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Pedestrian road safety in relation to urban road type and traffic flow

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Abstract

The paper presents an analysis of the relationship between pedestrian road safety, urban road type and motorists' traffic flow. A suitable index for the evaluation of the walkability level of an urban street is the pedestrian traffic flow and the walking behavior. The researchers examined six urban streets of various types in the city of Volos (a medium-sized Greek city, 130,000 inhabitants). They collected data of the pedestrian traffic flow and their legal or illegal walking behavior for each road segment of the examined streets. Furthermore, they collected data of motorists' traffic flow in the same road segments of the streets in the study area. The combination of those data with the administrative ranking of each road can indicate a walkability level of an examined street or a specific route and reveal pedestrians' mobility and safety issues. This study supports that walking behavior differs for various road types. Pedestrians with the highest rate of legal behavior were presented in main arterials (91.8%) and the lowest one in local streets (53.7%). Low level of motorized traffic flow in combination with maintenance and mobility problems in pedestrian infrastructure incites pedestrians to walk in the street thus underestimating their safety issues. Promotion of pedestrian mobility emphasizing in safety issues can change the modal split in favor of vulnerable road users, increase the sustainability index of an urban area and improve the citizens' quality of life.

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Keywords: pedestrian; road safety; road type; traffic flow; sustainability
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1. Introduction

This study presents an analysis of the relationship between pedestrian road safety, urban road type and motorists' traffic flow. The pedestrian traffic flow and the walking behavior can be a suitable index for the evaluation of the walkability level of an urban street. The researchers examined six urban streets of various types (arterials, collector arterials, local streets) in the city of Volos (a medium-sized Greek city). They collected data of the pedestrian traffic flow and their legal or illegal walking behavior for each road segment of the examined streets. Furthermore, they collected data of motorists' traffic flow in the same road segments of the streets in the study area. The authors support that a combination of those data with the type of each road segment can indicate a walkability level of a street or a specific walking route and reveal mobility and safety issues.

The relationship between walking and built environment can be examined using specific audit tools (Galanis and Eliou, 2012). Furthermore, the features of the pedestrian built environment can be graded, resulting to a walkability index (Galanis and Eliou, 2011a). Finally, the pedestrian urban infrastructure can be examined using walkability

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indicators (Galanis and Eliou, 2011b). This type of indicators can help engineers and stakeholders to find where the pedestrians face mobility problems across their desire route.

2. Literature review

Pedestrians are vulnerable roads users due to their exposal on higher risk level during their interaction with heavy or fast motorized traffic. There is a lot of research worldwide regarding pedestrian accident severity. The most common factors which influence pedestrian accidents are their age and gender, alcohol usage and vehicle type. Sze and Wong (2007) applied logistic regression in order to investigate the influence of contributory factors on the probability of fatality and sever injury. In pedestrian – vehicle crashes young (under 19 years) and older pedestrians (over 60 years) are more likely to be involved in fatal accidents than other age groups (Al-Ghamdi, 2002). Parameters that significantly influence the severity of the pedestrian injuries are the: vehicle type; drivers' or pedestrians' alcohol involvement and age (over 65 years), (Zajac and Ivan, 2003). The elderly are more vulnerable, higher speed limits lead to higher injury severity, accidents at signalized intersections are less severe and darkness leads to higher injury severity (Eluru et al., 2008). There is also an influence of personal and environmental characteristics on pedestrian severity in pedestrian-vehicle crashes. The environmental conditions should be examined more thoroughly and be an important consideration when planning urban areas (Clifton et al., 2009).

Walking with company and presence of high level pedestrian traffic flow in a street can increase the road safety level. Jacobsen (2003) concluded that doubling the pedestrian volume results to 32% reduction of traffic crashes with injuries. This can be explained because drivers are aware of pedestrians' presence and adapt their driving behavior. Higher vehicle speeds increase both the likelihood of a pedestrian being struck by a car and the severity of injury (Rosen and Sander, 2009). Most pedestrian deaths occur in urban areas, non-intersection location and at night (NHTSA, 2015). In 2013 4,735 pedestrians were killed in traffic crashes in the United States. This averages to one crash-related pedestrian death every two hours (NHTSA, 2015). Additionally, more than 150.000 pedestrians were treated in emergency departments for non-fatal crash-related injuries in 2013 (CDC, 2015). Pedestrians are 1.5 times more likely than passenger vehicle occupants to be killed in a car crash on each trip (Beck et al., 2007). In 2013, 5,712 pedestrians were killed in road accidents in the EU, which is 22% of all fatalities. In the last decade, in the European Union pedestrian fatalities were reduced by 37%, while the total number of fatalities was reduced by almost 45% (ERSO, 2015).

Citizens desire to live in a city where they will be able to walk with safety and convenience. Cities that are suitable to walking (walkable city) have many benefits for their citizens in terms of road and personal safety, convenience, accessibility to destinations, combined transportation and increased health level. The definition of walkability is not specific but can be explained as the suitability that the urban road environment offers to pedestrians (Lund, 2003; Southworth, 1997; Saelens et al., 2003). The walkability level differs among urban areas and cities. There are many differences related to economic, cultural and topographical factors. Pedestrians should be able to walk in the entire urban road network in order to reach their destinations. Promotion of walkability can improve the quality of life in urban areas and raise the sustainability footprint of the city.

There are major benefits from the promotion of walking both in urban and regional revel. Pedestrians do not consume fuel to travel, pollute the air or create noise. In urban areas the choice to walk depends on many factors. Shay et al. (2003) propose two groups of factors that influence walking: ability and motivation. The "motivation" factors relate to personal or social characteristics. Only with the presence of the ability factors can be the motivation factors operational in order to promote walking among citizens.

The distance and the time that is necessary for a commuter to reach his destination are major factors in order to travel on foot (Mackett, 2001). Pedestrians travel slowly, resulting to a limited distance of 1÷2 km they can reach conveniently. Issues more than road safety and mobility, like personal image and value of time are usually critical factors for citizens to select walking. Especially, highly paid workers cannot afford losing working time selecting to travel on foot or with public transport modes. Personal safety is also a major factor for many citizens to walk (Easton and Smith, 2003). Especially women avoid walking during night time selecting another transport mode or choosing not to travel. Many parents consider that their children face not only problems for their road but also personal safety when they walk (Jones and Bradshaw, 2000).