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An Analysis of Understanding of Traffic Signs among Drivers and Pedestrians in Dhaka, Bangladesh

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Abstract

This research demonstrates the percentage of drivers and pedestrians understanding the traffic sign in Dhaka, Bangladesh. The survey was conducted among 634 drivers inside and outside of Dhaka city. Moreover, 508 pedestrians participated in the survey within Dhaka city. In comparison, there were 863 male respondents and 279 female respondents among 1142 respondents. The survey took the form of multiple-choice questions that included the picture attached to each sign. However, the survey questionnaires included a few questions regarding driver gender, age, educational qualification, and driving experience. Similarly, the survey questionnaires for pedestrians had also been discussed questions regarding pedestrian gender, age, educational qualification, and job status. The overall traffic sign understanding of drivers was 68.68%. Moreover, the comprehensive traffic signs understanding of pedestrians was 64.5%. The findings showed that the drivers had a medium degree of understanding of the traffic sign's meaning. However, the study results showed that efforts are needed to educate the drivers and pedestrians about the proper interpretation and reaction to traffic signals.

Keywords

survey questionnaire, traffic signs, age, gender

1 Introduction

The transportation system is one of the essential components of an urban settlement's socioeconomic and physical structure. However, a well-planned transport network not only gives people mobility opportunities but also affects a city's growth trend and level of economic activity. In addition, traffic signals are one of the essential facts for drivers and pedestrians. Moreover, drivers and pedestrians need to understand traffic signs to avoid an accident on the road. Therefore, traffic control devices (TCDs) – signals and markings are crucial for the transportation system. Roadway TCDs include traffic signs, pavement markings, and traffic lights. Traffic signs are the most common and have been around the oldest of the three kinds of TCDs presently in use. Understanding the traffic signal is essential for the enforcement of traffic regulations for citizens and necessary for their road safety. Therefore, traffic signals are commonly used as the oldest and most widely used instruments for traffic control. Besides, road markings are used for driver's and pedestrian traffic guidance. Road markings provide advice and information to the driver about the roadway.

Traffic signs not only guide road users but also convey messages to them. However, the traffic signs can be ineffective if drivers or pedestrians do not understand the encoded messages from the traffic signs. Furthermore, the American National Standard Institute (ANSI Z535.3-2011) and the International Standardization Organization (ISO 3864-1:2011) recommend that symbols must meet a level of at least 85% or 67%, respectively, in a comprehension test to be satisfactory (Razzak and Hasan, 2010). In transportation engineering, traffic signs are one of the most important research topics for researchers. Actually, this research topic is directly connected with the engineering sector (especially transportation engineering), traffic safety (both for drivers and pedestrians), and not only knowledge about traffic signs are important in reducing congestion but also in decreasing the accident rate on the road. There is one public impression of the citizens that drivers and pedestrians do not have proper knowledge of traffic signs and marking. However, the lack of understanding of traffic signs could be a significant reason behind fatal road accidents.

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Road accidents do not only harm property and cars but also cause damage, fatal injuries, and cause unbearable pain and misery to the victim's family members.

The main objective of this research work is to determine the percentage of understanding of traffic signs in Dhaka capital of Bangladesh, both for drivers and pedestrians. Particularly for this reason, a survey will be conducted among drivers and pedestrians in Dhaka. Moreover, the study area and content of the survey form were analyzed in this research paper to obtain the primary research goal.

The structure of this article is the following: Section 2 describes the Study area, Section 3 contains the literature review, Section 4 reveals the content of the survey form, Section 5 contains the Results and Discussion, and finally, Section 6 concludes the paper.

2 Study area

Dhaka is the capital of Bangladesh. Moreover, Dhaka has a very crucial role in the economy of Bangladesh. In 1864, the municipality of Dhaka was formed to provide public services, including road maintenance, conservation, healthcare, and education. During the 1905 Bengal partition, Dhaka had been proclaimed the capital of East Bengal and Assam, the newly formed state. Dhaka was declared East Pakistan's capital after the partitioning of the Indo-Pak Sub-continent. Moreover, the city had demarcated its boundary up to thirty-one square km with a population of 250,000. After the declaration of Bangladesh's independence in 1971, Dhaka City's growth processes grew rapidly. Dhaka formed City Corporation under Dhaka Corporation Ordinance in 1983. In 2016, the area had extended to 304.17 square km (Roy et al., 2019).

