

**SAFETY ASPECTS OF THE BICYCLE TRAFFIC AND THE NEEDS OF
CYCLISTS IN THE CITY OF ZAGREB AND ITS SURROUNDING**

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Abstract: The goals of this study were: to determine the possibility of forecasting for the preferences of cycling on the basis of all relevant factors Zagreb cycling (1) and to determine the differences between the participants in all the relevant factors in Zagreb cycling, by gender, in relation to membership in the Association "Trad Union of bicyclists", type of cycling and part of the city where cyclists live (2). Over 3000 members of the Association and cyclists who are not members of the Association ("average" cyclist) are tested, using conveniently assembled questionnaire. It turned out that latent dimensions of the sub-questionnaires well represented themes: barriers to cycling, the role of the City in bicycle traffic, the purpose of using bicycle accident during bicycle traffic. People who are more inclined to participate in city traffic riding, often believe that the City should significantly improve conditions for cycling, tend to safer driving and more negative estimate lack of road cycling conditions in Zagreb. Women and members of the Union of cyclists often feel that the City should improve conditions for cycling and negatively evaluate the existing conditions of cycling, more often use the bike for different purposes and had frequent accidents bicycle. In the northern part of the city, Samobor, Zaprešić and Sesvete, Dugo Selo and Ivanja Reka participants were assessed to have the most adverse road conditions for cycling, while the wider center of Zagreb currently has the most favorable conditions for cycling. The results provide the guidance for improving the safety of the cycling in Zagreb and its surrounding, for taking constructive social actions at the state level and on the local-community level, as well as in the broader context of sustainable development.

Keywords: *barriers, social action, traffic accident, the role of city government*

Introduction

Safe cycling is a fundamental prerequisite for using this increasingly popular and also the cheapest means of transport, as well as means of the recreation. To improve road safety while riding bicycle, it is very important to consider all the factors, which are in relation to cycling in a certain area. In fact, it is precisely the issue of this article. The small number of studies is conducted in Croatia about these issues. Therefore, the findings of this study could give the clear guidelines to improve the safety of bike traffic, as well as to offer an incentive for more frequent and more widespread cycling.

Cycling (ie. cycle riding) is a great way to exercise and to stimulate physical development, especially among young people and children. In these age groups, cycling helps in the prevention of cardiovascular diseases. Today, cycling is a very widespread form of traffic, which spread very rapidly in developed, but still in underdeveloped countries (Plaut P., 2005). Modern trends in the world, as well as in Croatia, have supported the idea of living without the noise in terms of sustainable development, which implies a revival of traffic forms such as are walking, cycling and public transport (Dragičević V. et al., 2006).

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Research findings suggest that the use of bicycles as a means of transport and forms of recreation are more frequent in the cities of developed countries, contributing to the humanization of urban spaces and increasing the quality of life (Lukić A. et al., 2011). However, cyclists are probably the most vulnerable traffic participants (Li G. et al., 2011), while the children cyclists are the most exposed to injuries (Boström L. & Nilsson B., 2001). Results of the research in Croatia show that the overall percentage of deaths among cyclists on the roads decreased over the years, from 11.6% in 1998 to 8.2% in 2000 (Missoni E. & Kern J., 2003). The most common type of accident involving deaths in cyclist's accidents resulted from collisions of cars and bikes. In 1997, 81.3% of the total number of accidents in which cyclists died was the collisions of cars and bikes (Missoni E. & Kern J., 2003; Missoni E. & Kern J., 2007). The same authors have studied the behavior and attitudes of young cyclists in different urban environments towards wearing helmets. Moreover, these authors studied the diversity among behaviors and attitudes of young cyclists (aged from 10 to 15 years), with respect to the length of bicycle paths in Zagreb, Varaždin and Samobor. It turned out that there are no statistically significant differences between cities in the possession of the bicycle, while in relation to the possession of the helmet, the differences were statistically significant, in the direction of positive attitudes towards wearing helmets in Zagreb and Varaždin. In Samobor (a town with no bike lanes), young cyclists have negative attitudes towards wearing a helmet (Missoni & Kern, 2007).

