Strategy for the development of public transport*, the city authorities plan to implement systems enabling the purchase of an electronic ticket, creating a Park & Ride point on the radial end loops, increasing the share of public transport in the city's road traffic and limiting traffic in the centre of Lviv. A bicycle rental service has also appeared in the city since 2016.

Bari is a big port city on the Adriatic coast; the capital of the Italian region of Puglia. The city itself has a population of 320,257 inhabitants. Within Bari city itself there are urban buses services operated by a municipalized company, founded in 1965, called AMTAB. The company has a fleet of 234 buses, most of them powered by diesel, only a part (less than 20%) is powered by methane (Hosseini et al. 2019). Starting from 2020 will be included 2 electric buses. The average age of the available buses is around 10 years. There are 39 lines allow to serve 303 km, in last year around

[1] Marshrutka—is a small bus, designed to carry 9–20 passengers, not including the driver.

25 million of the persons were transported. According to last 'Urban Sustainable Mobility Plan', around 74% of people prefer private car or motorbike (52% and 22%, respectively) for move around the city, 18% of person prefer the public transport, and 5% of person adopt private bikes (Carli et al. 2015). Currently, only a 3% of persons in Bari adopt the service like bike-sharing, for this scope in last three years (2017–2019) 135 e-bikes have been provided by municipality of Bari (Ranieri et al. 2018; Digiesi et al. 2017). The carsharing service, provided by a national public company (ACI), was started in 2017, when the city received a fleet of 10 electric cars. The town of Bari promotes the use of bicycles, an eco-friendly means of transport that is both fast and efficient, through Bike Sharing (Barinbici), a bike rental service located in different locations around the city. The "Cicloattivi and the University" (biking) is a project promoted by the Puglia region and allows university students to rent folding bikes for a year, as well as promoting sustainable mobility and intermodal transport by both train and bus.

Oslo is an old town, but a relatively young city, and it has developed extensively in twentieth century as Norway has urbanized. In 2018 the city had a population of 673,469. Oslo has made generous use of fossil fuel dependent transportation technologies to access ever larger hinterlands in search of space for populations. Thanks to its green reputation, the city has won two prizes from the European Union for developing as a green city (Luccarelli and Røe 2013). This is a city with ambitious environmental targets aiming at reducing greenhouse gas emissions by 50% within 2030 (Plansamarbeidet 2015). Oslo has had a bikesharing scheme since 2002 (Alvik 2009). City council's proposition suggests several measures for the various municipal sector programs. For the transport sector, the most important measures are to ensure transition from individual car transport to public transport, increased cycling and walking. Public transport in Oslo is coordinated by Ruter AS and constitutes a network of travel possibilities by train, tram, subway, bus and boat almost 24 h per day. By 2020, public transport in Oslo will only use renewable energy. After that, all city buses will also have the Euro VI standard on their engines, which will significantly reduce both noise and local pollution. All public transport in the Oslo metropolitan area must be emissions-free by 2028 (Oslo Komune 2020).

2 Methodology

Authors will utilize following embedded case study methodology and survey research: statistical analysis (sampling scheme), developed survey questionnaire, applied survey and analysis of the results.

Based on obtained results chapter presents a comprehensive analysis and indicate future actions in order to increase green mobility and sustainability of city means of transportation. Authors try to point out how to boost the competitiveness of transport industries in selected European countries and how to achieve a city transport system

that is resource-efficient, climate and environmentally friendly, safe and seamless for the benefit of all citizens and society.

Questionnaire developed by authors consists of 64 questions including respondent's particulars.[2] The main section comprises questions with respect to means of transportation, available public transport options in given city and assessment of time, cost, distance of public transport. The other sections are divided dependent on particular means of transportation such as urban bikes, public transport (buses/trams etc.), carsharing, electric kick scooters, small urban buses, urban scooters and other means of transportation. Most of questions use Likert scale – five-point agreement scale used to measure respondents' agreement with a variety of statements by means of unipolar scales.

2.1 Research Results

As a result of the survey, which was conducted at the turn of January and February 2020, over 2000 responses were obtained from all analyzed cities. The respondents to whom the survey was addressed are young people (over 97% of respondents are people under 25 years of age) studying at universities. About 26% of respondents are also employed. In terms of gender, 45% of women and 55% of men took part in the survey. The results of the collected responses of the respondents are presented below.

The first question of survey asked the respondents what means of communication they use most often. Respondents could indicate several means of transport which they most often use on a daily basis. The Fig. 1 shows the distribution of respondents' answers. It can be seen that young people from Poznan, Lviv and Oslo most often choose public transport, i.e. trams, buses and trolleybuses, as the main means of transport (Poznan—almost 95% of respondents; Lviv—91% of respondents, Oslo—73.7% of respondents).

Students from Lviv also often use marshrutkas (small urban buses), which are also part of public transport (38% of respondents). Just over 10% of respondents from Poznan, 3% of respondents from Bari and 1.6% of respondents from Lviv use city bikes. Only 4.5% of respondents use electric kick scooters available in Poznan, currently such means of communication is not available in Lviv, Oslo and Bari. Lviv, Bari and Oslo are also not equipped with urban scooters. On the other hand, In Poznan only 0.5% of respondents use them. Therefore, the conclusion is that the use of city bicycles, electric kick scooters or urban scooters is poorly developed in the analyzed cities, and therefore more attention should be given to them in the context of their development and promotion. On the contrary, data from secondary sources show that the city bike network in Oslo is very well developed, which makes it possible

[2]In this article, the authors will present selected questions from the survey and throw spotlight on the results obtained.