Dhaka City has also experienced massive population growth and physical expansion. The population of the Dhaka Metropolitan Area is presently estimated to be 21 million people (macrotrends, 2020). Besides, Dhaka was ranked 7th among the top 20 largest cities in the World by population. However, Dhaka was ranked the third least livable city among 140 cities in the World in the Economist's Global Livable Cities Index, 2019 (The Economist Intelligence Unit, 2019). In 2018, Business Insider declared Dhaka the most crowded city in the World, with more than 23,000 people per square kilometer. Additionally, an estimated 2,000 people travel to the capital city of Bangladesh every day (Reader's Digest, 2020).

Bangladesh's entire socioeconomic growth primarily depends on the city of Dhaka. It's the country's nerve center and the main focus of all major activities. Mass transit is a requirement for the transport infrastructure for such a big city with massive commuting demand. In Dhaka, the bus is the only option for mass transit. However, no priority steps are available for the bus on the route. The current traffic congestion is caused by a lack of traffic management. Inefficient and malfunctioning traffic control is also one of the significant problems with the Dhaka City transportation system, which is heavily responsible for making the current system unproductive. Because of this enormous number of pedestrians involved in Dhaka City, the focus should be placed on their safety on both roads and their neighborhoods.

3 Literature review

McIlroy et al. (2020) researched pedestrian behaviors and traffic safety. In this article, an investigation has been performed on the link between traffic safety behaviors and pedestrian attitudes. Moreover, this research measured pedestrian behavior in six countries: Bangladesh, China, Kenya, Thailand, the UK, and Vietnam. A series of regression models were subjected to data from a survey of 3,423 individuals showing important ties between attitudes and pedestrian behaviors in all six countries. The strength of these relationships revealed discrepancies between countries, with weaker relations between attitudes and behaviors in Kenya and stronger connections in China (with other countries in-between the two) (McIlroy et al., 2020). In addition, this study studied the relationship between driver's comprehension of signs posted in three Gulf Cooperation Councils (GCCs) states, Bahrain, Qatar, and the United Arab Emirates (UAE), and some of their safety-related features. Prior to completing this research, questionnaires were distributed among the 6000 drivers in the three states. From 6000 drivers, 2820 drivers (47%) had responded. Understanding posted signs for drivers with broad driving experience proved substantially better than those with limited experience. Besides, the usage of seat belts needed to increase with the awareness of the signs displayed (Al-Madani, 2000).

Furthermore, researchers (Shinar and Vogelzang, 2013) evaluated the influence of ergonomic principles familiarity, standardization, and symbol concept compatibility on a traffic sign. Additionally, different unfamiliar symbolic traffic signs also tested the effect of adding text. In this study, 30 traffic signs were shown to drivers in three conditions: standard icon only, text only, and '+' code sign only. The velocity and consistency of interpretation had also been documented. Interface conditions and familiarity had affected both answer accuracy and response

time. The accuracy had improved when the signs were shown with the text, particularly when the subject was less familiar with the sign (Shinar and Vogelzang, 2013). This research sounds out which were precisely the more ergonomic warning Ecuadorian-traffic signs for the participants from a cognitive point of view and classifies them using the criteria of representativeness, univocity, and the number of errors caused by the participants. It is possible to detect which traffic symbols must be redesigned with those criteria. There are well-known economic, social, and psychological consequences of car accidents. Therefore, a single effort to solve this social problem will be appreciated (Vilchez, 2019). This research mainly focused on evaluating the various levels of 'situation awareness' held by drivers about these signs. Besides this research also analyzed the connection between dyslexia, road sign comprehension, and road sign situation awareness. The drivers had completed the roadside intervention and dyslexia. In fact, dyslexia was adversely correlated with the understanding of road signs and knowledge of the condition of road signs, indicating that the disease could be harmful in various ways of interpreting road signs. Complexities are represented in the form of a driver training scheme, 'SAFE', which implements a comprehensive method of traffic sign interpretation, taking into account sign meanings regarding both in-vehicle and out-vehicle aspects of driver behavior (Taylor et al., 2016).