However, despite the dangers in traffic using bicycle, the cycles as a means of transport have positive impacts on the health of the individual. Cycle does not pollute the environment or creates noise, while cycling infrastructure doesn't take much space (Pucher J. & Buehler R., 2008). Such as it is described above, this form of transport can be considered as competitive form of urban transport, especially to small and medium distances. In urban planning, there is a need for a harmonious development of the city and its infrastructure, and the results of research in developed countries are used to improve the quality of life and humanize the urban space (Gehl J., 2010). There is an increasing need for the introduction of an integrated transport system that combines and balances the use of various means of transportation: trains, cars and other motor vehicles, public transport, cycling and pedestrian traffic. The use of bicycles as a means of transport and form of recreational sport is more common in many cities of developed countries in the world (Lukić A. et al., 2011). In Copenhagen, 37% of all daily trips within the city (at work, at universities and schools) perform riding bicycles, while in Amsterdam all daily trips by bike have prevalence 54% (Gehl J., 2010). In a lesser but still significant percentage of daily trips by bike is in common various German and Swedish cities, but also in London, Paris and Barcelona (Pucher J. et al., 2010). However, the trend of increased use of bicycles follows from a number of factors: changes in the lifestyle, increased awareness of the individuals about the importance of bike, actions of city governments that invest or not invest considerable resources in cycle infrastructure and promotion of cycling, as well as about the use of bicycles in general, regardless of gender, age and level of education (Pucher J. & Buehler R., 2008). Moreover, studies confirm findings that the bike, with hiking, truly could be considered as the optimal mode of transportation, from environmental, social and economic point of view (Plaut P., 2005; Buehler R. & Pucher J., 2010). Although the tradition, culture, relief and climatic features are real obstacles to more frequent use of bicycles, the experiences of different countries has shown that these factors should not be decisive (Nankervis M., 1999). An important role to improve conditions for cycling have the city government, academic community and non-governmental organizations, state and / or local governments (Baker L., 2009).

According to the relief, Zagreb area is well adapted for bike traffic, because Zagreb is pretty lowland city, with most narrow urbanized area at altitudes between 110 and 125 m, which greatly facilitates the utilization of the bicycle as a means of transport (Bertić I.,

1994). In Zagreb, as well as in the Croatia, bicycle traffic and bicycle use have rarely been the subject of scientific interest. Only a few publications and articles are related on the use of bicycles as a means of transport (Halgota V., 2010; Missoni E. & Kern J., 2007; Lukić A. et al., 2011). The study, which actually substantially coincides with the goals of our research is the one conducted by Lukić A. et al. (2011). The examination of students of the University of Zagreb on the use of bicycles and other modes of transport in Zagreb, questioning students who are cyclists and non-cyclists, revealed that there are significant differences between these two student groups in the way of using bicycles and other means of transport (Lukić A. et al., 2011). Furthermore, it was found that on average 20.6% of students of the University of Zagreb used bikes at least once a month (except in cooler seasons), either as a means of transport or as a form of recreation. Elements of the existing cycling infrastructure in Zagreb (bike lanes, bike tracks and parking spaces) are rated very low, especially in the city center. Therefore, students suggest measures to improve cycling infrastructure and several other measures to increase the number of bike users (Lukić A. et al., 2011). Besides improving cycling infrastructure, students expect a host of other activities by the city government: subsidies for the purchase of bicycles and training of all road users. An important conclusion is that increasing the number of cyclists in students and in citizens of Zagreb in general, requires a series of interconnected measures. They point out the exceptional importance of making cycling master plan, which could be more effective with the creation of GIS spatial database of total cycling infrastructure in the City of Zagreb (Lukić A. et al., 2011).

The activities of non-governmental organizations to popularize the use of bicycles for everyday personal transportation, as well as a form of recreational sport (Association bicycle and Green Action) are more and more noticeable. Moreover, in Zagreb, a strong initiative to improve conditions for cycling gives the association "Trade Union of Cyclists" ("Sindikata biciklista" or SB), which point out that the increased use of bicycles is one of the most environmentally friendly solutions to reduce traffic noise (Sindikata biciklista, 2013). SB is a non-governmental organization whose primary objective is to affirm cycling as healthy, environmentally friendly and fast mode of transport. It protects the rights of cyclists, promote cycling and fight for the improvement of cycling infrastructure. They point out their own desire to make the bike more appealing to the masses, while they are supporting the trend that the cities become transformed in the direction of reducing the number of motor vehicles, and increasing dominance of pedestrians, cyclists and public transport (Sindikata biciklista, 2013).

