ANALYZING ROAD SIGNAGE COMPREHENSIBILITY AMONG DRIVERS IN LAHORE CITY, PAKISTAN

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Abstract
Road signage is an important component of traffic safety and convenient driving. It is a substantial tool placed on roads which target multiple users and give awareness about traffic situation to prevent casualties. This research aims to analyze the road signage comprehensibility of drivers with twenty different signs in Lahore City, Pakistan. Five hypothesis are made to assess comprehensibility in relation to personal characteristics of drivers (gender, marital status, age, education and driving experience). Total 400 questionnaires were filled from active driving license holders of Lahore for comprehensibility analysis. The research also incorporates interviews from officials of public sector organizations involved in managing road signs in Lahore. The findings of the study shows that, there is a strong correlation of driver comprehensibility with age, education and driving experience. The analysis depict that 14% people had high comprehensibility, 68% on medium level and 18% drivers with low road signage comprehension for the selected signs. The research claims that road sign comprehensibility should be significantly improved in drivers for effective traffic management in the city. The recommendations in this regard includes, adding section of road signage in formulation of urban plans and considering it especially for new infrastructural developments, as an element of road safety. Intergovernmental cooperation should be enhanced and awareness raising workshops must be organized for both novice and regular drivers.
Keywords: Road safety, accidents, comprehension, traffic management, Lahore

INTRODUCTION

Urban transportation has become collarbone for growth and management in the cities. The technological era of modern times is welcoming more and more vehicles to facilitate community by shortening distances with contributing ease. Globally, almost 1.2 Billion vehicles are running on roads, which has risen the concern for road safety and well-being (Voelker 2014). Traffic accidents are increasing at an alarming rate, approximately 1.35 million people die annually and it is expected to become seventh principal cause of death by the year 2030 (WHO 2020) World Health Organization claims that 90 percent of such cases occur in lower and middle income countries where governments on average are spending 3 percent of

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their Gross Domestic Product on casualties related to traffic accidents (WHO 2020). Safety measures work differently for countries, hence, there is a dire need for governments to focus on road safety to ensure residents security (Wegman 2017).

Pakistan is a developing country with worst record in road safety, which impends public health (Zaman 2019). It is rated 1st in Asia and 48th in the world for most deaths by traffic accidents (Rahman 2020). Every year, almost 27,582 people die and around 50,000 people become victim of disability from these crashes (WHO 2018). 60% of them are younger people in 16-45 years age group, especially males, belonging to laborers and vendors profession (Zia et al. 2018; Khan & Fatmi 2014). Pakistan faces economic loss (WHO 2015) of around 100 billion rupees annually from road traffic accidents (Ali et al. 2018), with highest death rate in Punjab Province followed by Sindh, Khyber Pakhtunkhwa and Baluchistan (Kazmi 2017). The increase in car ownership rate, infrastructural development and rapid urbanization have further exacerbated the risk of accidents (Arif et al. 2015) in the country with weak leadership in policy matters (Nazir et al. 2016). Despite this alarming situation, few researches exist in this context in Pakistan, and road safety is not given much consideration (Ahmed 2007).

Lahore, the 2nd largest city of Pakistan and 15th most populous city in the world (World Population Review 2020) has substandard records in terms of road causalities with annual accidents exceeding 40,000 (Shah et al. 2018). Most of the accidents are caused by the negligence of drivers, lack of awareness, rash driving, signal violation and poor maintenance of overused vehicles (Kazmi 2019; Shahzad 2016; Randhawa 2017). Cars and motorcycle are the most common vehicles used for commuting in the city which are 30.6% and 9% simultaneously responsible for road accidents (Rescue 1122 2020). Increase in deaths and injuries caused by traffic mishaps emphasize the need to resolve the issue at national and local level with strategic vision (WHO 2009). Driver inattention, non-compliance of traffic rules and distraction are the most plausible causes (Oviedo-Trespalacios et al. 2018; Alex & Alexander 2010) which if improved, can be helpful in reducing overall road injuries and deaths (Riaz & Shahid 2018).