Furthermore, researchers developed various models for evaluating pedestrian safety and capturing the impact of the severity of pedestrian and roadside activities. The analysis demonstrated the number of bus stops per unit of time, the amount of parking, pedestrian crossing and violations, the varying speed of traffic, and the number of side streets that intersect. However, the volume of intersecting traffic was considered one of the major risk factors associated with the possibility of a pedestrian collision. These variables were then related to the risk of a pedestrian collision using simplified regression models, models of which the Poisson tends to be the most satisfactory model (Kraidi and Evdorides, 2020). This research assessed driver awareness of some selected regulatory, alert, and informative signs through a driver survey. The survey was carried out among 202 drivers from Dhaka city. Forty-two (42) traffic signals had been evaluated/selected/shown etc. The findings showed that the drivers had a minimal understanding of the importance of the traffic signals. The total amount of recognition, calculated as a percentage of correct responses, was only around 50%. Over 80% of the participants recognized only four traffic signs: two regulatory signs and two warning signs. The number of drivers who correctly identified the regulatory signals, warning signs, and informative signs was 49%, 52%, and 55%, respectively. The study results suggested that efforts will be needed to train the drivers about the proper sense of and reaction to traffic signs (Razzak and Hasan, 2010).

Researchers had analyzed the aspects of factors affecting pedestrian's decisions to cross the street at junctions in Dhaka, Bangladesh. The findings of this research will assist policymakers in taking appropriate measures to address pedestrian safety issues (Zafri et al., 2020). Researchers conduct research on pedestrian behavior in Bangladesh in a metropolitan area. Despite the fact that they account for almost half of all fatal accidents, this percentage climbs to approximately 65 percent in the Dhaka metro region. There are certain safety concerns and suggestions that go along with it this research (Debnath et al., 2021). According to the findings, ANNs could be used to anticipate a jaywalker's trajectory as they cross the street. When this study was completed, it was anticipated to benefit automated driving technology and CAV technologies by enabling cars to successfully navigate through both groups of jaywalkers and humans (Anik et al., 2021).

4 Content of the survey form

In this research, a total of 40 signs were evaluated in Dhaka city and nearby places. The survey had been taken through a multiple-choice question that contained images connected to every sign. For the driver survey, the first part of the survey was collected through multiple questions with illustrations. In contrast, the second part of the survey included a few questions regarding driver gender, age, educational qualification, driving experience, and demographic location. The first part of the survey featured multiple questions with images for the pedestrian survey.

In contrast, the second part of the survey included a few questions regarding pedestrian gender, age, educational qualification, and job status. The survey questionnaires were written and portrayed both in Bengali and English. The survey responses included one accurate answer and three other incorrect answers for traffic sign images. The investigation was carried out among professionals as well as non-professional drivers. Around 634 drivers had completed the survey inside and outside of Dhaka city. However, 508 pedestrians had completed the survey inside Dhaka city. Although it was a little bit difficult to take the measure on-road, for this reason, various

car-parking areas, truck terminals, and bus terminals were selected for collecting the survey from drivers (professional drivers). Besides, survey responses were taken from different private companies, workshops, and universities. Additionally, survey forms were distributed on the busy road among ordinary people, university students, private company employees, homemakers, retail shop employers and employees, and business people (pedestrians).

Table 1 describes the demographic characteristics of the 1142 survey respondents. Moreover, 863 were male respondents, and 279 were female respondents. The age groups also had shown in Table 1. Besides, 302 respondents were from 18 to 22 years old, and a total percentage of 26.45% among 1142 respondents. However, the male percentage of this age group is 18.92, and the female percentage of this age group is 7.53. Moreover, 396 respondents were from the age group 23 to 32 years and a total percentage of 34.68. Although, the male percentage of this age group is 25.66, and the female percentage of this age group is 9.02. Additionally, 312 respondents were from the age group 33 to 42 years and a total percentage of 27.33. However, the male portion of this age group is 21.90, and the female percentage of this age group is 5.43. In addition, 84 respondents were from the age group 43 to 52 years and a total percentage of 7.35. However, the male portion of this age group is 6.04, and the female percentage of this age group is 1.31%. Besides, 48 respondents were from over 53 years, with a total percentage of 4.19. However, the male percentage of this age group is 3.06, and the female percentage of this age group is 1.13.