In this study, the general purpose was to examine the active cyclists (frequent road users by bike) in the City of Zagreb and in its environment. The attitudes of members of the association SB and the "average" Zagreb cyclists (non-members of the association) were examined, in terms of the various factors related to the issue of cycling in Zagreb. In order to obtain clear and undoubted conclusions, the first objective of the research was to find latent dimensions of the questions, grouped into different thematic units. This could possibly allow that these questions serve in the construction of measuring instruments for the determination of certain factors of cycling. The second objective was to determine the possibility of forecasts general preferences for cycling on the basis of all relevant factors Zagreb cycling (ie. their latent dimensions). Finally, third objective was to determine the differences between the parties in all the relevant factors of the Zagreb cycling, by gender, in relation to membership in the SB, type of riding bicycle and a part of the city where cyclists live.

Methods

Participants

The survey was conducted in Zagreb and its surroundings. According to the census of 2011, the Croatian capital has 790 017 inhabitants and over 50 miles of bike lanes (Državni zavod za statistiku, 2011).

The survey included a combination of purposeful (but highly representative sample, which included actually almost the entire population) of the members of the SB (N=1259) and snowball sample of cyclists (N=1831). Age of the participants was as follows: under 18 (46 or 1.6%), 18-24 years (619 or 20%), 25-34 years (1535 or 49.6%), 35-44 years (654 or 21.2%), 45-54 years (186 or 6%), 55-64 years (43 or 1.4%), 65 years and over (5 or 0.2%). Among all the participants, there were 1,643 men and 1,428 women.

Data collection method

Before the research, the participants were informed about the general purpose of the study (attitudes towards cycling in Zagreb), but in a way to avoid desirable responses. Voluntary nature of participation was emphasized, as well as the possibility of interrupt completing the questionnaire at any time. Participants were asked to complete questionnaires online, after the e-mail received with an offer to participate in this study. The items of the questionnaire used in research are realised by the members of the association SB. The questionnaire had not the characteristics of a measuring instrument, but contained the items that cover a number of thematic issues, with belonging Likert-type assessment scales, or the type of agreement/ disagreement (Yes / No). The content of questions and the assessments of the scales can be seen in Tables No 1 through No 4. The participants answered questions by an online survey, during 2012.

Statistical analysis

At the beginning of the analysis, the latent dimensions (method Principal Components Analysis, with or without Varimax rotation, depending on the number of the components obtained) and basic metric characteristics (reliability and construct validity) of the variables that covered the different topics in the questionnaire SB. In other words, for these thematic sections, the measuring instruments were constructed. Regression factor scores are used to determine the total score for each of the latent dimensions. To forecast general preference for cycling on the basis of all relevant factors Zagreb cycling, the complete multiple regression analysis was used, in order to maximize the amount of the explained variance.

Finally, to determine the differences, methods are chosen depending on the number of groups that have been compared, the number of participants in subgroups and normalities of the distributions: Kruskal-Wallis test and ANOVA (for comparison more than two independent groups of participants) and t-test to compare two groups of participants. All analyses are performed using the statistical package IBM SPSS 20.0.

Results

The results of the Kaiser-Meyer-Olkin measure of sample adequacy and Bartlett sphericity test indicate that the correlation matrix in sub-questionnaire *Barriers for the bicycle use* is suitable for factoring (Table 1). The variable *weather conditions* has the highest values of

communality and the correlation with the first principal component (*lack of physical conditions*). The variable *unconnected or non-existent bike tracks / lanes* has the highest values of communality and correlation with second principal component (*lack of road conditions*). The first principal component is defined by four variables, while the second is defined by only two items. However, the reliability of the second component is quite high, while for the first principal component the reliability is low but still satisfactory. The percentage of the variance explained for all variables of this sub-questionnaire is overall around 57%.

