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Daily Trips Characteristics in Novi Sad – Gender Differences

Ana VUJIČIĆ[1], Valentina MIROVIĆ[2], Jelena MITROVIĆ SIMIĆ[3], Nenad RUŠKIĆ[4]

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[1] ana.vujicic@uns.ac.rs, University of Novi Sad, Faculty of Technical Sciences, Department of Traffic Engineering
[2] plast@uns.ac.rs, University of Novi Sad, Faculty of Technical Sciences, Department of Traffic Engineering
[3] mjelena@uns.ac.rs, University of Novi Sad, Faculty of Technical Sciences, Department of Traffic Engineering
[4] nruskic@yahoo.com, University of Novi Sad, Faculty of Technical Sciences, Department of Traffic Engineering

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ABSTRACT
Modern transportation planning, building and city management tendencies are based on smart and green sustainability. Sustainable mobility and traffic safety can be improved by raising awareness of gender diversity in travel behaviour. The city of Novi Sad (Serbia) has had a tradition of traffic surveys for about 50 years. All measures for improvement of traffic in the city are based on this research. Travel characteristics in the city regarding gender differences are the source of different data, which can be based on sustainable urban mobility plans, transport demand management and gender equality levels. This paper analyses mobility, modal split and distribution by travel reason as a function of gender. Results were gathered using travel diaries (collected by household surveys) in the Smart plan of Novi Sad. The discussion is based on a descriptive analysis of the basic travel characteristics as a function of gender and a comparison with a previous traffic study – Nostram. The findings of the research indicated that there is a greater prevalence of male employment and higher usage of passenger vehicles among men than among women. Women use alternative modes of transport (walking, public transport and bicycle). Women do not have precise peak hours, while trips are scattered even outside peak hours. Their trips are more related to daily duties than entertainment.

KEYWORDS
gender; surveys; mobility; modal split; trip purposes.

1. INTRODUCTION

The city of Novi Sad (Vojvodina, Serbia) traditionally conducts traffic planning studies while practically managing traffic using the developed transport model NOSTRAM [1]. The current Traffic Study of the City of Novi Sad [2] was carried out in 2017. The data were collected through a series of field surveys. Proposed measures are given in the form of short-term, medium-term and long-term improvements to traffic conditions. These measures were introduced in 2019 from the perspective of sustainability and smart technologies [3]. The basic trip characteristics are trip route (origin-destination), mode of transportation used, trip purpose and trip duration. Mobility is the number of trips made, usually expressed per inhabitant per day. The subject of this paper is gender differences as a function of basic travel characteristics. Data on trips were obtained from household surveys (travel diaries). Differences in trip data were determined in relation to the previous research from the Traffic Study [1], with gender characteristics shown in [4] and [5, 6] by the authors of this paper. The literature in the field of transport planning has recognised this topic as very important for the last 15 years. The data collection methodology, processing and presentation of data in [2] are compatible with the previous Traffic Study from 2009 [1], which made the data comparable. This paper gives a comparison in mobility,

modal split and distribution by travel purpose between men and women. The purpose of this research about gender differences in transportation planning is the foundation for new traffic models or enhancing existing traffic models. Identifying gender differences in fundamental daily trip characteristics aims to improve transportation policies, transportation services and traffic safety.

2. LITERATURE REVIEW

Understanding the needs of different members of society contributes to reducing socio-economic and gender inequality. Research conducted in Serbia (excluding Novi Sad) as well as in the West Balkans region does not have data on the gender difference in travel characteristics. Serbia is the first country outside the European Union, where the gender equality index is calculated, which is 55.8/100 (e.g. the average of the members of the European Union is 66.2/100, while in Sweden, it is 83.6/100, for the period 2018 – 2020) [7], [8]. The United Nations provides the Sustainable Development Goals Agenda until 2030, so over 1,000 actions have been implemented to improve gender equality [9]. These actions are aimed at creating an inclusive and safe transportation environment for everyone, with a particular focus on the needs and challenges faced by women as users or professionals in transportation. The main focus should be on how women can improve sustainable mobility in cities. There are many ways to use alternative modes of transportation (public transport, cycling, car sharing, etc.) and support sustainable mobility policies. For example, in our big cities and also in regional big cities, women can raise awareness about the importance of sustainable mobility within communities and families. Because women are more and more mobile in the 21st century. In the past, women were limited in their mobility (because of unemployment and giving birth to many children). The modal split in the European Union (2020) shows the share of trips (in per cent) for women 46% versus 58% for men in a passenger car as a driver and as passenger (PC-driver and passenger), for public transport (PT) (women 23%, men 18%), on foot (women 19%, men 10%), bicycle (women 9%, men 8%), motorcycle (women 1%, men 3%), other ways (3%, both gender) [10].

Project [11] was published in Serbia in 2019 (2,400 respondents, five cities). The results show that the average mobility for women is 3.8 while for men is 3.6 trips/day. The share of trips (%) by type is: PC-driver (women 16, men 40), PC-passenger (women 16, men 6), PT (women 23, men 14), bicycle (women 6, men 8), on foot (women 39, men 32). Households spend up to 10% of their income (annually) on transportation needs. Children are accompanied to kindergarten/school by their mother (54%), father (26%), family member (18%) and nanny (2%). In Slovenia, the gender focus is more on the field of traffic safety. In Croatia [10], the data were collected as face-to-face interviews by the Institute of Social Sciences “Ivo Pilar” (about mode choices by gender and social characteristics). The results in [12] show that 70% of women travel as car drivers (compared to 84% of men). The remaining 30% of women prefer to use an alternative mode of transport (compared to 16% of men).

The results from German surveys [13] showed the following distribution: participation in trips (%) on foot (women 22.6, men 18.2), bicycle (women 11.4, men 11), PC-driver (women 36.5, men 56.6), PC-passenger (women 23.1, men 8.3), PT (women 6.2, men 5.3). Participation in trips (%) by a purpose: work (women 18, men 22), education (women 6, men 7), accompanying children (women 9, men 7), shopping (women 23, men 18), recreation (women 33, men 31). Results from the Household Survey in Vienna (Austria) [14] show the share of travel (%): on foot (women 31.5, men 24.8), bicycle (women 4.7, men 6.5), motorcycle (women 0.2, men 0.6), PC-driver (women 13.2, men 27), PC-passenger (women 10.9, men 6.3) and PT (women 39.4, men 34.8). Participation in trips (%) by a purpose: work (women 22, men 34), education (women 9, men 10), shopping (25 women, 17 men), recreation (31 women, 30 men). According to research from the National Transport Surveys in the United Kingdom [15], women’s daily mobility is 3 and men’s 2.5 trips/day. Modal split is (%): PC-driver (women 37, men 44), PC-passenger (women 24, men 17). The share of trips (%) by purpose is: returning home (women 15, men 24), work (women 14, men 20), transporting another person (women 11, men 8), shopping (women 15, men 10), education (3 both gender), recreation/going out (women 21, men 19), family care/socialising (women 21, men 17). The share of trips (%) by purpose in Italy [14] is: work (women 21, men 35), education (women 6, men 5), family care (shopping, visiting, etc., women 43, men 28), recreation (women 27, men 30). The results from the Household Survey in Spain [16] show that women’s mobility is 3.7 and men’s 3.5 trips/day. Modal split is (%): PC-driver and passenger (women 39, men 61), PT (women 21, men 9), walking/cycling (women 37, men 25), two-wheelers (women 3, men 5). Distribution of trips (%) for the most common purposes: returning home (45 both genders), work (women 12, men 21), shopping (women 10, men 4), accompanying children (women 6, men 3). The Household Survey in Warsaw

[17] (average mobility 2 trips/day) shows that the highest mobility is achieved by employed women – 2.4 compared to 2.2 trips/day for employed men. Also, female pensioners make 1.5 compared to 1.3 trips/per day/male pensioners. Modal split is: PC-driver and passenger (women 25, men 40), PT (women 52.3, men 40), on foot (women 20, men 15.2), bicycle (women 2,3, men 4). Distribution of trips (%) by most important purposes: returning home (both gender 45), work (women 23, men 28), education (women 5.5, men 6.6), recreation (women 11.8, men 8), accompanying another person (women 14.7, men 11.9). *Table 1* shows data from the Survey by the European Union Research Centre [14], which was conducted to determine the characteristics of the use of passenger cars in modal split.