Table 2 describes the educational status of the 1142 survey respondents. Besides, 330 (28.9%) respondents were not able to complete high school. Moreover, 179 (15.68%) respondents completed high school. Additionally, 252 (22.07%) respondents had completed their college education. In addition, 232 (20.31%) respondents had acquired their Bachelor's degree or equivalent. Although, 125 (10.94%) respondents had finished their Master's studies. However, only 24 (2.10%) respondents completed their PhD.

Table 3 describes the Driving Experience of the 634 driver respondents. Moreover, 133 respondents had a driving experience of 0 to 3 years, and the total percentage was 21 among 1142 respondents. In addition, 209 respondents had a driving experience of 4 to 9 years, and the total percentage was 33. Besides, 159 (25%) had a driving experience of 10 to 14 years. Additionally, 101 (16%) respondents had a driving experience of 15 to 19 years. However, only 32 (5%) respondents had a driving experience of more than 20 years. People from various educational backgrounds participated in this research; however, the outcome was unsatisfactory. The reason behind that students is not taught adequate traffic sign knowledge in high school or even college.

Table 4 shows the job status of the 508 pedestrian respondents. Moreover, 46 (9%) respondents were unemployed among 508 pedestrians. In addition, 173 (34%) respondent's current status as a student. Besides, 66 (13%) respondents were daily workers. Additionally, 132 (26%) respondents were currently employed by private companies. However, only 30 (6%) respondents were currently working in government services. Finally, 61 (12%) respondents were running their own businesses.

Table 1 Age and gender characteristics

Age group	18–22	23–32	33–42	43–52	Over 53	Total
Gender						
Male	216	293	250	69	35	863
Female	86	103	62	15	13	279
	302	396	312	84	48	1142

Table 2 Educational status of drivers and pedestrians

Educational background	Driver's respondent	Pedestrians respondent	Total
Eight grade or below	254	76	330
S.S.C	133	46	179
H.S.C	140	112	252
Bachelor's or equivalent	89	143	232
Master's	18	107	125
PhD	00	24	24
	634	508	1142

Table 3 Driving experience years of driver's

	Years	Number of drivers
Driving experience	0-3	133 (21%)
	4–9	209 (33%)
	10–14	159 (25%)
	15–19	101 (16%)
	20 or above	32 (5%)
Total		634 (100%)

Table 4 Job status of pedestrians

		Number of pedestrian
Job status	Unemployed	46 (9%)
	Student	173 (34%)
	Worker	66 (13%)
	Private company-employer	132 (26%)
	Government service holder	30 (6%)
	Businessman	61 (12%)
Total		508 (100%)

5 Results and discussion

Section 5 shows the translation of meanings of the selected signs in Table 5. Moreover, 40 different signs were shown to drivers and pedestrians to evaluate their understanding of the traffic sign in Bangladesh. 634 drivers had given their valuable survey responses for this research. Additionally, 508 pedestrians also gave their important survey responses to evaluate their understanding. However, the survey was conducted in a different place in Dhaka, Bangladesh. Section 5 showed the understanding of traffic signs between drivers and pedestrians for 40 different signs.

Table 5 Translation of meanings of the selected signs

Sign number (SN)	Sign meaning
SN1	Stop
SN2	Yield
SN3	No entry for vehicles
SN4	no trucks
SN5	No rickshaws
SN6	No vehicles over height shown
SN7	No parking
SN8	No stopping
SN9	No overtaking
SN10	No left turn
SN11	No U-turn
SN12	Speed limit
SN13	No horns
SN14	End of speed limit
SN15	Left only
SN16	Keep left
SN17	Turn left only
SN18	Keep left or right only
SN19	One way
SN20	Roundabout
SN21	No vehicles over maximum gross weight shown
SN22	T-junction
SN23	Major road ahead
SN24	Side road right
SN25	Pedestrian crossing
SN27	Road narrows
SN28	Double curve
SN29	Two-way traffic crosses a one-way road
SN30	Road bump
SN31	Hospital
SN32	Narrow bridge
SN33	Road work
SN34	Railway level crossing without a gate
SN35	Railway level crossing with gate
SN36	Railway crossing
SN37	Traffic lights
SN38	Parking place
SN39	Fire station
SN40	Bus stop