Table 1: Validity and reliability of the sub-questionnaire *Barriers for the bicycle use* (Principal Components Analysis, Varimax rotation)

Items – Barriers for the bicycle use	Lack of physical conditions	Lack of road conditions	Communalities
Weather conditions	0.774		0.611
Distance to the destination	0.719		0.534
Hilly terrain	0.630		0.401
The lack of showers / locker rooms the destination	0.525		0.353
Unrelated or non-existent bike paths / lanes		0.907	0.823
The feeling of insecurity due to motor vehicles		0.892	0.797
Eigenvalues	1.791	1.728	
Variance explained (%)	29.849	28.801	58.650
Reliability (Cronbach's alpha)	0.575	0.805	
Kaiser-Meyer-Olkin's measure of the sample's adequacy	0.579	Bartlett's test of sphericity (df=15)	392.592**

The results of the Kaiser-Meyer-Olkin measure of sample adequacy and Bartlett sphericity test indicate that the correlation matrix in sub-questionnaire *The role of the City in bicycle traffic* is suitable for factoring (Table 2). For the variable *Zagreb bicycle paths should be built primarily by subtracting the space of motor traffic, not of pedestrians* has the highest communality and correlation with the only principal component (*The role of the city in bicycle traffic*). Principal component is defined by six variables, and the reliability of the principal component tends to be medium high, and therefore satisfactory. The percentage of variance explained for all variables of this sub-questionnaire is overall around 39%.

The results of the Kaiser-Meyer-Olkin measure of sample adequacy and Bartlett sphericity test indicate that the correlation matrix in sub-questionnaire *The purpose of bicycle use* is suitable for factoring (Table 3). The variable *Other purposes (of using bicycles)* has the highest communality and correlation with the only principal component (*The purpose of using a bike*). This principal component is defined by five variables, while the reliability of the principal component tends to be medium high, and therefore satisfactory. The percentage of variance explained for all the variables of this sub-questionnaire is around 43%.

Table 2: Validity and reliability of the sub-questionnaire *The role of the City in bicycle traffic* (Principal Components Analysis, without rotation)

Items – The role of the City in bicycle traffic	City and cyclism	Communalities
Zagreb bicycle paths should be built primarily by subtracting space of motorized traffic, not to pedestrians	0.729	0.531
It is justified to reduce the number of parking spaces for certain locations in the city center, to improve conditions for cyclists and pedestrians	0.725	0.526
Zagreb bike paths are poorly maintained	0.652	0.424
City does not spend enough money for the needs of cyclists (R)	0.633	0.400
Yellow lanes on too narrow sidewalks are not adequate bicycle path, it is better not to draw the yellow lanes at such places	0.494	0.244
More quality bicycle lane / track and other infrastructure to encourage me to use more bike	0.488	0.238
Eigenvalues	2.364	
Variance explained (%)	39.392	
Reliability (Cronbach's alpha)	0.678	
Kaiser-Meyer-Olkin's measure of the sample's adequacy	0.746	
Bartlett's test of sphericity (df=15)	1911.771	

Table 3: Validity and reliability of the sub-questionnaire *The purpose of bicycle use* (Principal Components Analysis, without rotation)

Items – The purpose of bicycle use	Purpose of bicycle use	Communalities
Other purposes	0.779	0.607
Grocery shopping	0.764	0.583
Going to school, college ...	0.640	0.410
Sport, recreation, trips	0.563	0.317
Going to work	0.466	0.217
Eigenvalues	2.134	
Variance explained (%)	42.683	
Reliability (Cronbach's alpha)	0.638	
Kaiser-Meyer-Olkin's measure of the sample's adequacy	0.701	
Bartlett's test of sphericity (df=10)	1288.528**	

Za varijablu *Nalet biciklista dok ste bili pješak* najveći je i komunalitet i korelacija s jedinom glavnom komponentom (*Prometne nezgode tijekom prometovanja biciklom*). Glavnu komponentu definiraju četiri varijable, a pouzdanost za glavnu komponentu je vrlo niska, ali još uvijek zadovoljavajuća. Postotak objašnjene varijance svim varijablama ovog subupitnika ukupno iznosi oko 45 %.