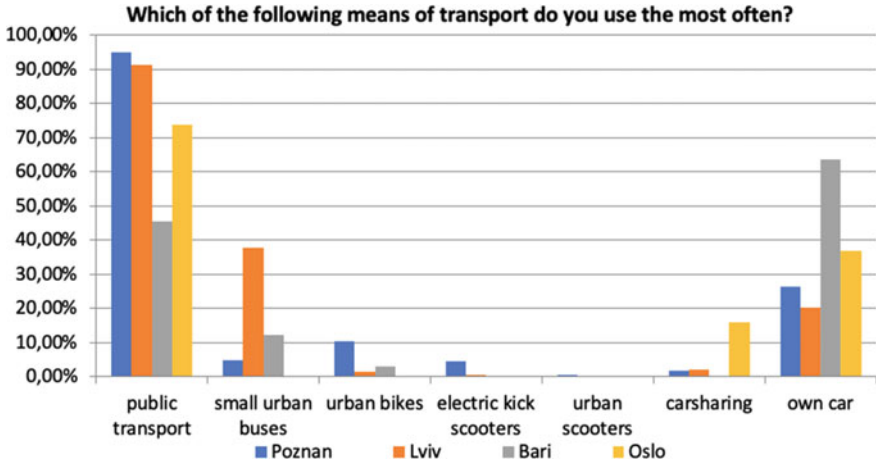

Fig. 1 The distribution of answers on question 1. (*Source* Own elaboration)

to conclude that respondents prefer other means of transport or their own bicycles instead of city bikes.

In Oslo quite big number of respondents (15.3%) use carsharing whereas Poznan and Lviv have a similar level of carsharing (around 2%). In Bari such service is not used by interviewees. It should be noted that in Bari the highest number of respondents (i.e. 63.3%) indicated their own car as the most preferred means of transport.

A fairly large group of respondents, as in Oslo, Poznan and also in Lviv prefer to travel by their own car (36.8%, 26.3% and 20.3% respectively).

The second question concerned the recognition of which of these means of communication are actually available in specific cities (Fig. 2). Respondents from Poznan, Oslo and Bari indicated that all suggested types of communication are available in the city, but there are no marshrutkas in these cities. Most likely, they confused the means of transport with ordinary buses. This means that the question posed has not been formulated precisely enough. A similar situation occurred in the case of Lviv, Oslo and Bari, where there are no urban scooters and electric kick scooters rental points and which, apparently, were treated as privately owned means of transport.

Third and fourth question in the survey verified how many respondents spend time on commuting every day (Fig. 3a), as well as what average distance they travel each day (Fig. 3b).

Figure 3a shows that almost 63% of respondents from Poznan require up to 1 h for travel time every day, and about 32% of those surveyed spend 1–2 h on travel. In Lviv, near to 73% of respondents devote up to 1 h commuting time and about 24%—up to 1–2 h. In Bari and Oslo also most of the respondents spend to transport up to 1 h (respectively near to 52% and 69%).

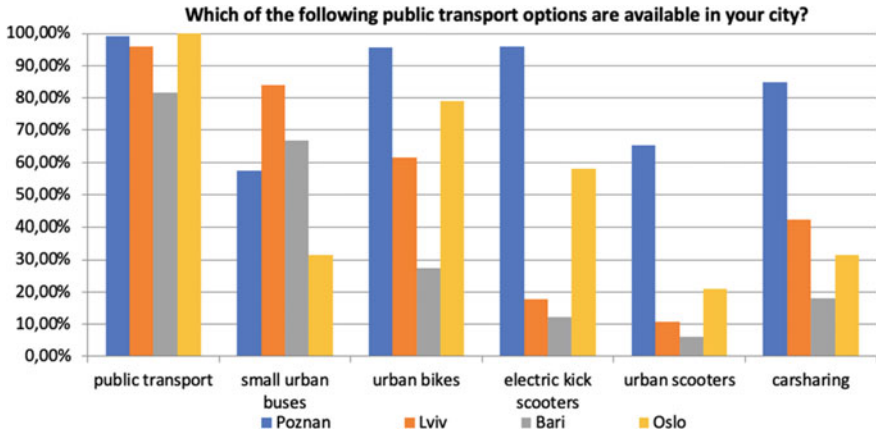

Fig. 2 The distribution of answers on question 2. (*Source* Own elaboration)

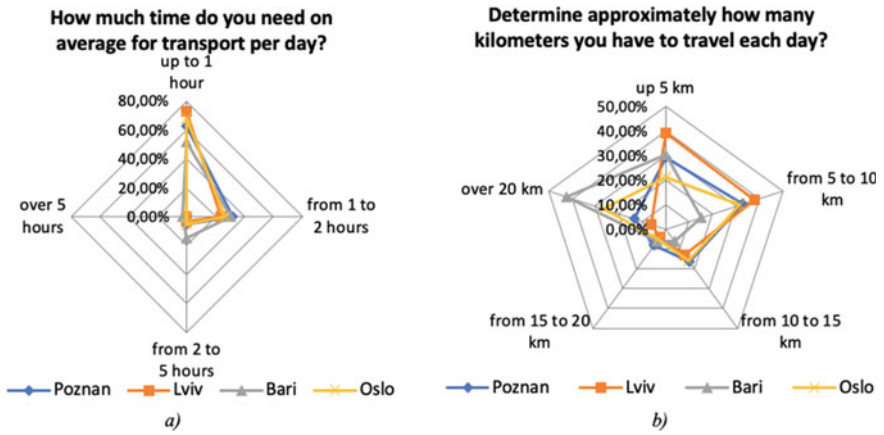

Fig. 3 The distribution of answers on questions 3 and 4. (*Source* Own elaboration)