Table 1 – Results of the survey of the European Commission – The Joint Research Centre (2012) [14]

Country	**Mobility/per day**		**Car usage (day/week)**		**Home-based trips (%)**	
	women	men	women	men	women	men
France	3	2.7	4.6	4.9	26	32
Germany	2.6	2.4	4.5	4.8	33	35
Italy	2.7	2.7	4.1	4.9	32	34
Poland	2.6	2.4	4.8	5	23	29
Spain	2.2	2.4	3.9	4.7	32	32
UK	2.7	2.5	4.3	4.5	29	34

Tables 2 and *Table 3* present a comparison of the research findings on travel characteristics (modal split and purpose of travel) as they relate to gender, as previously mentioned. The available data indicate that women utilise cars as passengers more frequently than as drivers. Additionally, women tend to rely on alternative transportation modes more than men, including public transport, bicycles and walking. Furthermore, women's trips are more likely to be for shopping, recreation, transporting others and family care.

Table 2 – Travel distribution (%) by gender and transport mode according to analysed surveys

	PC (driver)		**PC (passenger)**		**PC (both)**		**Public transport**		**On foot**		**Bicycle**		**Motorcycle**		**Others**	
	W	M	W	M	W	M	W	M	W	M	W	M	W	M	W	M
EU	-	-	-	-	46	58	23	18	19	10	9	8	1	3	3	3
Serbia	16	40	16	6	-	-	23	14	39	32	6	8	-	-	-	-
Croatia	70	84	-	-	-	-	-	-	-	-	-	-	-	-	30	16
Germany	36.5	56.6	23.1	8.3	-	-	6.2	5.3	22.6	18.2	11.4	11	-	-	-	-
Austria	13.2	27	10.9	6.3	-	-	39.4	34.8	31.5	24.8	4.7	6.5	0.2	0.6	-	-
UK	37	44	24	17	-	-	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	39	61	21	9	37*	25*	-	-	3	5	-	-
Poland	-	-	-	-	25	40	52.3	40	20	15.2	2.3	4	-	-	-	-
Canada**	55	75	10	5	-	-	30	15	4	2	1	2	-	-	-	-

W – women; M – men
- No available data
*Including bicycle
**Working trips

Table 3 – Travel distribution (%) by gender and purpose according to analysed surveys

	Work		**Education**		**Accompanying children**		**Shopping**		**Recreation**		**Returning home**		**Transport of another person**		**Family care/ socialising**	
	W	M	W	M	W	M	W	M	W	M	W	M	W	M	W	M
Germany	18	22	6	7	9	7	23	18	33	31	-	-	-	-	-	-
Austria	22	34	9	10	-	-	25	17	31	30	-	-	-	-	-	-
UK	14	20	3	3	-	-	15	10	21	19	15	24	11	8	21	17
Italy	21	35	6	5	-	-	-	-	27	30	-	-	-	-	43	28
Spain	12	21			6	3	10	4	-	-	45	45	-	-	-	-
Poland	23	28	5.5	6.6	-	-	-	-	11.8	8	45	45	14.7	11.9	-	-

W – women; M – men

- No available data

Modal split results for Toronto (Canada) from Travel Diary [18] show that women are passengers in the car in 25% and men in 20% of their school trips. The share of using the school bus is about 20% and walking about 40% of the journey for both genders. The modal split of work trips (%) is: walking (women 4, men 2), cycling (women 1, men 2), PC-driver (women 55, men 75), PC-passenger (women 10, men 5) and PT (women 30, men 15). Research from South America is based on data from the Household Survey [21] from Medel and Bogotá in Colombia and Sao Paulo in Brazil. It has been proven that men make more work trips while women take more trips for shopping. Also, women's journeys are spatially more dispersed in the city areas. Besides that, the results showed that men with a higher income are more mobile than women of the same category.

For the Tokyo region (Japan), online household surveys are conducted every 10 years. The average mobility of women is 3, and of men, 2.7 trips/day. The data shown in the paper [19] showed that the most mobile men are over 60 years old, who live alone or with 1 person (3.25 trips/day), and the least mobile are men aged 25–35 who live in a household with 3 members (2.5 trips/day). On the other hand, women are more mobile if they live with several members. Employed women aged 35–45 make up to 3.5 trips/day if they live with 3 members. Research in the paper [20] shows that women in African and Asian cities have low mobility or do not travel compared to women in Europe, and North and South America. In Africa and Asia, the share of walking in the modal split is up to 60% for women (30% for men). In the cities of South America, the share of public transport is about 30% in the modal split for both genders, while the share of walking is 30–40% for women and 20–30% for men. The share of bicycle trips is high in European cities (presumably due to the climate and relief) and significantly participates in the modal split (10–20% of daily trips for both genders). The share of bicycle journeys in Asian countries is in favour of men, while in Europe, the share of bicycle journeys is equal to or just a bit greater by women (presumably the employment and education levels of women in Europe are higher than Asian or African women). The research [21] showed that in Asian cities, men travel more than 15 and women up to 10 kilometres per day to go to work (or return home). In European cities, the acceptable distance between home and work is 5–10 km for both genders. The average daily travel time for going to work (returning home) is 25–30 minutes for men and about 20 minutes for women.

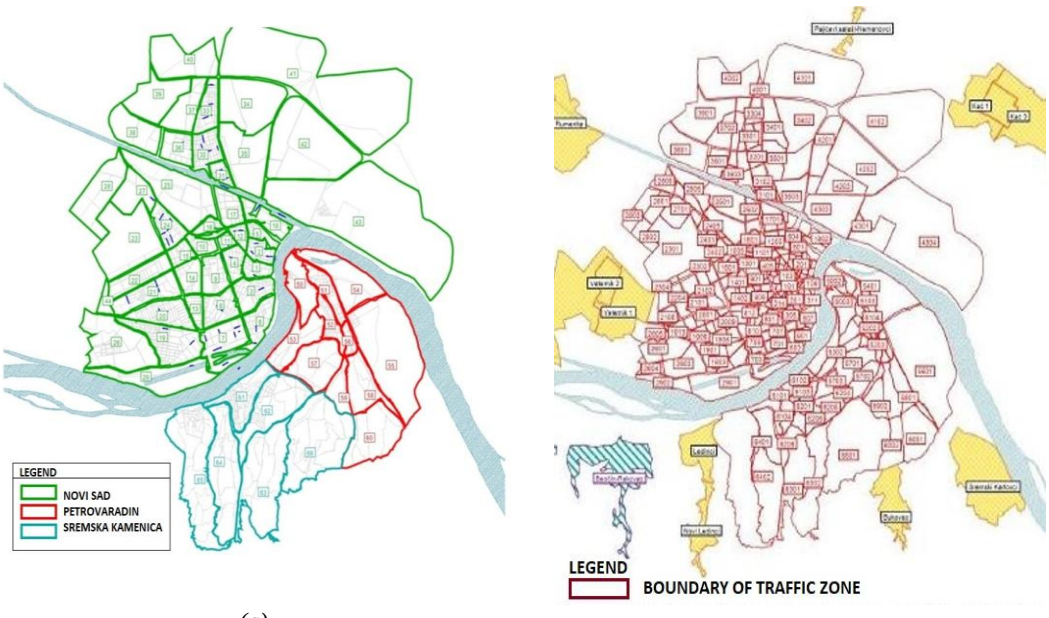
Finally, a review of research on gender mobility during the COVID-19 pandemic is given. The paper [23] shows the results of gender mobility collected by locating smartphones during the days of restricted movement in Italy, Portugal and Spain. The mobility of women is lower than the mobility of men. The mobility of women aged 25–45 is the lowest during online classes from the national education system. The research in the paper [24] was carried out because many sick and deceased women were recorded compared to other European countries (at the same time, Belgium has a high degree of gender equality). The results show that women travelled more for going to work, shopping or transporting another person than men.