The results of the Kaiser-Meyer-Olkin measure of sample adequacy and Bartlett sphericity test indicate that the correlation matrix in sub-questionnaire *Traffic accidents*

during riding bicycle is suitable for factoring (Table 4). For the variable *The crush caused by cyclists when you were a pedestrian* has the highest communality and correlation with the only principal component (*Traffic accidents during riding bike*). The principal component is defined by four variables, while the reliability of the principal component is very low, but still satisfactory. The percentage of variance explained for all variables of this sub-questionnaire is around 45%.

Table 4: Validity and reliability of the sub-questionnaire *Traffic accidents during riding bicycle* (Principal Components Analysis, without rotation)

Items – Traffic accidents during riding bicycle	Traffic accidents	Communalities
The crush caused by cyclists when you were a pedestrian	0.823	0.678
The crush of the pedestrians while you ride the bike	0.715	0.511
Harassment (hoot, swearing, deliberate dangerous driving ...) by the driver of a motor vehicle	0.649	0.422
Traffic accident with another cyclist while you control the bike	0.429	0.184
Eigenvalues	1.794	
Variance explained (%)	44.862	
Reliability (Cronbach's alpha)	0.540	
Kaiser-Meyer-Olkin's measure of the sample's adequacy	0.618	
Bartlett's test of sphericity (df=10)	1313.065**	

Statistički značajni prediktori za kriterij *sudjelovanje u prometu biciklom je uloga Grada u biciklističkom prometu*. Što više smatraju da bi Grad značajnije trebao poboljšati uvjete za biciklizam, biciklisti su skloniji sudjelovati u gradskom prometu biciklom.

Table 5 shows the results of the complete multiple regression analysis with different variables related to the propensity of cycling as the criteria and factors of Zagreb cycling as the predictors. Statistically significant predictors for general criteria *Frequency of cycling in 2012th* and *The most common daily distance* (as the indicators for the propensity of cycling) is the lack of physical conditions. In more inferior physical conditions for riding bicycle in traffic (*Unrelated or non-existent bike tracks / lanes* and *Feeling of insecurity due to motor vehicles*), cyclists more often ride a bicycle and ride on greater daily distances. Statistically significant predictors for the criteria *Participating in bicycle traffic* is *The role of the City in cycling traffic*. Cyclists who believe more that the *City should significantly improve conditions for cycling*, are more likely to participate in city traffic by bicycle.

Table 6 shows the differences in factors Zagreb cycling by gender and in relation to membership in the SB. It turned out that the members of the SB are more critical of *The role of the City in cycling traffic* (comparison of what could be done and the current situation), as well as in relation to the *Lack of physical conditions* (eg. showers or distance) for cycling. On the other hand, the members of SB had more frequent traffic accidents by bicycle and more often used bike for different purposes. By gender, women are more critical in relation to the lack of physical conditions and the role of the City in bicycle traffic, more often had small traffic accident during a using bicycle in traffic and more often used bicycle for different purposes.

Table 5: Results of the complete multiple regression analysis with different variables linked with the preference of riding bicycle as criteria and the factors of Zagreb's bicyclism as predictors

Criteria – frequency of cycling course during 2012.			Complete regression analysis		
Predictors – factors of the cyclism	Beta	t	p (t)		
Lack of road conditions	.206	3.371	.001	R=0.262; R ² =0.054 F (4, 251)= 4.635**	
Lack of physical conditions	.072	1.025	.307		
The role of the City in bicycle traffic	.123	1.727	.085		
Traffic accidents during involvement in cycle traffic	.020	.330	.742		
Criteria - the most common daily distance			Complete regression analysis		
Predictors – factors of the cyclism	Beta	t	p (t)		
Lack of road conditions	.234	3.818	.000	R=0.249; R ² =0.047 F (4, 251)= 4.157**	
Lack of physical conditions	-.096	-1.354	.177		
The role of the City in bicycle traffic	.025	.352	.725		
Traffic accidents during involvement in cycle traffic	.014	.224	.823		
Criteria – contributing in traffic riding bike			Complete regression analysis		
Predictors – factors of the cyclism	Beta	t	p (t)		
Lack of road conditions	.072	1.135	.258	R=0.289; R ² =0.068 F (4, 231)= 5.253**	
Lack of physical conditions	-.047	-.649	.517		
The role of the City in bicycle traffic	.309	4.229	.000		
Traffic accidents during involvement in cycle traffic	-.002	-.031	.975		