In turn, Fig. 3b shows that just over 29% of students from Poznan travel daily up to 5 km, 33%—from 5 to 10 km/day and 16.4%—from 10 to 15 km/day. Quite a large group (13.4% of respondents from Poznan) travels over 20 km every day. In Lviv, the situation is slightly different: 39% daily travels up to 5 km, almost 38%—from 5 to 10 km/day and 13%—from 10 to 15 km/day. In Oslo, the results obtained are very similar to the situation in Poznan.

In Oslo, the results obtained are very similar to the situation in Poznan, solely more people travel more than 20 km a day (26.3% of respondents). In Bari, a smaller number of respondents have to pass a distance of 5–10 km (about 15% of respondents) and most surveyed have to travel more than 20 km (almost 43% of respondents).

The above results may be dictated by the fact that Poznan is a more geographically spread city compared to Lviv, and therefore students are forced to travel a greater distance. Whereas In Bari and Oslo students commute to studies from districts and smaller villages outside the city centre, which is confirmed by the results obtained.

In the next—***fifth—question*** authors asked what is the average monthly amount of charges incurred for transport. In Poznan students pay monthly near to 13.5 EUR (56 PLN), in Lviv 10.47 EUR (290.29 UAH), in Bari 40 EURO and in Oslo 82.36 EUR (959 NOK). Comparing the costs to average wages in individual countries, it should be noted that the costs dedicated to communication in Poznan constitute 1.4% in relation to the net remuneration in Poland (average monthly salary in 2019—962 EURO). In Lviv these costs amount to 2.75% compared to the net salary in Ukraine (average monthly salary in 2019—381 EURO). In Bari it is 3.24% respectively (average monthly salary in 2019 in Italy—1233 EURO) and in Oslo—2,72% (average monthly salary in Norway in 2019—3033 EURO). It can be seen that the highest percentage of costs is paid by Bari respondents. Students from Lviv as the second in a comparative analysis pay a fairly large percentage of transport costs. Oslo ranks third in this respect and the smallest percentage of communication costs in relation to average earnings is paid by respondents from Poznan.

The ***sixth question*** refers directly to public transport, and more precisely—the frequency of its use by respondents. Figure 4 shows that 98.25% of people use Poznan trams and buses. Similarly, in Lviv, 96.41% of people use trams, trolley buses and city buses, and almost 81% of respondents use marshrutkas. In Oslo public transport is mainly used by 84.21% of respondents. In the contrary in Bari the percentage share of student commuters using public transport is much lower (48.48% of respondents).

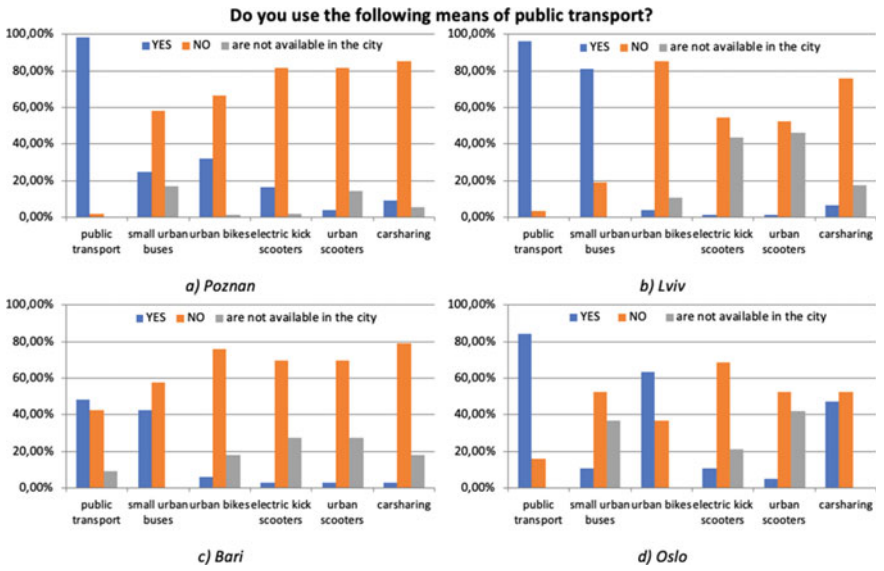

Fig. 4 The distribution of answers on question 6. (*Source* Own elaboration)

A significant difference can be seen in the case of city bikes, which are used by 63.16% of respondents in Oslo, 32.13% of respondents in Poznan and only 6% in Bari and less than 4% in Lviv. 16.62% of students in Poznan use electric kick scooters. The obtained research results draw attention to the need to develop particular types of communication, as it will directly contribute to the development of green mobility in the city. Less than 4% of respondents use urban scooters in Poznan, and 9.15% carsharing. The carsharing has generated small interest among Lviv students and Bari students alike (6.37% and 3.03% respectively). Such mode of transport is not popular because of its cost. On the other hand, 47.37% students from Oslo indicated that they use carsharing. It may also be dictated by the better financial standing of students in Norway.