3. METHODOLOGY AND STUDY AREA OF RESEARCH

Novi Sad is a tourist destination, a cultural and university centre, as well as the second largest city in Serbia. It is in the centre of Southeast Europe, on the banks of the Danube and the Pannonian Plain (*Figure 1*). Currently, the migration balance of the city is positive. The rate of natural increase was positive for the last time in 2018. About 400,000 inhabitants live in 2 city municipalities and 12 suburban settlements. The average age is about 40 years. The motorisation rate is 300 cars/1,000 inhabitants, which is higher than the national level (in Serbia, the current motorisation rate is 286 cars/1,000 inhabitants) [8].

Figure 1 – Novi Sad in Europe and the Republic of Serbia [25]

In the General Plan of Novi Sad, there are 61 traffic districts (*Figure 2a*) or preformed as 300 traffic zones (*Figure 2b*). The survey results were collected in areas formed by traffic zones. The survey form consisted of a joint socio-economic characteristics sheet for all household members and an individual questionnaire with a Travel Diary, where every change of residence during the 24 hours on the survey day was recorded (every travel). If the surveyed person completed at least one trip, they wrote down the characteristics of that trip. Characteristics were: source (address, which is assigned to the traffic zone), time of departure, mode of transportation used (including walking), trip purpose, trip destination (address, which is assigned to the traffic zone) and arrival time [2].



(a) *(b)*

Figure 2 – Field of the research – a) Traffic districts in the city of Novi Sad; b) Traffic zones in the city of Novi Sad [2]

After expanding the data obtained from the surveys, the daily number of trips was determined as 766,777 trips/day, which was 3.3 trips/inhabitant/day. On foot made 40% of all trips, while the passenger car was the most used mode of transportation. Surveyed persons travelled 22.60% of all daily trips in the city as a driver. The trip purpose was returning to the house/apartment (42.33%), going to work/education (18.33%) and shopping (10.65%). The average duration of all trips was 17 minutes while going to work/education was 19.5 minutes. The morning peak hour is 7–8 h, while the afternoon peak hour is 16–17 h [2].

4. RESULTS AND ANALYSIS OF COLLECTED DATA

For this paper following data were analysed: mobility, time distribution, modal split and purpose distribution as a function of gender. More than 10,000 Travel Diaries were used (53% women and 47% men, older than 6 years). It is noted that the household survey responded to questions such as distance travelled, number of people in the household, number of cars in the household etc. In this paper, variables were not combined. Results are presented as a basis for creating a new model in function by gender.

4.1 Results by gender mobility and time in Novi Sad

Of the total number of trips, 55% were made by women and 45% by men. A total of 2,7% of women, 2.7%, did not travel on the survey travel day, while among the sample of men, 1.07% did not travel. Comparing the corresponding answers in the survey for both genders, it was noticed that 75% of them are over 55 years old (over 80% unemployed/retired). The average daily mobility achieved in Novi Sad for women is 3.38 and 3.30 trips/day for men. The average travel time for women is 15.9 and for men 16.86 minutes. The time distribution of trips is presented in *Chart 1*.

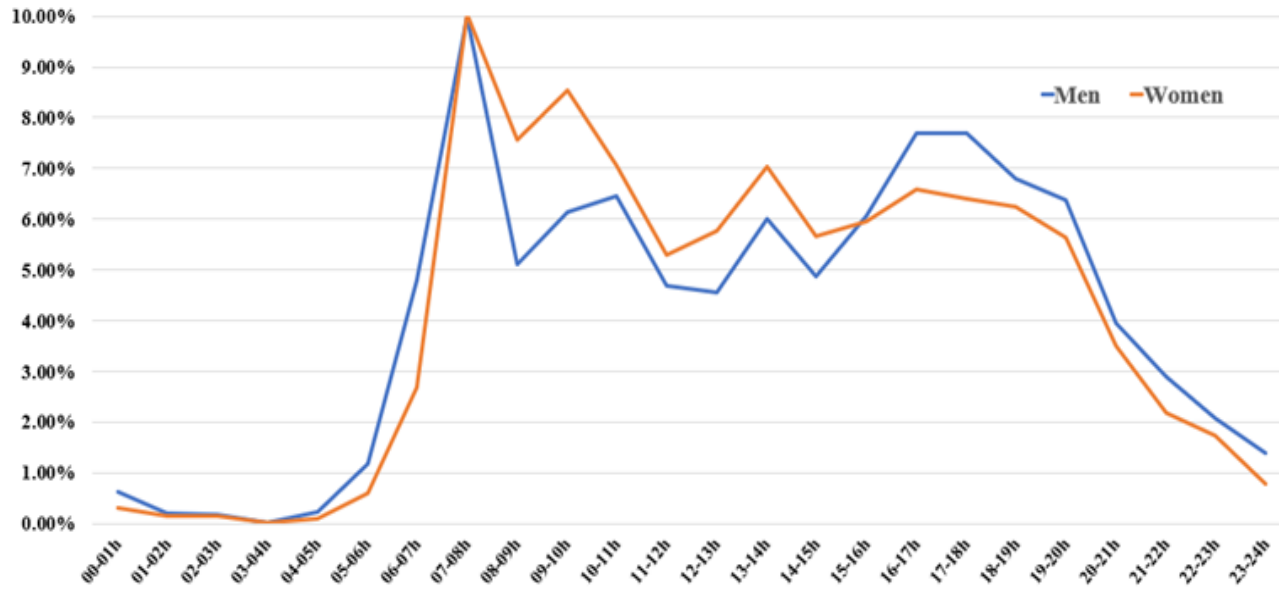


Chart 1 – Time distribution (%) by gender

Chart 1 shows that both genders make 10% of all trips in the morning peak hour of 7–8 h. The share of men's trips after morning peak hour drops sharply and remains lower for hours compared to women's trips. On the other hand, women's journeys are dispersed; for women, the afternoon peak time is 13–14 h (7.1% of all trips). For men, the afternoon peak hour is 16–17 h with 7.7% of all trips made (while almost 7.68% of trips are from 17–18 h). Men's trips are more frequent than women's trips after 15 h.

4.2 Modal split and time of day travel distribution (by modal split) as a function of gender in Novi Sad

The distribution by modes of transport as a function of gender (*Chart 2*) is the most important result of this paper. Significant differences between the genders are observed. Men are more dominant in making motorised

trips in Novi Sad. Women make only 12.57% of PC-driver trips compared to 34.78% of such trips by men. Women as PC passengers make 12.52% of trips compared to 8.10% of men's trips (in addition, 2.92% of women's trips are made using taxis compared to 1.73% of men's travels). Almost the same, 0.28% of women's trips were made on a scooter/motorcycle, compared to 1.29% of men's trips. On the other hand, in the case of alternative modes of transport, the share of trips is in favour of women: on foot, 45.59% of women's trips compared to 33.05% of men's trips, PT 17.36% of women's trips compared to 12.56% of men's trips and by bicycle 9, 07% of female trips versus 8.50% of male trips.