Fig. 1 illustrates the Bar chart showing the percentage understanding of Drivers versus (vs.) Pedestrian Traffic signs (TS) (SN1-SN8). Moreover, understanding of SN-1 among drivers was 71 percent, and 85 percent was pedestrians. Although, the SN-2 was understood by 25 percent of drivers and 19 percent of pedestrians, respectively. However, 34 percent of Drivers understood SN-3, whereas pedestrians understood 48 percent. Additionally, 62 percent of drivers recognized SN-4, whereas the pedestrians recognized 78 percent. Furthermore, drivers had acknowledged 66 percent the understanding of SN-5, and pedestrians had acknowledged 88 percent. In comparison, the drivers had interpreted the meaning of SN-6 as 43 percent and pedestrians as 77 percent. Overall, drivers had interpreted the meaning of SN-7 as 76%, and pedestrians as 71%. Finally, 59 percent of drivers had acknowledged the interpretation of SN-8, and pedestrians were 68 percent.

Fig. 2 demonstrates the Bar chart showing the percentage understanding of Drivers versus Pedestrian Traffic signs (SN9-SN16). Moreover, understanding of SN-9 among drivers was 87 percent, and 72 percent of pedestrians were correctly acknowledged. Although, the SN-10 82 percent of drivers understood where pedestrians percentage was 51. However, 79 percent of drivers understood SN-11, and pedestrians understood 70 percent. Additionally, 96 percent of drivers recognized SN-12, and the pedestrians recognized 92 percent. Furthermore, 93 percent of drivers had acknowledged the understanding of SN-13, and 95 percent of pedestrians understood the sign. In comparison, the drivers had interpreted the meaning of SN-14 as 77 percent

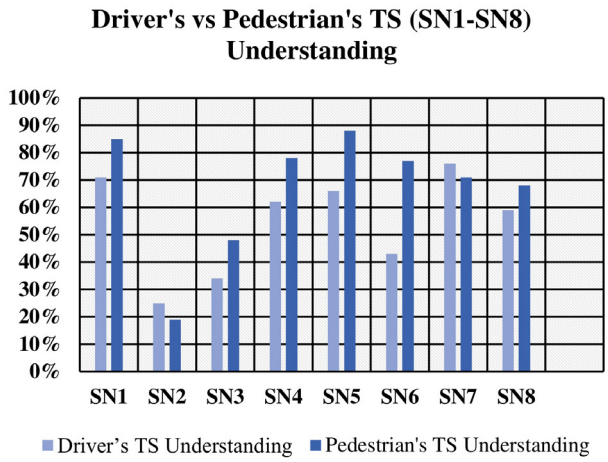

Fig. 1 Bar chart showing the percentage understanding of driver vs. pedestrian's TS (SN1-SN8)

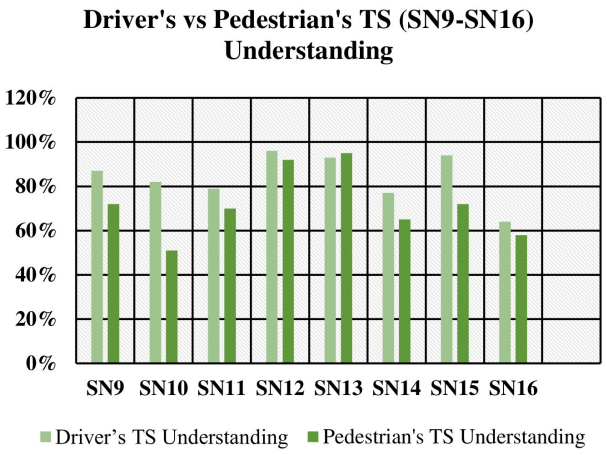

Fig. 2 Bar chart showing the percentage understanding of driver vs. pedestrian's TS (SN9-SN16)

and pedestrians as 65 percent. Overall, drivers had interpreted the meaning of SN-15 as 94%, and pedestrians as 72%. Finally, 64 percent of drivers had acknowledged the interpretation of SN-16. On the other hand, 58 percent of pedestrians acknowledged the SN-16.