Figure 5 is the answer to the ***seventh question***—how often do people use public transport? An analysis of the answers obtained indicates that in Poznan 66.41% of respondents use public transport every day, and 22.51% use it at least several times a week. 1.34% and slightly more—2.68%—ride a city bike ride in Poznan every day, several times a week. Almost 95% of respondents from Poznan have never used urban scooters, less than 90% have never used carsharing, almost 77% have never used electric kick scooters and almost 60% have never used city bikes. In Oslo similar to Poznan near to 60% of respondents use public transport every day. In the contrary in Lviv, none of the respondents use city bikes every day, rather young people use a given means of communication several times a month (5.58%) or several times a year (9.56%). In Bari solely 18.18% of respondents use public transport every day and 36,36% surveyed have never used such means of transportation.

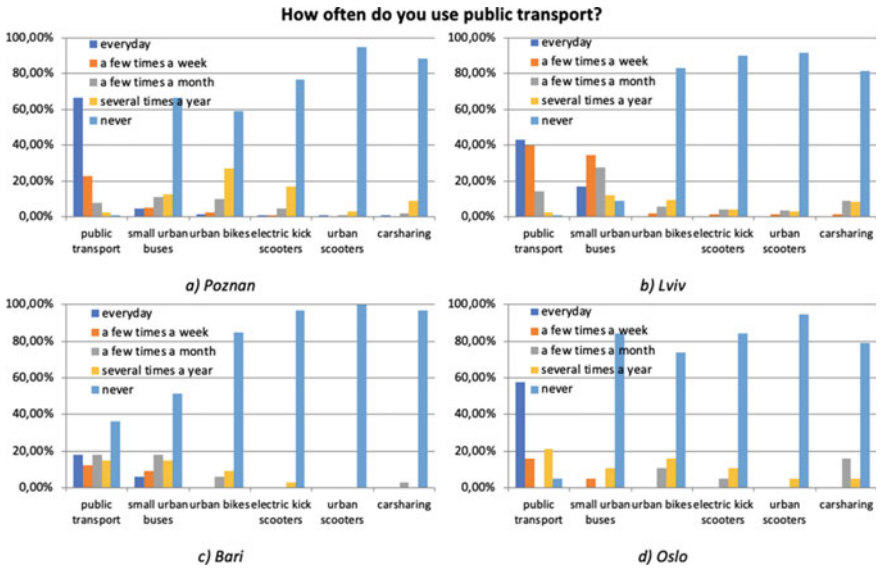

Fig. 5 The distribution of respondents in question 7. (*Source* Own elaboration)

In Lviv, hardly more than 43% of respondents use public transport and 17,13% of respondents use marshrutkas every day. Several times a week, almost 40% of people use public transport, while 34.66% use marshrutkas. Almost 83% surveyed have never used urban bikes in Lviv and 81,27% have never used carsharing.

Respondents were also asked about the reasons for not using certain means of communication. Among the reasons for not using city bikes, respondents in Poznan most often indicated a complicated procedure for renting them (25.8%), lack of comfort (19.9%), too long distance to travel (19.2%) and a high price for the service (17, 9%). In Oslo 66,7% prefer different mode of transport. The other reasons they mentioned: too long distance to travel (40%), bad infrastructure of urban bike paths (26,7%), lack of comfort (26,7%), travel time too long (20%). Lviv respondents pointed out that the lack of use of city bikes is primarily related to poor cycling infrastructure (35.8%), lack of comfort (27.6%), lack of safety (21.1%) and too long distance to travel (20.7%). In Bari the most important obstacles to use city bikes are as follows: prefer different mode of transport (14.8%), too long distance to travel (16.8%), bad technical condition of city bikes (22.2%), complicated procedure for renting them (14.8%). On the basis of above results, it can be seen that students do not prefer city bikes due to lack of comfort and too long distance to travel.

The lack of use of electric kick scooters in Poznan is primarily due to the excessive price (57.3%), lack of comfort (23.8%) and lack of safety (20.8%). Regarding the last reason, the respondents have repeatedly indicated that there are no clear rules regarding how to move the scooter around the city. Exactly the same hierarchy of answers was obtained by the reasons for not using urban scooters in Poznan (25.5%, 20.9% and 16.1% respectively). People who do not use carsharing in Poznan indicated that the price of a given service is too high (50.8%), rental rules are risky (39%) and that the rental procedure is too complicated (19.9%). In Oslo 14,3% of respondents also agreed that rental procedure is too complicated. Almost 43 students in Oslo prefer different mode of transport and 7% of them do not have driving license. In Lviv, respondents also do not use carsharing, because they think the price is too high (58.3%), the rules for renting a car are risky (30.1%), and the renting procedure is too complicated (28%).

It should be mentioned that in all cities respondents clearly see the prospects for the development of such public transport as bicycles, electric kick scooter or urban scooters.