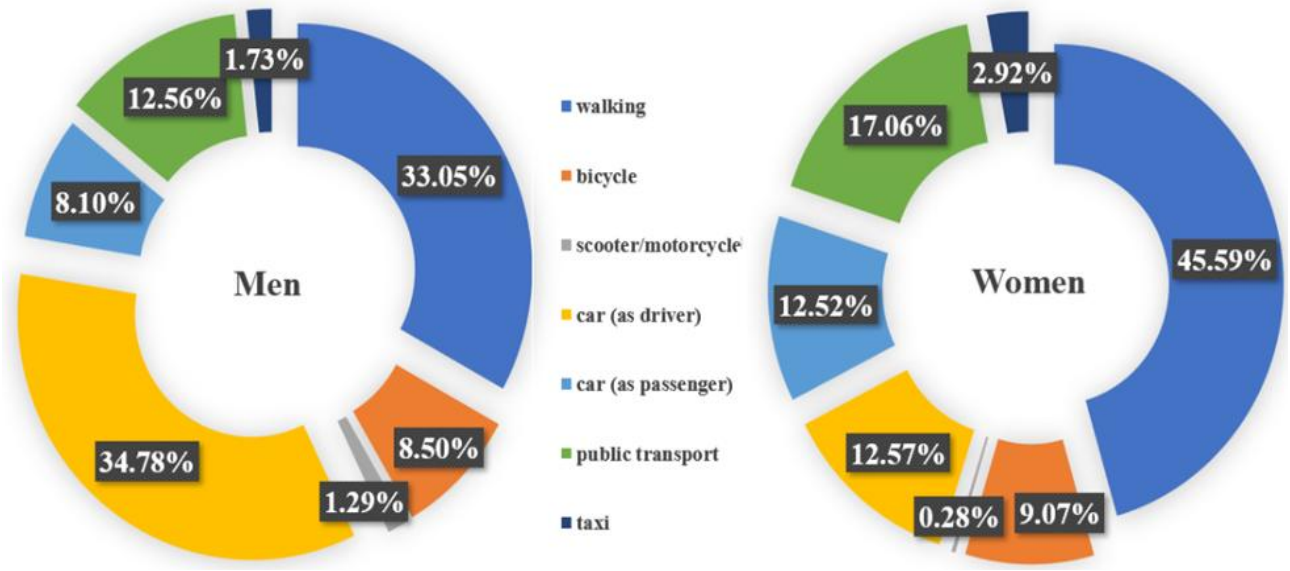


Chart 2 – Travel distribution (%) by gender and transport mode per day

Chart 4 shows the time distribution as a function of transport mode. It should be noted that the modal split is narrowed to the basic modes of transport (due to the individually low number of trips by motor two-wheeler drivers and passengers in taxis, these trips are combined with car trips). The percentages of trips indicated by the orange line are female trips per hour, and the blue line is the participation of male trips per hour. Among the genders, the smallest deviations are in the involvement of PC-driver trips during the day, while the largest is for the time distribution of bicycle trips. The peaks (percentage of the most trips) for each type of transport in the morning period (00–12 h) and the afternoon period (12–24 h) are marked.

The time distribution of trips made on foot is similar between the genders. Deviations occur between 7–10 h and 15–18 h. At 7 h, the share of trips on foot is 9.50% for both genders. After that, the women made several trips on foot until 15 h. After 15 h and during the evening (night), men's trips are twice as much as women's. The largest share of walking trips for women occurs at 9 h (11.48%) and 13 h (8.26%), while for men at 7 h (9.51 %) and 15 h (8.38 %). The smallest deviations in the percentage of trips during the day between genders are in PC-driver trips of all the transportation modes analysed. The largest share of trips in the morning is 7–8 h (12.81% female drivers and 10.18% male drivers). After that, the percentage of trips decreases (around 4–5%) for both genders. Between peak hours, the rate of trips by women is higher, while after 16 h, it is higher for men. Some minor differences are visible in the percentage of PC-passenger trips. After 7 h (percentage of trips for both genders 9%), the participation of these trips drops to 2% for women and 3% for men. After 15 h, male passenger trips become more dominant (about 8%) until 19 h, when the participation of women as passengers is at a maximum (10.76%). Also, differences are visible in the time distribution of PT (city bus) trips. The morning peak hour at 7 h was obvious (the share of men's trips was 12.94%, and women's was 10.83%). Travel participation is almost the same by 13 h. After that, the share of women's trips prevails (8.30%) until 17 h, slightly decreasing. Men have a share of trips dominant at 16–17 h (8.96%) and 19–20 h (7% when the number of trips decreases). The most significant differences in travel participation between

genders during the day are in bicycle trips. Men's trips happen in the morning peak period 7–8 h (9.56%), then decrease, and then increase again to 9% in the period 10–11 h. During the day, the participation of men's travel is lower than women's, except in the period 16–18 h (8.33%). It can be seen that women's trips are distributed between 7 and 19 h without significant deviations, which is a unique case in terms of time distribution. Men's trips by bicycle are more pronounced after 19 h and at night.

4.3 Distribution by purposes and temporal travel distribution (by purposes) as a function of gender in Novi Sad

The distribution by purposes is given in *Chart 3*. The most common purpose is "returning home" (39.56% of all women's trips and 41.40% of all men's trips). The second purpose with an almost equal trip share is "transport of another person" (about 2% of trips). Gender inequality is observed in the participation of trips with the "going to work" purpose for men, 14.93% of trips, and for women, 9% of trips. The percentage of trips to "school/faculty" is 7.74% for women compared to 6.04% for men. Also, the participation of women is higher for: "shopping" – 12.69% of trips compared to 8% of men's journeys, "usage of services" (6.29% of trips versus 5.04% of men's trips), "private visit" (6.87% vs. 6.29% of men's trips) and other trips (5.54% vs. 4.46% of men's journeys). "Private visit" could include a family visit or a friend's visit. "Official visit" refers to trips that are conducted for business purposes, such as attending meetings or representing an organisation. It can be seen that women travel more to take care of the household (children). On the other hand, trips with relaxation purposes were more used by men, with the following percentages – socialising/entertainment (5.39% vs. 4.21% of women's trips) and recreation/training (3.27% vs. 2.57% of women's journeys).