Table 6: Differences in the factors of Zagreb's bicyclism according to gender and the membership in the Association "Trade Union of the bicyclists"

Variables – factors of the cyclism	Trade Union of the bicyclists (N)	Mean	Std. Dev.	t-test
The role of the City in bicycle traffic	No (1247)	0.001	1.001	-10.033**
	Yes (936)	-0.006	1.006	
Lack of physical conditions	No (337)	-0.043	1.012	-2.483*
	Yes (50)	0.290	0.866	
Lack of road conditions	No (337)	-0.174	1.099	0.048
	Yes (50)	0.232	0.794	
Traffic accidents during involvement in cycle traffic	No (1781)	-0.052	0.984	-3.460**
	Yes (1225)	0.076	1.019	
The purpose of using bicycles	No (1594)	-0.128	0.993	-6.262**
	Yes (1170)	0.168	0.984	
Variables – factors of the cyclism	Gender	Mean	Std. Dev.	t-test
The role of the City in bicycle traffic	men (1163)	-0.038	1.062	-1.956*
	women (1007)	0.045	0.926	
Lack of physical conditions	men (150)	-0.248	0.984	-3.955**
	women (237)	0.157	0.980	
Lack of road conditions	men (150)	-0.027	1.034	-0.427
	women (237)	0.017	0.980	
Traffic accidents during involvement in cycle traffic	men (1596)	-0.136	0.920	-8.113**
	women (1362)	0.161	1.065	
The purpose of using bicycles	men (1028)	-0.076	0.951	-3.643**
	women (748)	0.101	1.053	

Table 7: Differences in the factors of Zagreb's bicyclism according to quarter of the City and the type of riding bicycle (Kruskal-Wallisov test i ANOVA)

Variables – factors of the cyclism	Part of the city (N)	Mean	Std. Dev.	Hi ² -test
The role of the City in bicycle traffic	wider City center (1328)	0.057	0.946	12.445
	western part (536)	-0.062	1.103	
	eastern part (383)	0.073	0.964	
	northern part (168)	-0.109	1.263	
	southern part (439)	-0.004	0.848	
	Sesvete, Dugo Selo, Ivanja Reka (76)	0.015	1.195	
	Velika Gorica, Velika Mlaka (41)	-0.374	1.196	
	Samobor, Zaprešić (49)	-0.353	1.138	
Lack of physical conditions	wider City center (1328)	0.070	0.962	5.013
	western part (536)	-0.058	0.986	
	eastern part (383)	0.086	1.047	
	northern part (168)	0.057	1.138	
	southern part (439)	0.001	0.975	
	Sesvete, Dugo Selo, Ivanja Reka (76)	-0.480	0.877	
	Velika Gorica, Velika Mlaka (41)	0.068	0.746	
	Samobor, Zaprešić (49)	-0.186	1.158	
Lack of road conditions	wider City center (1328)	-0.245	0.902	15.607*
	western part (536)	0.136	1.074	
	eastern part (383)	0.209	1.124	
	northern part (168)	0.428	1.056	
	southern part (439)	0.047	0.993	
	Sesvete, Dugo Selo, Ivanja Reka (76)	-0.106	0.759	
	Velika Gorica, Velika Mlaka (41)	0.142	0.704	
	Samobor, Zaprešić (49)	-0.153	0.722	
Traffic accidents during involvement in cycle traffic	wider City center (1328)	0.017	0.993	9.983
	western part (536)	-0.013	1.024	
	eastern part (383)	0.063	1.036	
	northern part (168)	-0.150	0.848	
	southern part (439)	-0.005	1.004	
	Sesvete, Dugo Selo, Ivanja Reka (76)	0.065	1.019	
	Velika Gorica, Velika Mlaka (41)	-0.056	0.968	
	Samobor, Zaprešić (49)	-0.273	0.895	
The purpose of using bicycles	wider City center (1328)	0.093	1.039	18.257*
	western part (536)	-0.094	0.973	
	eastern part (383)	0.003	0.954	
	northern part (168)	-0.202	0.992	
	southern part (439)	-0.035	0.966	
	Sesvete, Dugo Selo, Ivanja Reka (76)	-0.315	0.978	
	Velika Gorica, Velika Mlaka (41)	-0.252	0.824	
	Samobor, Zaprešić (49)	-0.188	0.827	
Variables – factors of the cyclism	Type of cycling (N)	Mean	Std. Dev.	F-test
The role of the City in bicycle traffic	large road with heavy traffic and high speeds	0.109	0.867	0.242 (df=2,1896)
	roads with lower traffic and lower speeds and cycle paths / lanes	0.078	0.859	
	only on sidewalks and bike paths / lanes	0.069	1.059	
Traffic accidents during involvement in cycle traffic	large road with heavy traffic and high speeds	0.102	1.066	2.414 (df=2,2602)
	roads with lower traffic and lower speeds and cycle paths / lanes	0.009	0.996	
	only on sidewalks and bike paths / lanes	0.093	0.978	
The purpose of using bicycles	large road with heavy traffic and high speeds	-0.217	0.980	18-536** (df=2,1778)
	roads with lower traffic and lower speeds and cycle paths / lanes	0.021	0.986	
	only on sidewalks and bike paths /	0.244	1.025	