Road signs are the most common traffic safety tools placed on roads which provide guidelines, warnings and information to the users. Readers are made aware about traffic and road situation with the help of specifically designed icons (Brucal et al. 2015) which convey message in form of symbolic representation or text. For smooth traffic flow, roads should have proper signage to minimize traffic mishaps. If the message conveyed by signs are properly followed by drivers, then it will be helpful in maintaining discipline on roads. Signs make drivers aware about their destinations, entry, exit and turning points on road in advance by allowing free flow traffic. (The Road to Change 2013).

Signs must be located at a place where drivers have sufficient time to think about the message displayed on icons (Jamson 2005). They should be created with additional text on or under them to increase clarity

among drivers (Yakut 2006). The success of this tool depends upon the comprehensibility of drivers for those signs, if they fail to understand them, then safety of users is at high risk (Ghadban et al. 2018) Therefore, comprehension of road signs is the most common factor which affect safe driving

The placement and design aspects of road signs were studied in various past researches i.e. color, lightning conditions and sharpness of signs, but very less studies emphasis on understanding of road signs in drivers. The research about comprehensibility of traffic signs started almost in 1966, early studies evaluated understanding about local signs and mostly concluded that they were far from satisfactory (Zhang & Chan 2013). With the passage of time research criteria enhanced and studies also included drivers' individual factor like gender, age, driving experience, education background etc. for comprehension test.

Al-Madani & Al-Janahi (2002a, 2002b) explored the relationship between comprehensibility and personal characteristics of drivers and another research by Shinar et al. (2003) focused on cross-cultural study about comprehensibility of road signs. Ng and Chan (2007, 2008) studied the effects of design features and driver factors on the comprehensibility of road signs. Another study by Makinde and Opeyemi (2012) explored that age, education and driving experience have high degree of association with understanding of road signs whereas marital status and age don't have any effect on understanding level. Culture is also an important determinant in understanding signs (Ou & Liu 2012)

By keeping in consideration, the importance of road signs in accident reduction and the role of personal characteristics of drivers in traffic safety parameters. This research explores level of comprehensibility and appropriateness of road signage among drivers in Lahore, capital city of Punjab Province in Pakistan. The paper aims to evaluate signage comprehensibility in drivers of Lahore; obtain suggestions and recommendation from representatives of road and traffic management authorities at local level and to devise recommendations for enhanced road signage system and comprehensibility among drivers in Lahore.

2 MATERIALS AND METHODS

The research had been carried out in an explorative mode to determine impacts of road signage comprehensibility among drivers in Lahore. Data was collected from primary as well as secondary sources. Secondary data was taken through research journals, articles and newspaper blogs majorly focusing on traffic safety. In case of primary data, interviews were conducted with different officials of public sector organizations responsible for signage in Lahore. A map was prepared to mark roads with best signage and markings in the city.

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Questionnaire survey was also conducted among the active driving license holder in Lahore. Questionnaire consisted of three main sections which had multiple choice questions to be asked from respondents. Sections one considered the personal and socioeconomic characteristics of drivers like gender, education, age and experience to road accidents. Section two, included public views about road signs, where respondents were questioned about their perception on their level of knowledge, readability and the impact of road signs on their driving.

Section three, basically dealt with comprehensibility of road signs, meaning of twenty different road signs were asked from drivers to check comprehension. All the signs had multiple choice options about their description. Multiple choice questions were asked as it reduces the chance for drivers to develop their opinion about the sign and the respondents were bound to answer from the provided options (Hawkins et al. 1993). Six regulatory, eight warning and six informative signs were included in questionnaire. For the determination of sample size for questionnaire filling, Solvin method was used:

$$n= N/ 1+Ne2$$

According to City Traffic Police, Lahore, there were almost 22, 06145 total number of active driving license holders in March 2018, which was taken as N in the formula above. By taking margin of error as 5%, sample size of 400 was taken for questionnaire analysis as described below:

$$n= N/ 1+Ne2$$

$$n= 22, 06145/ 1+ (2,206,145*(0.05)2)$$

$$n= 400$$

Questionnaire data was analyzed further with Correlation and Chi Square Test in SPSS. Five research hypothesis were formulated to verify the relationship between comprehensibility and driver's personal characteristics namely Gender, Marital Status, Education Level and Driving Experience.