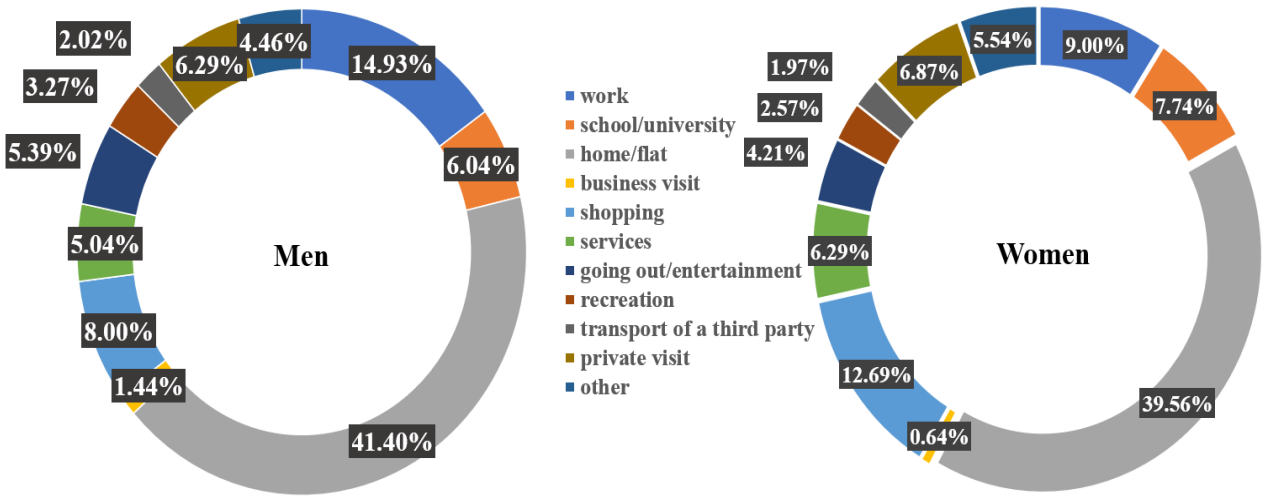


Chart 3 – Travel distribution (%) by gender and purpose per day

Chart 5 shows the time distribution of trips for each purpose among genders. The percentages of trips indicated by the orange line are the participation of women's trips per hour, and the blue line is the participation of men's trips per hour. The "going to work" trip purpose has a similar time distribution. During the morning hours, there is a slight advantage in men's trips (between 7–8 h participation is 33.38% of men's trips, compared to 31.38% of women's trips). Deviations occur between 12 and 15 h. The most significant difference between these trips is between 13 and 14 h, where the percentage of trips by women (7.16%) is higher than men's (3.97%). The purpose of the trip "going to school or college" is active from 6 to 14 h, with the highest participation at 7–8 h (44.66% of women's trips and 37.58% of men's trips), then 13–14 h (women 12.88%, men 18.46% of trips for this purpose). The purpose of "returning home/to the apartment" during the day for women has no significant deviations (about 5% per hour), while for men, participation in this purpose prevails between 15 to 19 h (over 10% per hour). Purpose "shopping" makes up to 50% of trips for women in the

morning hours (respective participation, 7–8 h – 7.35%; 8–9 h – 17.96% and 9–10 h – 21.9%). The "shopping" trend among men is lower in the morning, a little more at 17–18 h (8.16% of trips for this purpose). Daily participation in "using services" trips is more uniform for women's trips. The schedule of men's trips for the same purpose peaks at 10 to 11 h with a share of 16% of these trips and 9% at 16–17 h. The time distribution of trips for "socialisation/entertainment" shows a percentage increase in participation as the day progresses. For both genders, trips with a share of 10 to 15% of this purpose dominate in the evening hours. Men make the highest share of trips for this purpose, 20–21 h (12.77%), while for women, it is 19–20 h (12.20%). Most trips with the purpose of "recreation" are made between 9 to 10 h (women 4.67% and men 7.82%) and 18 to 19 h (women 19.33% and men 16.76%). The time distribution for "transport of another person" shows the highest activity for both genders at 7–8 h, where women and 24.47% by men made even 35.65% of the total number of these trips. In the period from 17 to 20 h, deviations are visible (men made 11.70% of trips for this purpose, and only 4.35% by women). "Private visits" are active from 8 h to 22 h and are more evenly distributed among women. A share of 8.23% of the total number of these trips by women takes place between 10 and 11 h. Men's trips with this purpose are more frequent at night (13.82% of men's trips with this purpose in the period 18–19 h).

4.4 Modal split and distribution by purposes as a function of gender in Novi Sad

Chart 6 shows the distribution of trips by the purpose for each dominant mode of transportation. Among the genders during the day, the most deviations are the participation of trips by bicycle and in a passenger car. The most similar distribution is related to walking. The differences are in going shopping (women 18.79%, men 13.55% of all trips on foot), going to work (women 4.17%, men 6.87% of all journeys on foot) and going to school/university (women 6.74%, men 9.14% of all trips on foot). The distribution of trips by purpose PC-drivers has the most deviations for returning home (women 25.82%, men 40.12%), going to university (women 13.19%, men 0.72%), transporting another person (women 11.26%, men 5.33%) and going to work (women 19.09%, men 22.63%). The share of trips made by driving a passenger car is without significant difference for "recreation" and "private or official visit". The most significant percentage deviations in the participation of PC-passenger trips between genders are for the following purposes: going to work (women 8.83%, men 15.42%), going on a private visit (women 7.20%, men 14.34%) and going on an official visit (women 0.55%, men 3.60%). The purposes with no difference in the mode of transportation are: going to school or university, using services and socialising. The distribution of PT trips is similar between the genders in the case of: going to work, going to school/college, returning home, and private and official visits. Differences in the participation of PT trips are visible for socialisation purposes for women 3.65% and men 0.20% of trips, then in the use of services (women 5%, men 1.92%) and shopping (women 3%, men 6.38%). Trips made by bicycle have the most different share of purposes between the sexes. The most significant differences in the percentage of purposes carried out by bicycle are: going to work (women 14.46%, men 8.38%), shopping (women 15.24%, men 9.31%), using services (women 9.9%, men 6.37%) and socialisation (women 2.10%, men 4.41%). For the "transport of another person" in the case of travelling by bicycle, it is assumed that children are transported in an adequate seat (the share of trips for this purpose for women is 1.14% and for men 0.49% of trips). Among the genders, participation in bicycle trips with the smallest deviation is "going to school/college".