The eighth question was asked to indicate the level of satisfaction of respondents with the use of specific means of transport (Fig. 6). It can be seen that the use of public transport in Poznan is rated. Almost 35% of respondents assess their level of satisfaction as average for the use of trams and buses. In turn, 52.88% of respondents are satisfied with the use of city bikes, and 38.12% are average satisfied with the use of a given means of transport. 55.04% of respondents indicate that their level of satisfaction with the use of electric kick scooters is high or very high, while little above 32% of respondents define this level as average. For urban scooters, the figures are: 52.45% - satisfied and very satisfied, 29.37% - average satisfied. With regard to carsharing, almost 64% of respondents described their level of satisfaction as high/very high, and 26.32% as average. It should be noted here that for any means

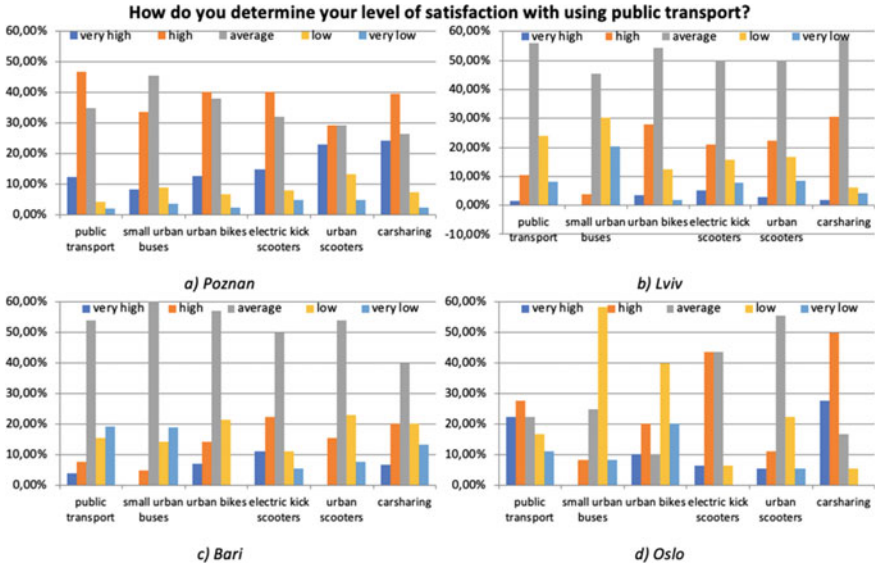

Fig. 6 The distribution of answers on question 8. (*Source* Own elaboration)

of communication the "very low level of satisfaction" option did not exceed even 5%, and the "low level of satisfaction" option—9%, except for city scooters, which received 13.29% of respondents' answers in a given option. This means that travelers are generally satisfied with the available means of transport in the city of Poznan. It is also interesting that public transport received the smallest percentage of negative answers—6.14% (the sum of the answers "low level of satisfaction" and "very low level of satisfaction").

In Lviv, public transport is rated at an average level of satisfaction—55.82% of responses. At a high and very high level, it was rated by slightly over 12%. Even less respondents are satisfied with the use of marshtrutkas—3.9% satisfied and 45.45% average satisfied with traveling on a given means of transport. For city bikes, the satisfaction level reaches 31.58% (the sum of "high" and "very high"). In turn, 54.39% of respondents indicated that they are average satisfied with their use. On the other hand, carsharing shows 32.65% satisfied users and 57.14% average users. Respondents indicate that over 32% are not satisfied with the use of public transport (the sum of "low" and "very low" responses), and more than 50% of respondents are not satisfied with the use of small urban buses (the sum of "low" and "very low"). The results are a signal as well as a direction of development which the city government should focus on.

In Bari the majority of respondents evaluate all means of public transport at average level (public transport—near to 54%, urban bikes—57%, carsharing—40%) Only about 11% of surveyed students are satisfied with using public transport at very high and high level and almost 35% is not satisfied (sum of results "low" and "very low). Similar answers can be observed for carsharing (33% of surveyed students).

From the other hand 6,67 of respondents if very high satisfied and 20% of respondents is high satisfied using carsharing services. The number of answers placed in the middle of the rating scale indicates great opportunities to improve the current level of satisfaction.

In Oslo comparing to other cities the level of satisfaction is the highest. Public transport obtained almost 50% of satisfied answers indicating "very high" and "high" options. 30% of respondents is also satisfied with using city bikes and 77,78% of respondents is satisfied with carsharing services. In both cases the sum of "high" and "very high" answers is taken into account. The number of received responses can on the one hand confirm the quality of transport services offered in Oslo as well as be proof of the level of life satisfaction among students in Oslo.

The goal of the ***ninth question*** was to identify the most important advantages of different modes of public transport (Fig. 7). In Poznan the respondents indicated that public transport's (i.e. trams and buses) biggest advantages are: accessibility (18.17%), price (65.25%) and travel time (49.56%). As the fourth criterion, the respondents distinguished health and ecology (25.66%). Speaking about city bikes, the respondents consider health and ecology (44.43%), accessibility (31.55%) and price (25.95%) as the biggest advantages. In turn, the biggest advantages of electric scooters are accessibility (23.62%), comfort (18.72%), health and ecology (17.90%) and travel time (17.84%). Poznan respondents use scooters because of travel time (12.71%), comfort (11.37%) and accessibility (8.1%). Carsharing is chosen primarily for comfort (23.44%), privacy (19.94%) and travel time (12.01%).