3 RESULTS AND DISCUSSIONS

3.1. INTERVIEW ANALYSIS

In Lahore City, road signage is managed mainly by two local organizations Traffic Engineering and Planning Agency (TEPA) and City Traffic Police (CTP), moreover, Rescue 1122 provides emergency services in many situations to the general public like in case of traffic accidents through ambulance facility in different cities of Punjab including Lahore. A set of comprehensive interviews were conducted to have proper in sight about working mechanism of these institutions. The details of these interviews are discussed below:

3.1.1. Traffic Engineering and Planning Agency (TEPA)

TEPA was established in 1987, under Lahore Development Authority Act, 1975 with the aim to monitor transportation planning and design functions in Lahore City. The agency prepares and implements traffic management and engineering plans, cater the needs of road users as well as design and maintain road markings, road signs and traffic signs in Lahore to accomplish the very purpose (LUTMP 2011). TEPA gets funds and budget from Lahore Development Authority (LDA) or Town Municipal Administration (TMA) of Lahore for its working. The provision of funds and budget depends upon the area of jurisdiction in which the development work is going on.

For the placement of road signage TEPA follows the standards given in "Punjab Traffic and Transport Manual 2008" and "American Association of State Highway and Transportation Officials" (AASHTO) Green Book." Traffic signs are placed by keeping in view the traffic volume and ratio of accidents on the specified road.

According to the interviewee TEPA officials, traffic signage on major roads of Lahore is good but not enough. The signs placed on the roads are only necessary signs, on the contrary they are clearly insufficient. If road signage will be increased on roads, it will be easier for visitors and new inhabitants to move from one place to another. The respondents claimed that improved road signage conditions will make traffic flow even better in the city.

The officials were of the view that best locations regarding traffic signage are corridors along Canal Road, Main Boulevard Gulberg, Ferozepur Road and some segments along Ring Road. Whereas, North Lahore is considered as worst area in terms of traffic signage. No signs are placed on these roads because people don't follow them.

3.1.2. City Traffic Police (CTP)

City Traffic Police (CTP) is the most effective department to maintain the traffic management in Lahore. The prime objective of city traffic police is to control over speeding, assure compliance to traffic and safety rules, check over drug driving, monitor antisocial and criminal use of vehicles on the roads, seizing un-authorized and un-licensed vehicles with maximum concern towards reduction of road accidents.

The traffic police officers were of the view that traffic signage is not enough as per requirements of roads and their usage. There are only a couple of roads that have ample signage but good road signage in actually missing at all. People drive reckless with over-speeding and they have generally no idea about the local speed limit that tends to increase the accident ratio.

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The officials were of the opinion that only 10% to 20% of the road users follow the road signage correctly. Only three to four roads of Lahore have good traffic signage which include Mall Road, Ferozepur Road, Main Boulevard Gulberg and Jail Road have appropriate signs. The recommendations of CTP are not entertained in a considerable manner by TEPA.

3.1.3. Rescue 1122

Rescue 1122 is the organization which provides largest humanitarian service in Pakistan with emergency services in all the districts of Punjab Province. The service was initiated in 2004 from Lahore City with timely ambulance facility to general public in case of any emergency situation. The main mission of Rescue team is to ensure safety by providing an efficient and effective emergency system management in community. In the time period of sixteen years in Lahore, total 23261207 calls were responded from which 621083 request were for road accidents. (Rescue 1122 2020)

When asked about the main cause of accident in Lahore, the official responded mostly it is due to “reckless driving” especially on Canal Road. In case of many emergency situations, the reason behind the accident is that: “Everyone seems in hurry, and try to disobey the rules”, which makes the situation worse. Vehicle ownership has increased in Lahore, motor bikers and rickshaw drivers create mess by crossing vehicles in wrong way in case of traffic jams. Furthermore many times the main reason behind accidents is the absence of U-turn sign on roads, when drivers take sudden turns which creates problem in traffic flow. They were of the view that: “Not in all cases, but yes the disobedience of traffic and road rules leads towards accidents in most places”.