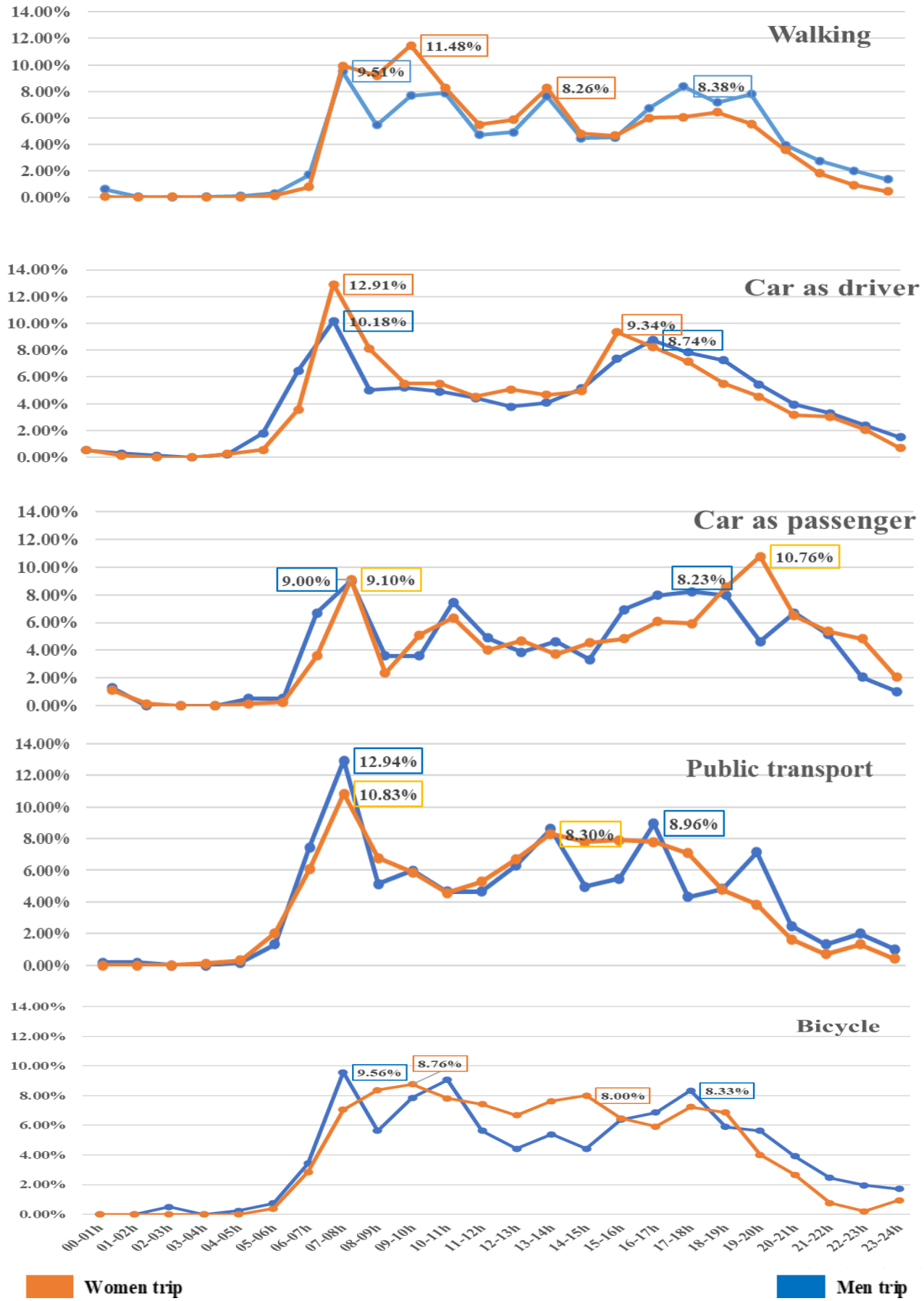


Chart 4 – The modal split in time distribution by gender

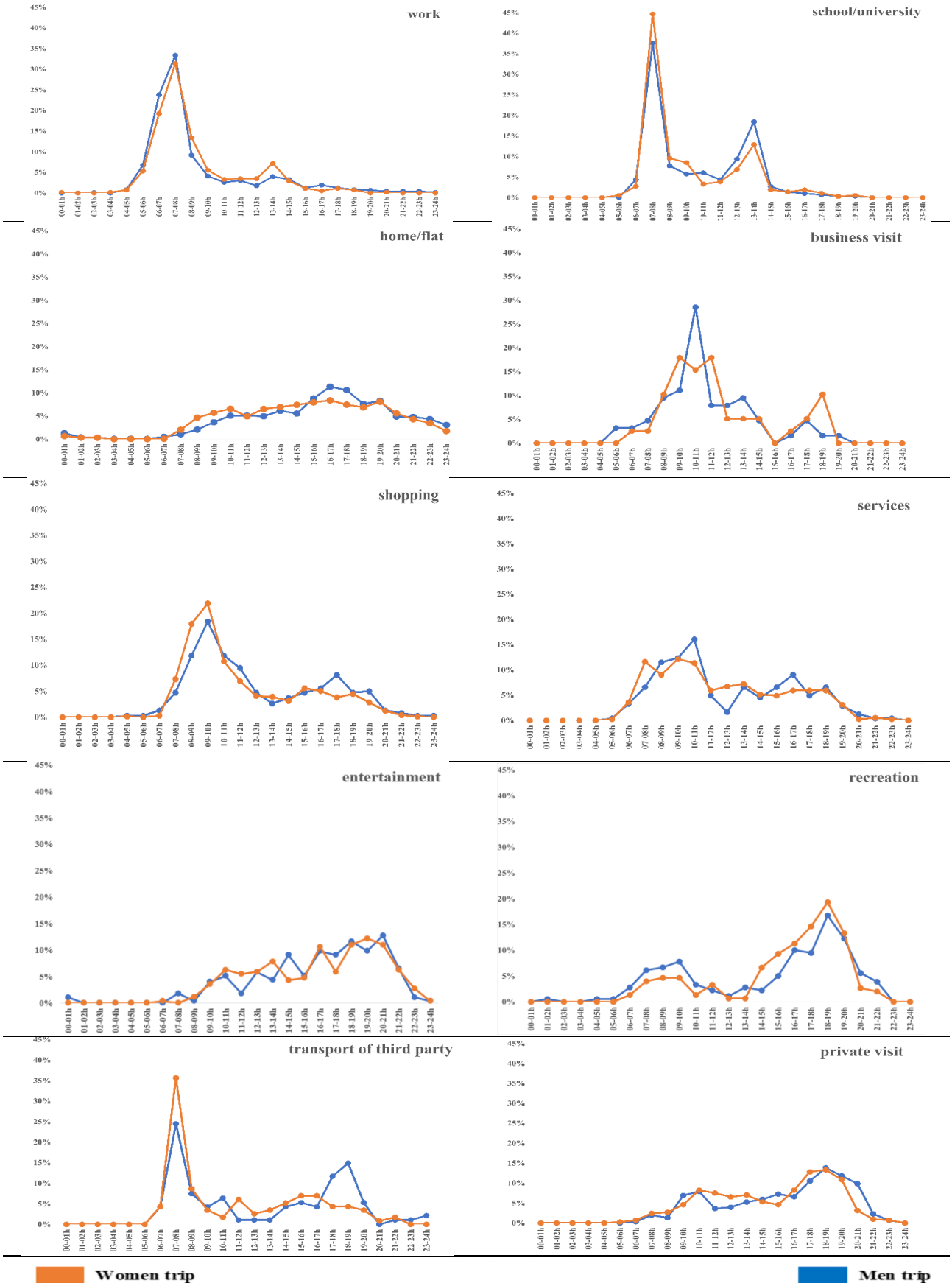


Chart 5 – Temporal travel distribution (%) by purposes and gender

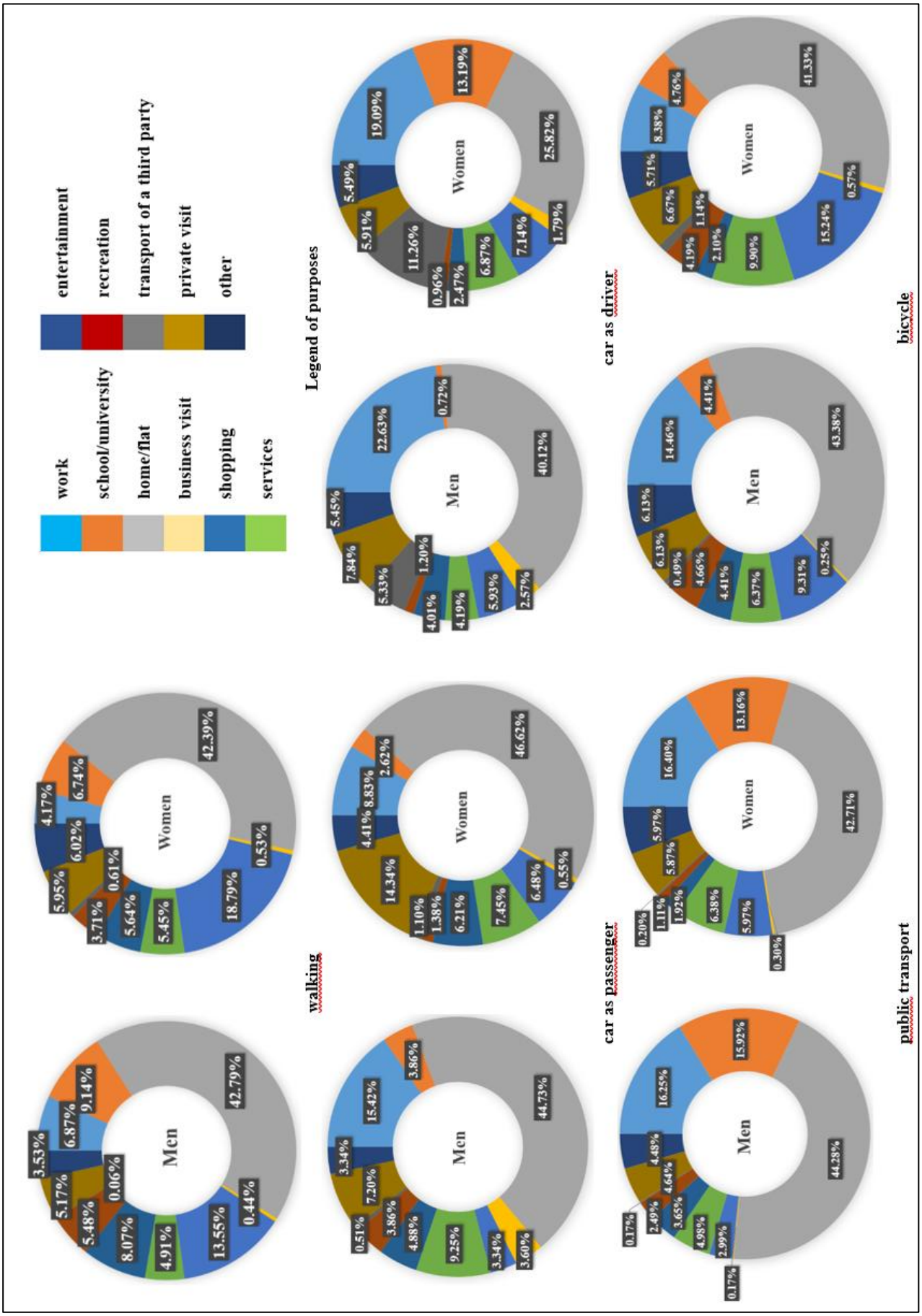


Chart 6 – Travel distribution (%) by purposes and modal split as a function of gender