Fig. 3 displays the Bar chart showing the percentage understanding of Driver vs. Pedestrian's Traffic Sign (SN17-SN24). Moreover, understanding of the SN-17 among drivers, 65 percent recognized it properly, while 49 percent of pedestrians recognized the same sign correctly. Although the SN-18, 78% of drivers understood correctly, and 65 percent of pedestrians recognized the traffic sign. However, 85 percent of drivers understood SN-19, and pedestrians understood 89 percent. Additionally, the percentage of drivers who recognized SN-20 was 81 percent, while the percentage of pedestrians was 88 percent. Additionally, drivers understood SN-21 at a percentage of 36, whereas pedestrians recognized it at a percentage of 28. In comparison, the drivers had interpreted the meaning of SN-22 properly as 59 percent and pedestrians as 45 percent. Besides, drivers had interpreted the meaning of SN-23 correctly as 32%, and pedestrians as 21%. Finally, Sixty-eight percent of drivers and fifty-two percent of pedestrians agreed on the recognition of sign-24.

Fig. 4 illustrates the Bar chart showing the percentage understanding of Driver vs. Pedestrian's Traffic Sign (SN25-SN32). Moreover, Drivers comprehended SN-25 at a rate of 95%, while pedestrians comprehended it at a rate of 98 percent. Although, the SN-26 had understood by 42 percent of drivers and 27 percent of pedestrians, respectively. However, 63 percent of Drivers understood SN-27 appropriately, and 51 percent of pedestrians were able to understand the TS in an accurate way. Additionally, Drivers identified SN-28 at a rate of 75%, while pedestrians recognized it at 68%. Furthermore, Drivers understood SN-29 to the extent of 80%, while pedestrians understood it to the extent of 78%. In comparison, the drivers had interpreted the meaning of SN-30 as 96 percent and pedestrians as 92 percent. Overall, drivers had interpreted the meaning of SN-31 as 58%, and pedestrians as 35%. Finally, 73 percent of drivers and 79 percent of pedestrians agreed on the reading of sign-32.

Fig. 5 shows the Bar chart showing the percentage understanding of Driver vs. Pedestrian's Traffic Sign (SN33-SN40). Moreover, understanding of the SN-33, 58 percent of drivers recognized it perfectly, and 39 percent of pedestrians were able to understand the TS. However, 77% of the time, drivers comprehended SN-34, whereas pedestrians comprehended it 62% of the time. However, drivers had a 26 percent understanding of SN-35, while 18 percent of pedestrians had

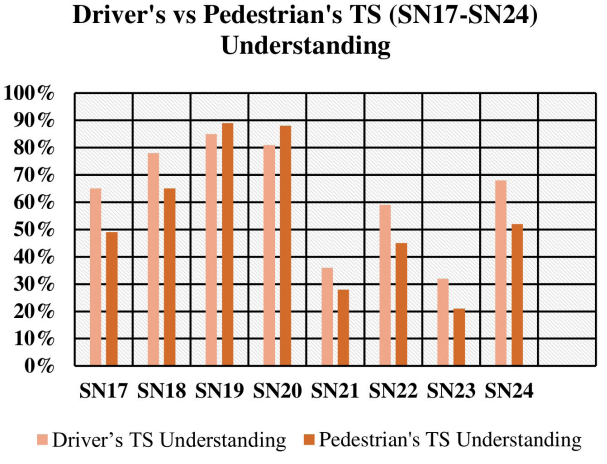

Fig. 3 Bar chart showing the percentage understanding of driver vs. pedestrian's TS (SN17-SN24)