The areas with best and worst road condition and signage were also identified from them to get their viewpoint. They responded "Canal Road, Main Boulevard Gulberg, Jail Road, Ferozepur Road, Maulana Shaukat Ali Road, Khayaban-e-Firdousi Road as well as roads in Cantonment and Defense are best, whereas Walled City is the worst area from road condition and signage point. Therefore in case of any emergency situation, in areas like Shah Alam it’s difficult to reach at those places for rescue.

3.1.4. Mapping Roads with Best Signs

Based on the practical observations of the interviewed officials from TEPA, CTP and Rescue 1122 and reconnaissance surveys by the authors, a map was prepared which indicates the location of roads with best signage in Lahore. These roads includes Canal Road, Ferozpur Road, Mall Road, Main Boulevard Gulberg, Main Boulevard Allama Iqbal Town, Maulana Shoukat Ali Road, M.M. Alam Road, Link Road and Khayaban e Jinnah Road as shown in Fig I.

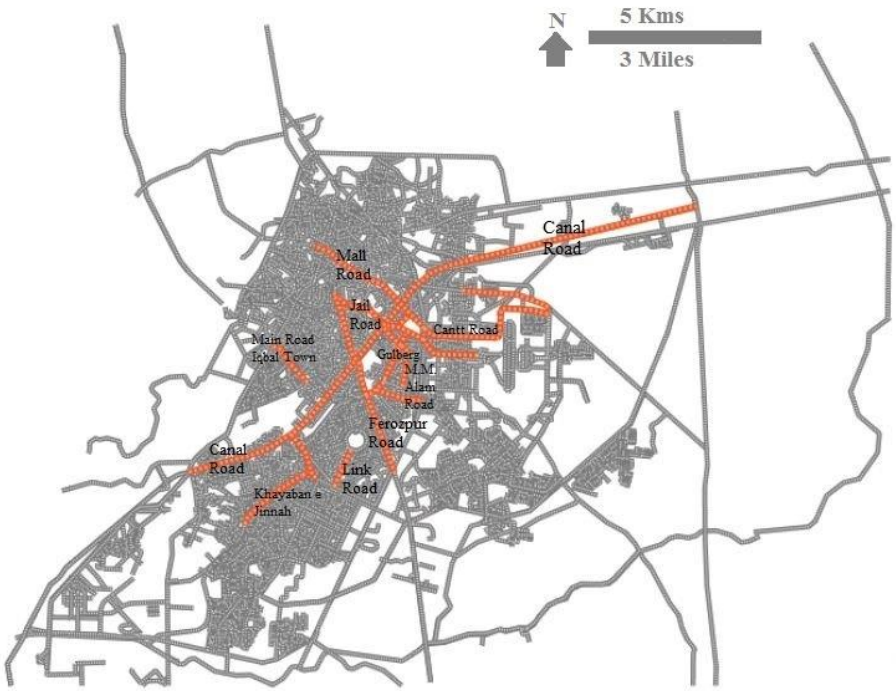

FIGURE 1 - ROADS WITH BEST SIGNS IN LAHORE. (SOURCE: AUTHORS OWN WORK, 2020)

3.2. QUESTIONNAIRE ANALYSIS

3.2.1. Personal Characteristics of Drivers

Personal characteristics of drivers impacts their comprehensibility about signs, therefore, it was given special consideration in the questionnaire. Table I, shows complete details of personal characteristics of the respondents, which included 56% males and 44% females drivers with 61% married and 39% unmarried people. Comprehensibility of road signs increases with age (Al Madani & Al-Janahi 2002b), the analysis showed that (30%) respondents were young drivers of 18-24 age, 23% belonged to 25-30 and 9% were above the age of 50. 42% drivers had medium level of education and 67% people use car and 14% drive car and motorbike for commuting. 16% of the respondents had less than two years of driving experience, most people (25%) with 2-5 years expertise, whereas 8% with more than 30 years of driving history.