5. DISCUSSION

Although less than 10 years passed between the two Traffic Studies in Novi Sad, many factors influenced the increase in the number of daily trips (immigration, the increase of passenger cars on the network, the construction of new apartment blocks, boulevards, bicycle paths and bridges). Men's travel time is 1 minute longer than women's. Men use more motorised modes of transport (especially during peak hours), so they are more likely to participate in traffic jams. *Chart 1* shows the more significant number of women's daily trips in the period from 7 to 15 h. Although, 68.5% of men compared to 53.4% of women among the surveyed persons are employed/going to school or university. Afternoon, evening and night trips are more often by men.

In the literature, the definition of cultural determinant [30, 31] is given as a combination of factors that influence travel characteristics under the environment's influence. It should be noted that in Serbia, the percentage of women who have passed the driving test is only 35%, so it makes sense that women more often travel as passengers than as drivers. Bicycle trips in the modal split are the only mode of transportation with almost the same participation between the genders but with the most significant difference in the distribution of the trip purpose. The distribution of trips by passenger car as a driver is mostly related to peak hours and primary trips (home-work/education) for both genders. The time distribution of trips when using PT (buses) in Novi Sad shows that women's trips are more even, without noticeable peaks (the reason can be seen in the modal split because women use cars less than men). The bicycle is used least often for primary trips by both genders. It can be seen that women's more dominant purposes are taking care of the household and other people. On the other hand, the participation in trips was higher among men in entertainment/recreation. Considering the variety of purposes, it is assumed that women perform the so-called travel chains (which could be proven by analysing the sources and destinations of travel). Based on some pilot projects for further research, the authors believe that they should focus on analysing the distance between the origin and destination of the trip. Upon examining the database, indications suggest that women, depending on their age and the number of household members, tend to travel more. The time distribution of work trips shows that women go to work more in the period 8–15 h. A noticeable number of men go to work at 3–20 h. The schedule of going to school/college is realistic. It was shown that men return to their homes/apartments mostly between 15 and 18 h. Women return to their homes/apartments scattered throughout the day. This is another confirmation that women often make chains of trips and perform more purposes than usual trips for men. Participation in trips for shopping, especially for using services, shows that these needs are more pronounced among women throughout the day. Indeed, more detailed analyses are needed to detect whether these are personal or household needs. From the total number of trips with purposes "entertainment, leisure, going out", a significantly larger number were undertaken by men. Also, in the time distribution of the "recreation" purpose, it can be seen that men have a more uniform distribution of travel participation during the day. Women do the same, usually between 16 and 20 h. The purpose of "transport of another person" of both genders relates to work/school shifts (car sharing, care work). The trip purpose of a private visit is more even for women during the day and men in the afternoon and evening. The survey (travel) days were Tuesday, Wednesday and Thursday, so the time allocation for "socialisation, recreation, transport of another person" depends on the respondent's employment. It should be noted that *Chart 5* does not show the time distribution of trips between the genders for "other" (the motive of the journey is not specified). The data show that there were no such trips between 21 and 6 h.

According to the shares of trips by purpose, separately for each mode of transport (*Chart 6*), "shopping" is the only purpose where women made more trips in all five aspects. Both genders' motives for walking trips are similar (except for "shopping"). The most room for discussion is the distribution of trips made by driving a passenger car. For "returning home" and "going to work" there is a low percentage of women, and a significantly higher percentage of trips for "shopping, using services, transporting another person". For example, women make twice as many trips to "transport another person". So, in the case of driving a passenger car, women will perform purposes that are not necessarily personal because they drive less for "socialisation, recreation" compared to men. On the other hand, a more detailed look at the role of passengers in the car (transportation sharing) shows that women go for more private visits and shopping, and men for work/official visits. The distribution of purposes in PT (city bus) trips is the most even between the genders. Preference is given to primary trips ("work/school/academic" and "return to home/apartment"). No other form of transport has this much share of primary trips. For women, these three purposes take up 72.27%, and for men, 76.45% of PT trips. In this paper, it was shown that women make twice as many PT trips with the purpose of "shopping" and significantly more PT trips for the reason "using services" and "private visits".

Travel related to socialisation/entertainment purposes is in favour of the man. Men make twice as many PT trips for "socialisation" or "recreation". This confirms the thesis that taking care of the household/members (or children) is the reason for women's trips, which is also the case with bicycle trips. Women ride a bicycle more often for "shopping, using services, transport of another person" and caring for "socialisation, entertainment, recreation", compared to men. In Novi Sad, due to favourable relief and climatic conditions, it is common for children to be transported on bicycles (in special seats). Based on this discussion, it is clear that women's trips are more rational in using alternative modes of transportation. Some of the reasons why women use alternative modes of transport more often include lower employment rates among women compared to men, and fewer driving licences among women compared to men. Namely, for most purposes, using motorised modes of transport, men strongly influence the modal split in the city, disrupting sustainable mobility and environmental awareness.

The main limitation of research in Serbia is the lack of data about respondents' income in the Household Surveys (2009 and 2017). The survey organisers believed that the results would not be complete and credible. Nowadays, the standard and quality of life in Novi Sad are increasing. Introducing a section on income in the next Household Survey is recommended. Investigating the current situation in the field, the authors find similar works, most often as a function of the gender and income of the respondents [26, 27] in three groups: below-average, average and above-average standard [28, 29].

5.1 Comparison of gender mobility and time distribution between 2017 and 2009

The average realised mobility by gender was equal (3 trips/inhabitant/day). So, mobility has increased. Also, the number of respondents who did not travel on the survey day in 2017 is much lower than in 2009. Of the total number of trips in 2009, 51% were made by women. Previously, 5.75% of men did not travel at all, and neither did 7.13% of women (half over 55 years old) [4]. It was observed that the average duration of women's journeys decreased significantly (15.9 minutes) since it was 17.34 minutes, and 16.6 minutes for men (it is now 0.3 minutes longer) [4]. However, it is more important to note that in 2017, a longer average duration of work trips and trips back home was observed (20–25 minutes, compared to the former 17–19 minutes). It is believed that the working hours have been moved and the traffic is heavier due to greater construction and immigration. A comparison of the time distribution of trips (*Figure 1* [4]) shows differences in afternoon trips. The morning peak hour for both genders was 7–8 h in 2009 as well (travel share 8.26% for women and 8.46% for men), while it is the same for both genders in 2017 (10% of travel). The afternoon peak hour differed, as it was 16–17h for women (7.52% of trips) and 15–16h for men (8% of trips, as well as in the period 16–17 h). It was observed that the afternoon peak time for men moved an hour later. Men generally have an afternoon peak, while women's trips have entirely changed. Namely, in 2017 according to the results, it was in the period 13–14h (7.7% of the total daily number of trips), which is early. Compared to 2009, women's journeys are now more dispersed and lower in the later hours. In the future, the authors believe that there will be even greater dispersal of trips and stretching of peak hours.