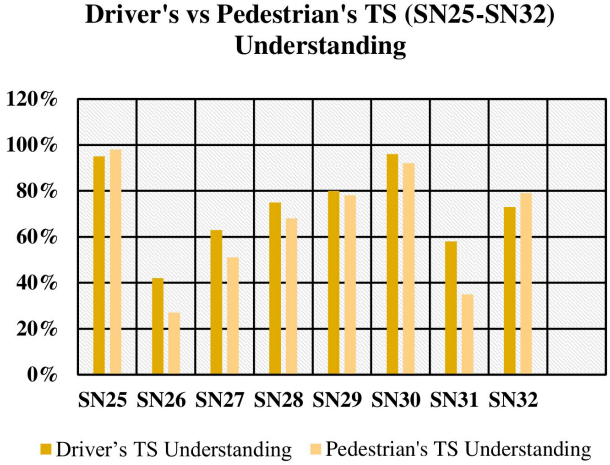

Fig. 4 Bar chart showing the percentage understanding of driver vs. pedestrian's TS (SN25-SN32)

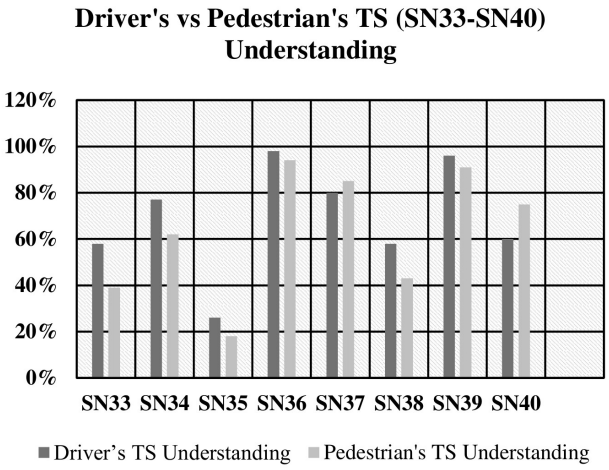

Fig. 5 Bar chart showing the percentage understanding of driver vs. pedestrian's TS (SN33-SN40)

understood the sign. Additionally, 98 percent of drivers recognized SN-36 and the pedestrians 94 percent.

Furthermore, 80 percent of drivers had acknowledged the understanding of SN-37, and where 85 percent of pedestrians understood the sign. In comparison, the drivers had interpreted the meaning of SN-38 as 58 percent and pedestrians as 43 percent. Overall, drivers had interpreted the meaning of SN-39 as 96 points and pedestrians as 91%. Finally, 60 percent of drivers and 75 percent of pedestrians had acknowledged the interpretation of SN-40, respectively.

6 Conclusion

Traffic signs are resources that provide motorists and pedestrians with vital knowledge about specific road conditions. In this research, 40 signs were shown to the drivers and pedestrians to check their understanding of traffic signals in Dhaka, Bangladesh. Around 634 drivers completed the survey inside and outside Dhaka city. However, 508 pedestrians had completed the survey inside Dhaka City. In contrast, among 1142 respondents, there were 863 male respondents and 279 female respondents. The driver's average perception of traffic signals was 68.68 percent. In comparison, the average perception of traffic signals among pedestrians was 64.5 percent. The findings showed that the drivers had a medium degree of understanding of the traffic sign's meaning. On the other hand, the findings showed a modest level of understanding by drivers and pedestrians of the significance of road signs. The study results showed that efforts are needed to educate the drivers and pedestrians about the right interpretation and reaction of traffic signals. The findings showed that even the age and education qualifications of participants were an enormous effect on their answers. They are also crucial for stakeholders in the domain of traffic education to distribute resources properly. Although to improve the understanding, one major initiative needs to be taken that add a chapter entitled "Basic Traffic Sign in Bangladesh" in higher school to improve people's understanding of traffic signs. However, more initiatives can be taken, such as public awareness seminars for drivers and pedestrians monthly organized by driving schools, high schools, colleges, universities, government offices, and private offices. According to the findings, a possible solution is to undertake yet another research on the topic of teaching traffic signals at Dhaka's public elementary and secondary schools. These guidelines will be adopted or pursued through the cooperation of traffic control authorities, law enforcement officers, and mobility experts.

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