In Lviv, the biggest advantages of public transport are the price (65.34%), accessibility (60.16%), comfort (36.65%) and travel time (27.49%). Marshrutkas are

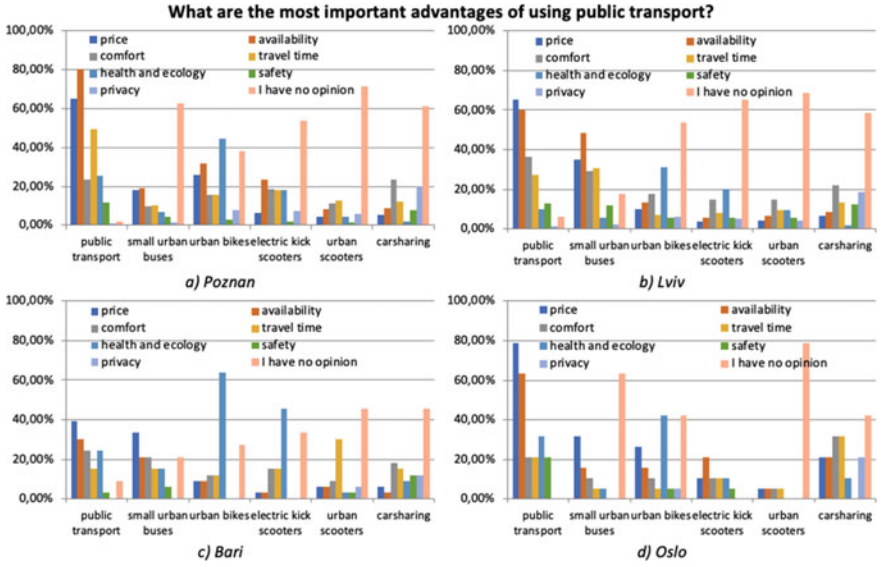

Fig. 7 The distribution of answers on question 9. (*Source* Own elaboration)

chosen primarily for their availability (48.61%), price (35.06%), travel time (30.68%) and comfort (29.08%). Respondents use city bikes because of their health and ecology (31.08%), comfort (17.53%) and accessibility (13.55%). On the other hand, carsharing services in Lviv were used for the same reasons as in Poznan: comfort (21.91%), privacy (18.73%) and travel time (13.55%).

In Bari the respondents pointed out the most important advantages of public transport: price (39.39%), availability (30.3%), comfort (24.24%), health and ecology (24.24%). Whereas urban bikes and electric kick scooters received the most indications on health and ecology (respectively 63.64% and 45.45%). The travel time and comfort were evaluated at lower level comparing to public transport. (12% for city bikes and 15% for electric kick scooters). Carsharing was evaluated at similar level (from 12 to 18% of respondents) regarding travel time, safety, privacy and comfort. Comparing to Poznan and Lviv price for public transport is recognized as smaller advantage probably due to higher prices for public communication.

In Oslo the most respondents selected price as the biggest advantage for public transport (almost 79% of respondents) despite the fact that in this city prices for public transport are the most expensive. The other circumstances for above transport are availability (63.16% of respondents), health and ecology (almost 32% of respondents), travel time and comfort (both about 21% of answers). The health and ecology for city bikes was chosen by a similar number of surveyed as in Bari and Poznan. Another advantage was price (26.31% of surveyed) and availability (15.79% of surveyed). More respondents than in other cities chose the advantage of comfort for carsharing (almost 32%).

In all cities, the most important advantages of public transport are, therefore, price, availability and travel time, bicycles as a means of transport are chosen primarily for health and environmental reasons, and carsharing is enjoyed by people who value privacy and comfort.

Owing to the ***tenth question***, it was possible to obtain information on how respondents assess the technical condition of individual means of communication (Fig. 8). The condition of Poznan trams and buses is rated as good by 33.20% of respondents and rather as good by 51.08% of respondents, which in general constitutes nearly over 84% of positive answers. The condition of city bikes in Poznan is assessed as good by 19.79% of respondents and by 40.28% of respondents as rather good. The distribution of answers regarding the electric kick scooters indicated 27.41% of satisfied users and 42.07% of rather satisfied users, respectively. Subject to urban scooters (it should be mentioned that this is the mode of transport that is least often used by respondents in Poznan) the percentage of the highest indications is about 32.97% and the percentage of "rather good" answers is 34.41%. The technical condition of shared cars is evaluated as good by 46.13% of respondents and rather good by 32.87% of respondents. City bikes received the largest percentage of negative responses (16%). Therefore, one should pay attention to a given means of communication, because poor condition of bicycles may lead to a collision or accident of road users.

In Lviv, the situation is as follows: the technical condition of public transport is assessed as good in 5.65% of cases and in 30.24% of cases as rather good. The sum of positive answers is therefore less than 36%. The technical condition of marshrutkas