5.2 Comparison of the modal split and distribution by purpose as a function of gender between 2017 and 2009

The most significant changes occurred in the modal split based on *Chart 2* compared to *Figure 4* [4]. The number of trips by passenger car as a driver and passenger increased, while the use of PT and walking decreased in the modal split. A step toward sustainable and green mobility was only achieved in the increased use of bicycles for daily trips by both genders (in [4], only 3.17% of men's trips and 1.92% of women's journeys). It is important to note that today's share of bicycle trips is estimated to be greater than 10% of the total modal split in Novi Sad. Data from 2009, shown in [4], show that both genders walked more (men 40.16%, and women even 54.06% of trips). By comparing the data, it can be seen that in 2009 both genders used PT more (23.59% of women's journeys and 18.27% of men's trips). Compared to 2009, prices of tickets for public transport increased by 60%.

Nevertheless, the PT network and the comfort and quality of transportation in vehicles have improved. Unfortunately, the share of PT trips continues to decrease due to the increased use of private passenger cars. From the comprehensive research conducted, it was concluded that the number of vehicles, primarily passenger cars, on the network has increased. It must be noted that the TAXI transportation service has become more expensive over the years, so the number of these trips in 2017 is negligible compared to 2009. The number of trips by women as drivers increased from 8.37% [4] to 12.57% and travelled as passengers increased from

7.56% [4] to 12.52%. The number of trips by men as drivers also increased, from 29.75% [4] to 34.78%, and trips by a passenger from 4.8% [4] to 8.10%. By summarising the participation of trip types, it can be concluded that 44.6% of men's trips depend on one passenger car on the network (as a driver, passenger or in a TAXI).

On the other hand, women depend on a car only for 28% of trips, while 72% of their trips are not dependent on a passenger car. A detailed interpretation of the trips share according to purpose between the two observed periods does not show as many changes as the analysis of modal split as a function of gender. In 2009, trips back home/to the apartment were more represented than in 2017, while men and women were equal with 42.6% of trips [4]. Also, there were more trips to work for both genders, with men at 15% versus women at 10.48% of trips [4]. School/college-related travel in 2017 is more for women than in 2009 when such a journey was almost equal between the genders (6.94% of women's travel, vs. 6.76% of men's travel) [4].

6. CONCLUSION

The most important differences between the genders in travel in Novi Sad can be seen in the choice of travel modes, purpose and travel time. According to the available studies, it can be concluded that daily mobility on weekdays in Novi Sad is currently the highest in Serbia. The motorisation rate is second higher, behind the City of Belgrade. The lifestyle and personal capabilities of the individual determine purposes, while the spatial distribution of the trip determines which mode of transportation is chosen for the journey. In this paper, it can be seen that men are more employed and drive more passenger cars than women. Women use alternative modes of transport (walking, public transport, bicycle, car sharing as a passenger, TAXI). Women do not have precise peak hours, while trips are scattered even outside peak hours. Their trips are more related to daily duties than entertainment. Compared to the study from 2009 (for both genders), the most critical differences are an increase in average mobility and an increase in the number of trips made by passenger car (and bicycle), resulting in a decrease in PT trips. Observing the time distribution of travel participation, especially by purpose, it is concluded that the most significant time differences in the occurrence of trips are for the following purposes: use of services, socialisation and transport of another person.

In future work, we are hopeful to research the role of gender in the function of: income and financial status, family status and driver status. Also, we agree that differences in mobility can vary depending on the age and residence address. Also, individuals with different levels of education and occupations may have different needs and opportunities regarding mobility. Sometimes, mobility can be limited by different levels of infrastructure development. In rural and poor areas, various cultural and social norms can shape individuals' mobility choices. Furthermore, it is necessary to strengthen the cooperation of traffic planners with sociologists. This would give a better insight into the actual workload of women travelling to take care of the household. Comprehensive surveys aim to form a suitable model because women are more likely to form travel chains. The authors have already researched travel characteristics by age group [4], which they will continue to do. Statistical processing of the features of gender mobility for trips in peak hours is also planned, which in the Travel Diaries from 2017 was not adequate due to the dispersion of women's trips in the period 12–18h. Also, for the last three years, the population has been actively using electric scooters along the bicycle lanes in Novi Sad. It is desirable to determine their participation in the modal split and examine the limitation of the length of the journey, carrying loads and transporting children (compared to a bicycle).

It is concluded that gender is one of the crucial socio-variables influencing network travel characteristics. The contribution of these results is reflected in updating the city's transport model and creating the base for future research. The transport model of Novi Sad was established in 2009 under the name NOSTRAM to make the General Urban Plan until 2030 in the "VISUM" software. The model consists of a simulation model of the transport network and traffic demand matrices. The model was transferred to the road network using a multi-class technique equilibrium assignment with capacity limitations on the road network [3]. Gender-based travel matrices would be a pilot project modelled on global trends. Also, these results are dual and the local community can use them for new transport policy and traffic management. It is suggested that men use sustainable modes of transport more. The importance of promoting gender equality needs to be by focusing on sustainable options because the global goal is to reduce pollution caused by vehicles. If our aim is gender equality, we should be working toward sustainable transport modes at the same gender rate. Gender equality should be based on approximately equal distribution of travel modes and travel time distribution. Indeed, the influence of gender differences in mobility can lead to improving and reorganising the transport offer, promoting sustainability and green mobility in Novi Sad.

ACKNOWLEDGEMENTS

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Ana VUJIČIĆ, Valentina MIROVIĆ, Jelena MITROVIĆ SIMIĆ, Nenad RUŠKIĆ

Karakteristike dnevnih putovanja prema polnim razlikama u Novom Sadu

Sažetak:
Savremeno planiranje, projektovanje i upravljanje saobraćajem u gradovima bazirano je na pametnoj i zelenoj održivosti. Održiva mobilnost i bezbjednost saobraćaja može se unaprijediti podizanjem svijesti o rodnim razlikama tokom vršenja svakodnevnih putovanja u gradovima. Grad Novi Sad (Republika Srbija) ima tradiciju dugu preko 50 godina u izradi planerskih saobraćajnih studija. Pri tom, mjere unaprjeđenja saobraćaja u gradu su zasnovane na rezultatima dobijenim u anketama. Karakteristike putovanja u gradu prema polnim razlikama, su izvor različitih podataka, koji mogu biti osnova za planove održive mobilnosti, upravljanje saobraćajnom potražnjom i postizanje rodne ravnopravnosti. U ovom radu se analizira mobilnost, vidovna raspodjela putovanja i raspodjela putovanja prema svrhama u funkciji pola. Rezultati su prikazani obradom podataka dobijenih u Dnevnicima putovanja (sakupljenih u Anketama u domaćinstvu) tokom saobraćajne studije ''Smart plan - Novi Sad''. Diskusija je bazirana na deskriptivnoj analizi osnovnih karakteristika putovanja prema polnim razlikama, koje se porede sa prethodno dobijenim rezultatima iz saobraćajne studije ''Nostram''. Zaključci pokazuju da muškarci vrše više putovanja sa svrhom posao, kao i da muškarci više koriste putničke automobile kao vozači, u odnosu na žene. Žene više koriste alternativne vidove prevoza, kao što su pješačenje, javni gradski prevoz, bicikl. Putovanja vršena od strane žena su više raspršena tokom dana, nema preciznog vršnog časa, u odnosu na muškarce. Takođe, putovanja vršena od strane žena su više vezana za svakodnevne obaveze nego za razonodu/druženje.

Ključne riječi:
pol; ankete; mobilnost; vidovna raspodjela putovanja; raspodjela prema svrhama putovanja.