Table 7 shows the differences in factors of Zagreb cycling, depending on the part of the City where the participants live in and the type of cycling (run by major roads and in smaller roads or only on the sidewalks). It turned out that the lack of road conditions is usually noticed by the residents of the northern part of Zagreb (Podsljemenska zone), while the least is noticed for the population of wider center of Zagreb (bounded roughly by Heinzelova street, Slavonska / Ljubljanska Avenue and Zagreb Road). Moreover, the inhabitants of the wider center of Zagreb the most commonly use their bikes for different purposes, while the rarest do it the residents from Sesvete, Dugo Selo, Ivanja Reka. Finally, there are no differences in perceptions of the role of the City in cycling traffic in relation to the type of riding. None statistically significantly differences are found among cyclists in terms of the number of traffic accidents and inconveniences. However, it seems like that cyclists who ride only on sidewalks and bike tracks/ lanes (ie. those who are inclining to the safest riding) are more likely to use a bicycle for different purposes.

Discussion

The main findings of the research indicate that found latent dimensions of the sub-questionnaires well represented given topics: *the barriers to cycling, the role of the City in bicycle traffic, the purpose of the use of bicycles* and *a traffic accidents during bicycle traffic*. Furthermore, since the resulting latent dimensions have satisfactory reliability, it can be considered that new measuring instruments have been constructed, with initially good measuring characteristics (reliability and construct validity). These instruments could be used in future studies of similar themes in other urban (but potentially and rural) Croatian communities. It could be said that this certain topics are key factors for the use of the bicycle as a means of traffic in the City of Zagreb, which is consistent with the analyses in other research (Research into Barriers to Cycling in New South Wales, 2009; Pucher et al., 2010; Lukić A. et al., 2011).

Results of regression analyzes show that people who are more inclined to participate in city traffic by bike, more often believe that the City should significantly improve the conditions for cycling. More frequent user of bike per a year and per a week more often believe that the lack of road cycling conditions is significantly expressed. Overall, women and members of the SB more often feel that the conditions for cycling should be improved by the City government and negatively evaluate existing conditions for biking. They also frequently use bicycles for different purposes and they often had traffic accidents by bicycle. The northern part of the town, region Samobor, Zaprešić, and region Sesvete, Dugo Selo and Ivanja Reka have estimated the most adverse road conditions for cycling. The conditions for cycling are estimated as the best in the town center of Zagreb. A similar trend is also associated with a variety of purposes for using bicycles. Bicycles are more commonly used in the improved traffic and other conditions for cycling. Finally, cyclists who more often ride the bike for different purposes, are more inclined to safe driving. In other words, from all mentioned above, it follows that the critical conditions for safe cycling are primarily road conditions (shortcomings). However, the City government should significantly improve conditions for cycling, for example, by reducing the traffic of motor vehicles (Pološki D. et al., 2008).