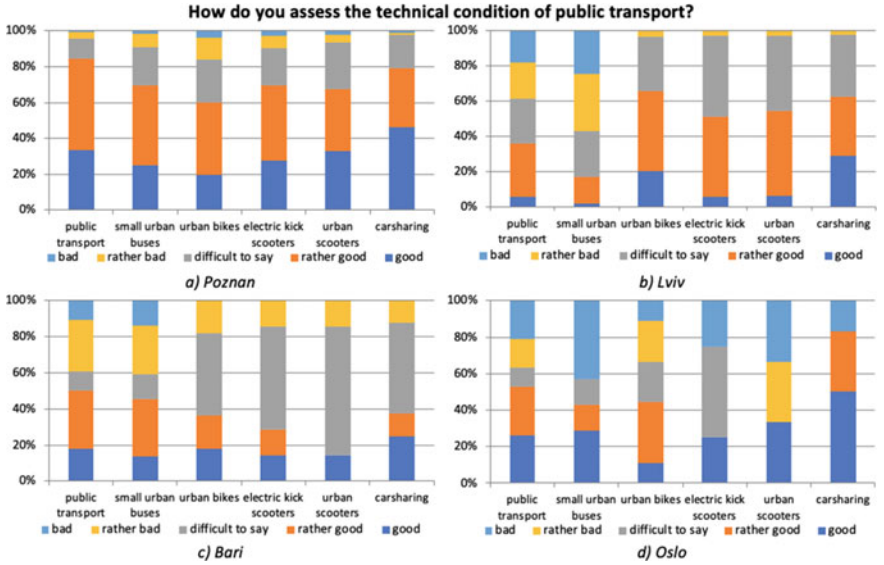

Fig. 8 The distribution of answers on question 10. (*Source* Own elaboration)

is the worst of all these types of communication in Lviv. Only 2.16% of respondents indicated good technical condition of vehicles and less than 15% indicated rather good condition, which in total gives less than 17% of positive opinions. The technical condition of city bikes is definitely better, as 20.31% of respondents indicated that they rated their condition as good, and 45.31%—rather good, which gives 65.63% of positive responses. The condition of rented cars in carsharing is also positive: 29.17% of respondents rated their condition as good and 33.33%—rather good. City authorities should devote considerable attention to the technical condition of public transport, as well as small urban buses, since it is the latter means of transport which has obtained the largest percentage of negative responses (56.71%).

In Bari almost 18% of respondents assess technical condition of public transport as very good and 32.14% as rather good. On the other hand, the similar number of answers select condition rather bad and bad (28.57% and 10.71% respectively). Considering urban bikes 45.45% of respondents cannot decide how to evaluate their technical condition. At the same time 36% of surveyed think that this condition is very good and good. None of respondents suggest that technical condition of urban bikes and carsharing is bad. Almost half of research sample cannot decide how to assess the technical quality of carsharing. This distribution of answers may result from the number of respondents who do not use selected means of transport, preferring their own car.

In the last of the cities surveyed (Oslo) more than 50% of respondents recognized a technical condition of public transport as good and rather good but also nearer to 36% evaluate this condition as bad and rather bad. This may be due to the varied technical condition of different vehicles in public transport. City bikes according to

surveyed are in a good condition (25% of respondents) and simultaneously in a bad condition by the same number of respondents. The better situation is for carsharing, 50% of respondents evaluate its technical condition as good and 33.33% as rather good.

In each city, the technical condition of the available urban mobility modes should be analyzed and, if possible, dependent on technical resources further improvements should be done.

The last ***eleventh question*** that the authors will present under this article will be the assessment of the amount of fees for individual means of communication (Fig. 9). 35.2% of Poznan users determine that the prices of city buses and trams are high or very high. Prices are medium for more than half of users (51.23%). As for city bikes, in 17.47% of cases, fixed usage prices are perceived as high or very high, and in 41.45% of cases—as medium. Poznan respondents estimate the prices for renting scooters and scooters as definitely too high (81.53% and 68.38% respectively of the indications "very high price" and "high price"). This confirms the previously presented information on the reasons for not using the means of transport. The fee for car renting is also considered as too high (67.90%).

Lviv public transport is rated as expensive or very expensive in 35.89% of cases. Over half of the respondents (52.82%) determine public transport charges at medium level. In the case of small urban buses, 48.7% of users indicated that the charges for a given means of transport are high or very high. 48.44% think marshrutkas charges are moderate. For bicycles, just over 40% of users' prices are too high or high, and 48.44% see them as medium. Carsharing is perceived as the most expensive in Lviv, where exactly half of the respondents consider car rental too expensive or expensive,

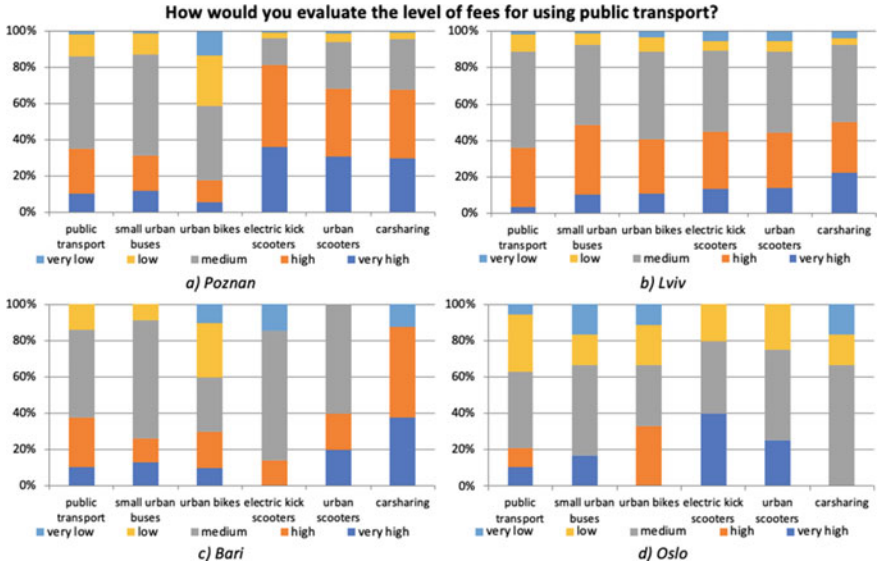

Fig. 9 The distribution of answers on question 11. (*Source* Own elaboration)

and 42.59%—as medium. At this time, information about the reasons for not using carsharing in Lviv due to the high price of the service is also confirmed.