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TABLE 1 - PERSONAL CHARACTERISTICS OF RESPONDENT DRIVERS

Personal Characteristics of Respondents	Categories	Percentage
Gender	Male	56.40%
	Female	43.50%
Marital Status	Unmarried	39%
	Married	61%
Age Group	18-24 years	30%
	25-30 years	23%
	30-40 years	23%
	40-50 years	16%
	Above 50 years	9%
Education	High	34%
	Medium	42%
	Low	11%
	Illiterate	13%
Vehicle Drived	Car	67%
	Car, Motorbike	14%
	Motorbike	9%
	Rickshaw	4%
	Bus/Van	6%
Driving Experience	Less than 2 years	16%
	2 - 5 years	25%
	6 - 10 years	19%
	11 - 15 years	15%
	16 - 20 years	13%
	21 - 30 years	5%
	More than 30 years	8%

3.2.2. Public Views about Road Accidents

Road signs are helpful in reducing accidents and traffic hindrances on roads, respondents were inquired about their frequency of witnessing and experiencing accidents while driving. (Figure II) details that 18% witness accident almost every day, 46% had never faced any personal road causality. Whereas 19% witness accident once a month and 4% experience it monthly.

When inquired about the major causes of accidents in Lahore, 35% blamed reckless driving, 21% believed non-compliance of signs, 14% thought over speeding, 12% assumed distracted driving, 11% reason lack of experience, 5% thought improper signage on roads and 2% were of the opinion that design defects are the major impeding factors.

Respondents were also inquired about their perception regarding knowledge of road signs, 41% thought they have enough knowledge and 52% believe they have very little knowledge. Majority of respondents (89%) claimed that they easily understand signs on roads with 80% assured placed signs quite easy to read in Lahore City.

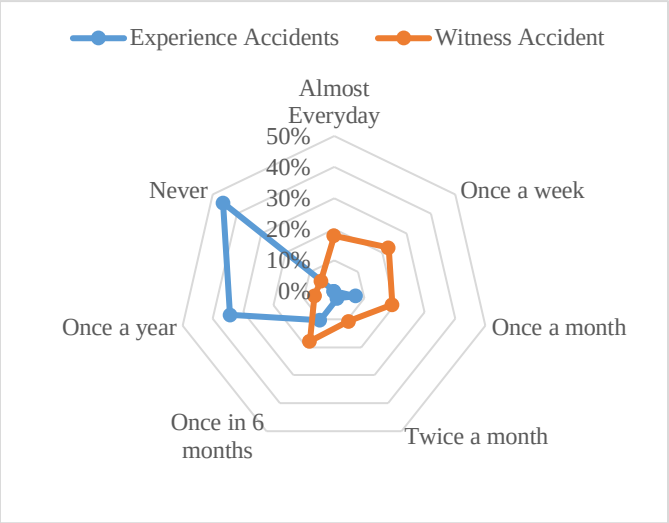

FIGURE2 - FREQUENCY OF EXPERIENCE VS WITNESS ACCIDENTS

3.2.3. Analyzing of Road Signage Comprehensibility

In this section, respondents were inquired about the meaning of twenty different road signs from traffic signs manual of City Traffic Police (CTP) Lahore. All the provided options were closely related to the actual meaning of the sign. Figure III, depicts the percentage analysis of the road signs used in the study. All the respondents knew the meaning of road sign 'Men at work' and 'U turn' (100%), whereas only 20% were familiar with the sign of 'One way road.