Particular importance should be given to the importance of the specific characteristics of the population (for example, what women considered as key factors for frequent cycling), as well as to the specifics of existing transport infrastructure and the relief of certain parts of the city. Similar are actually the barriers that prevent people to regularly ride a bike in Sydney and the region. Australian researchers emphasized four main barriers

(Research into Barriers to Cycling in New South Wales, 2009): negative image of cyclists and cycling among non-cyclists (a); perceived threats to urban and suburban cycling because of the perceived or real lack of safe places to ride a bike, with the fear of collisions with motor vehicles (b); lack of facilities for storage or lock bicycles (c); little or no understanding or confirmation on the benefits of the cycling as a mode of traffic (d). Key issues that do not support cycling as transportation options are: the inconvenience of transportation by bike, which caused the need to use other forms of transportation (a); lack of time, ie. the slowness of bicycles (b); lack of facilities for the storage of bicycles (c); perception that cycling is not „cool“ mode of transportation (d) costs of the cycling (e) (Research into Barriers to Cycling in New South Wales, 2009).

An important advantage of this research is the fact that this is the most comprehensive survey so far in Croatia, which was conducted in terms of the problems of cycling and cycling conditions in the city of Zagreb, but also in general in the Croatian urban environments (in the study is included more than 3,000 participants). Unlike studies that have compared mostly cyclists and non-cyclists, in this study all participants were cyclists, with different age groups, occupations, genders and other relevant characteristics. Particularly important is the fact that the application of empirical research has contributed to the systematic approach of such issues. The findings from this study can not only productive contribute to defining working program of the association SB, but also could serve in the evaluation of achieved goals, similarly as the projects implemented in major European cities (Pucher J. et al., 2010). The lack of the research is somewhat smaller representativeness of the snowball sample, used for selecting the members of the sample of average cyclists.

Conclusion

Latent dimensions (as the initial version of a set of new measuring instruments) well represented given thematic issues relating to Zagreb cycling: the barriers to cycling, the role of the City in the bicycle trade, the purpose of the use of bicycles and a traffic accident during bicycle traffic. People who more often participate in city traffic by bike, women and the members of the SB, more often think that the City should significantly improve conditions for cycling and negatively estimate the lack of road conditions for cycling in Zagreb. Wider surrounding of the center of Zagreb currently has the most favorable conditions for cycling. Cyclists who ride bicycles more often for different purposes, are more inclined to safe driving.

The possibility of practical application of research results is multiple: the results provide a guidance for taking constructive social actions at the state level and the local community, not only to improve conditions for cycling and transport infrastructure in general, but also in terms of promoting awareness of sustainable urban development and healthy lifestyles in general. The key barriers to cycling are also the challenges for motivating to use cycling as a means of transport: Australian researchers consider applying the the theory of reasoned action for these purposes (Ajzen I., 1993). There is a need to increase the safety of bicycle traffic through building constructive infrastructure, particularly by clearly separate bicycle lanes, where the bikers can drive safely. Furthermore, it is important to ensure the bicycle storage facilities in the workplace for the cyclists. It is necessary to motivate people to think more about the advantages, instead about the disadvantages of cycling, while certain financial incentives could be used to encourage cycling (Research into Barriers to Cycling in New South Wales, 2009). Experiences from Sydney indicate that there is a need of marketing activities aimed at: promoting cycling (in the sense of encouraging the public that think about these issues); promoting current achievements in this regard; providing information about the cycling for those who are interested in cycling, but also employers (about the benefits of cycling for their employees).

It is important to raise the responsibility of the community, developing types of programs that can be imported. Finally, it is important to promote the benefits of cycling, and to inform people about safer routes for bicycle traffic (Research into Barriers to Cycling in New South Wales, 2009).

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