From Bari respondents' point of view the fees for public transport are very high (10.34%) and high (27.59%). At the same time 48.28% of them perceive these fees as medium. The answers for city bikes are divided in very similar proportions: 30% of respondents assess fees as high and very high, medium and low. The fees for carsharing are definitely too high (37.5% of respondents—very high, 50% of respondents—high).

In Oslo almost 20% of respondents perceive fees for public transport as very high and high. Whereas by 42% of respondents their level is medium and by 31.58% of respondents is low. Urban bikes' fee by more than 60% of surveyed are assessed as high and medium (in each group 33% of answers). The level of fees was assessed as low and very low: for carsharing by 33% of respondents, urban scooters by 25% of respondents, city bikes by 33% of respondents.

There are many aspects that can affect the assessment of the price level of various means of public transport in the cities analyzed. Therefore, detailed conclusions depend on the level of earnings, correlation between the frequency of journeys and the distance to overcome. The above results show that in Italy and Norway prices are generally perceived as lower compared to Poland and Ukraine, which may be conditioned by the social status of citizens. The exception is the assessment of carsharing services in Bari.

3 Conclusions

Summing up the results of the conducted analyses, it should be stated that the most common means of transport used by respondents of the surveyed countries is public transport. Similarly, a large proportion of people prefer their own means of transport. Further research directions should include verifying the criteria encouraging owners of their own vehicles to switch to public transport, including bicycles or scooters.

Research also indicates that a significant proportion of respondents never use green transport such as bicycles or electric kick scooters. This is dictated by the lack of services in the city, or a weak marketing campaign encouraging potential users to use the given means of transport. Interestingly, one of the problems with using such services is, according to respondents, the complicated procedure for renting a bicycle or electric kick scooter. The request is a signal to the city authorities to work on simplifying such procedures as well as explaining on a larger scale how to rent a specific means of transport.

Review also reflects the need to modernize transport rolling stock in three of the surveyed cities, as respondents show average satisfaction with its use. Despite this, respondents distinguish the price as the main advantage of public transport in all countries. At this point, further research directions could include queries regarding users' consent to temporarily increase prices for public transport in order to modernize transport rolling stock.

Positive in all four cities is the fact that answerers see opportunities for developing green mobility in their cities. This signals the awareness of the respondents about the impact of transport on the natural environment, so they expect for infrastructural and informational support from the authorities. Public transport showed the most minimal changes, with demand remaining constant over the study period. The main improvements were in technology, such as smart-phone apps to buy tickets and check timetables.

In Italy there are plans underway to develop bike sharing schemes in different cities including Bari, with funding provided by the national government. The environmental benefits of bike sharing are at its best when bike sharing does not substitute walking, cycling or public transport and when it is combined with public transportation in covering the first and last mile of public transportation journeys.

Making cities smarter and more sustainable is a major aim of the European Union. Improving the sustainability of transport is prioritized through measures such as encouraging cycling, improving public transport and providing incentives for low-emission vehicles.

Bicycle sharing programmes serve as an alternative transportation mode in cities and provide public access to pick-up and drop-off bikes at numerous locations (Shaheen 2010; Kuppusamy et al. 2019). The potential environmental benefit of such programmes is however debated as a considerable number of trips are substituting other green transportation modes and the sustainable impact of bike sharing is argued to be limited (Fishman et al. 2013).

The use of a bicycle for everyday travel is particularly advantageous over short distances. According to research carried out in the European Union, the average distance of most displacements carried out in cities does not exceed several kilometres. At such distances—considering the traffic congestion—a bicycle may turn out faster than a car and public transport. Mobility is one of the most difficult topics to face in metropolitan large areas. It involves both environmental and economic aspects and needs both high technologies and virtuous behaviors' people.

Among the solutions that can improve the conditions of cycling in the city include: creating bicycle paths that run in the field regardless of the road system or within the lane, separating bicycle lanes on the road, separating bus and bicycle lanes, two-way bicycle traffic allowed on one-way streets with limited traffic and speed with the possible separation of a counter-cycle for bicycles, introduction of bicycle locks at intersections with traffic lights, introduction of markings for cyclists (organizational and information), allowing the transport of bicycles in public transport, adaptation of interchanges to leave bicycles in the "park and ride" system, introduction of a city bike rental system.

There is a need to continuously monitor mobility initiatives, for example by using the indicator-based assessment to ensure projects are implemented effectively and to understand what aspects of governance help ensure sustainable-transport schemes are realized.

Transport is one of the most important factors determining the country's economic development. A well-developed transport infrastructure strengthens the social, economic and spatial cohesion of the country and contributes to strengthening the

competitiveness of the Polish economy. Modern infrastructure and an effective transport system are conducive to the country's economic growth, and the country's location on international transport routes is one of the important competitive advantages. Mobility in urban areas is also an important facilitator for growth and employment and for sustainable development.

The main contribution of this article is the assessment of actual situation in terms of different mode of transport. Authors plan to develop herein research in order to recognize green mobility activities in surveyed cities. Another perspective will be also the evaluation of support given by city authorities and European Union funds. Due to Logistics 4.0 trends it will be valuable to recognize actual trends towards efficient, connected and automated transport systems that are sustainable, safe and accessible for all citizens.

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