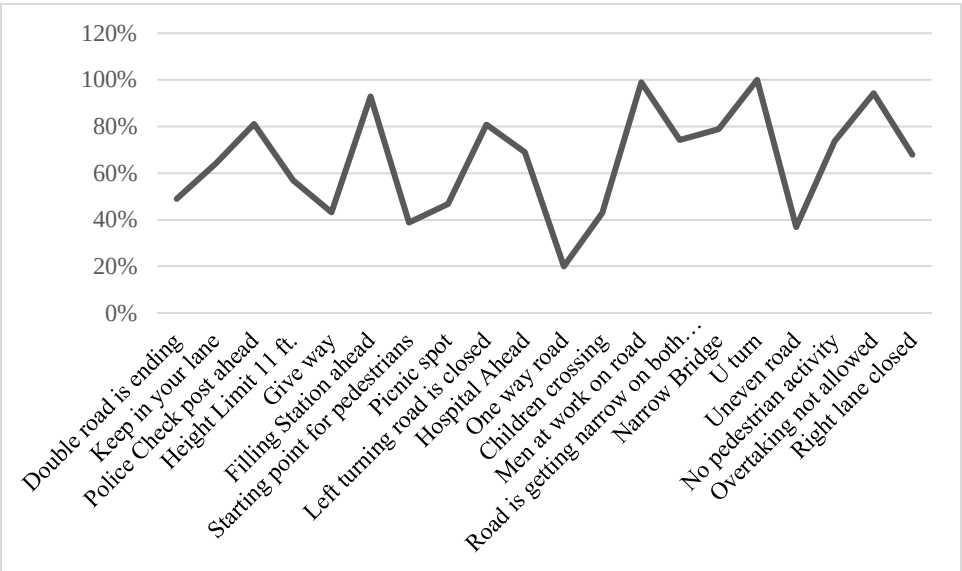

FIGURE 3 - RESULTS SHOWING RESPONDENTS KNOWLEDGE OF ROAD SIGNS.

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3.2.4. Drivers Comprehensibility

On the basis of above mentioned twenty signs, comprehensibility for each respondent was calculated. The signs correctly answered were evaluated and the cumulative score was assigned to each surveyed driver. The most number of signs correctly answered by any respondent were "18", none of the respondent correctly answered all signs. The least number of correct answers by any respondent was "3" signs.

In this way, all the responses were checked and three categories were formulated to further divide comprehensibility as High, Medium and Low. Respondents with correct answer between 0-10 were categorized as "Low", from 11-15 value as "Medium" and in range of 16-20 were evaluated with "High" comprehensibility in the surveyed drivers. Results revealed that 68% falls in 'Medium' category of comprehensibility with most of the respondents (21%) had given correct answers to eleven signs. 18% people had 'Low' and 14% had 'High' comprehensibility for the selected road signs.

3.2.5. Testing of Research Hypothesis

Five research hypothesis were tested to examine comprehensibility with driver personal characteristics including gender, marital status, age, education and driving experience. Chi Square Test on SPSS Software was used for this purpose, alpha value less than and equal to 0.05 shows that there exists a strong relation between the variables. Table II, shows the results of Chi Square test, there is a strong significance (apha value: 0.000) between age, education and driving experience of respondents and comprehensibility. Whereas the apha value of 0.292 and 0.224 between comprehensibility and respondents gender and marital status proves that, there is no association between these variables.

TABLE 2 - CHI SQUARE TEST BETWEEN DRIVERS PERSONAL CHARACTERISTICS AND THEIR COMPREHENSIBILITY

Chi Square Test	Value	df	Alpha (Asymp. Sig.) (2-sided)
Gender and Comprehensibility	2.464[a]	2	.292
Marital Status and Comprehensibility	10.615[a]	8	.224
Age and Comprehensibility	77.886[a]	8	.000
Education and Comprehensibility	36.164[a]	6	.000
Driving Experience and Comprehensibility	71.464[a]	12	.000

Correlation analysis between comprehensibility, education and knowledge of signs proves that people having high comprehensibility belonged to high and medium educational background with 50% and 22.5% perception about enough knowledge of signs respectively. People with medium information about signage and medium education had 18% comprehensibility. Moreover, 30% females with high knowledge about

signs never faced any accident, while 25% male with high comprehensibility experience accident once a year.

Relationship between comprehensibility, gender and age showed that female in 25-30 years and males of 30-40 age have lowest level (20%) and (32%) knowledge of road signs. Highest comprehensibility (25%) in female respondents were observed in age group of 40-50 but in males (27.5%) familiarity exists in drivers above 50 years. Hence, it proves that comprehensibility is dependent on age irrespective of respondent's gender.

Cross tabulation among comprehensibility, gender and driving experience reveals that females with 21-30 years and males of more than 30 years driving experience have high comprehensibility with values as 12.5% and 27.5% respectively. The lowest ability to understand road signs correctly was in 12% females with less than 2 years of experience, whereas, in males less awareness was observed among drivers with 2-5 years of driving (16%). Young drivers with less than 5 years of experience recognized less signs in both genders in comparison, respondents with high comprehension level had more driving experience. Therefore, the analysis claims that comprehensibility increases with driving experience.

4. CONCLUSIONS

Traffic accidents are increasing at an alarming rate with higher risk in lower and middle income countries. Urbanization, increase in car ownership and infrastructure developments are intensifying the threats of accidents. Governments are taking different measures to reduce this situation, but the most plausible causes of failure could be non-compliance of traffic rules and driver behavior. Road signs are effective in providing safety to the users and also ensures smooth traffic flow for community well-being. The effectiveness of these depends upon the comprehensibility of users for the signs, which if improved, can be helpful in reducing overall road causalities.

The interviews from officials of TEPA, CTP and Rescue 1122 infers that there is no proper road signage on traffic corridors of Lahore especially, within Walled City Area and its surroundings. There is lack of coordination among departments which bring ineffective traffic management in context of road signage in the city. Moreover, there are no national legislations for road safety to be followed by departments, hence international manuals are consulted in times of need.

The questionnaire analysis showed that most of the people suffer road accident once in a week (23%) whereas 18% witness accidents almost every day, 19% once a month and 11% twice a month. Most of the people were of the view (35%) that reckless driving is the basic reason behind occurrence of an accident and only 21% believed they occur due to non-compliance of road signs. The comprehensibility

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of drivers infer that 68% had medium comprehensibility whereas, 18% fall in low category and only 14% had high comprehensibility for traffic signs. Though medium comprehensibility carries most of the percentage, but 21% respondents from this category answered 11 signs correctly.

89% of the respondents indicated positively about understanding of road signage and only 74% claimed that proper signage brings ease to driving and improve traffic flow. 72.5% respondents perceived rightly about enough knowledge of road signage, on the other hand, in 41.6% of medium comprehensibility only 16% had wrong self-perception, as they had low level comprehensibility in the analysis.

In all categories of comprehensibility, the results revealed that females experience less accidents than males. (High: 42.5% versus 57.5%; Medium: 46.3% versus 53.7%; Low 34% versus 66%)

It is proved from the analysis that comprehensibility is dependent on age irrespective of respondent's gender. Novice drivers having experience less than 5 years recognized less signs as compared to experienced drivers with high comprehensibility. Thus experience plays vital role in increasing knowledge of road signs.

The research hypothesis through application of Chi Square Tests proved that there exists strong association between comprehensibility of drivers with age, education and driving experience. But comprehensibility has no relation with gender and marital status of drivers.

Following are the competent recommendations developed in the light of conducted research:

1. The plan approval of new infrastructural developments should be included for proper road safety plan along with placement plan for key road signage.
2. There must be awareness workshops for active driving license holders. It should be mandatory for regular drivers to attend annual awareness seminars of road safety for license renewal.
3. Higher authorities should work for making of proper legislation and regulation framework. National road safety manual must be prepared proper designs of road signage.
4. The road signage may be included as a part of urban plan. Subject planning by urban planners for the specific issue should be done for the purpose of road safety.
5. There should be intergovernmental cooperation among the departments. TEPA officials should pay more attention to endorsements of Traffic Police Department. They must also consult Rescue 1122 for their observation and accident records to identify corridors that bear potential risk.

6. The driver licensing must be improved in Pakistan. The criteria of issuance should be redefined by giving more weightage health, education and conviction status as well. No license should be issued unless the applicant attend at least two (2) workshops road safety.

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