GROSTLOG 2020
Global Research on Sustainable Transport & Logistics

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

A STUDY OF PHYSIOLOGICAL MEASURE OF DRIVER BEHAVIOUR IN DIFFERENT AGE AT THE INTERSECTION

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Abstract. This paper presents a study on the physiological measure of driver behavior in different age at the intersection. Road accidents are related to bad driving behavior, such as driving recklessly, speeding and tendency to drive aggressively. Young drivers tend to drive aggressively compared to older drivers. Driving aggressively or speeding during driving could increase the level of physiological responses such as blood pressure. The main objective is to analyze the relationship between different age, speed and blood pressure of the drivers throughout the journey at the intersection. About 36 of participant drivers should be involved in this study. Due to Covid-19, only 16 of participant drivers 20-24 years old and 25-29 years old had managed to complete the drive test at fieldwork and a new questionnaire had been prepared for 70 respondents of non-participant drivers. For participant drivers, the data such as blood pressure were recorded by using OMRON Digital Wrist Blood Pressure Monitor and speed of car was obtained by using a car of Perodua Axia. For non-participant drivers, a questionnaire had been prepared to collect more information data for drivers' behavior in different age. From the result obtained for participant drivers and non-participant drivers, age of drivers and driver-related factors such as speeding or aggressive driving could be the factors for the higher reading of blood pressure during driving. Therefore, further studies are needed in order to bring a better understanding of the factor that influencing the reading of blood pressure during driving, especially at the un-signalized roundabout.

Keywords: driver behaviour, blood pressure, drivers of different age, aggressive driving, speeding.

Introduction

Driving is a complex dynamic process-control activity which is requiring motor, visual and cognitive reactions. There are several factors that can adversely affect driver behaviour (Freydier et al., 2016). Driver behaviour is considered as one of the factors for the increase number of road accidents, especially at the intersection (De Waard & Brookhuis, 2010). Physiological measurement is one of the factors which affect the mental demand and this action will contribute to the rising of physical body response. Physiological responses such as constriction of blood vessels where it can increase the blood pressure, can change due to the behaviour of the drivers during driving. In addition, most of accidents are caused by the drivers who speed up or commit certain forms of traffic violations during driving. Fast driving, aggressiveness and lack of time are the factors that lead to speeding during driving (Rendon-Velez et al., 2016).

Many studies have concluded that there is a relationship exist between age of drivers and occurrence of accidents. Nowadays, most of young drivers become more disrespectful, aggressive and distracted during driving (Galovski et al., 2003). In facts, during arousal associated with anger or hostility, there are the rising of blood pressure (Shope, 2006). Road users faced some problems with the roundabout regarding to the geometric design, traffic control devices and improper driver behaviour. The negotiation speed should be based on safety consideration, which is less than 48 km/hr at the roundabout. Driver behaviour and performance of drivers are influenced by roundabout geometry (Md Diah et al., 2010). An insufficient deflection of movement may lead to a lack of control of the speed at the entrance of roundabout. However, when the roundabout provides many lanes of traffic with higher capacity, driver

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behaviour management becomes less effective, even with additional short lanes. As a result, the number of road accidents are higher (Silva et al., 2014).

This study was focused on the physiological responses of driver with different age who was driving during non-peak hour traffic at the roundabout. In this study, speed of vehicle and the reading of blood pressure of the drivers would be compared when the drivers are driving at the intersection area, which is un-signalized roundabout.

Method

Research methodology flowchart is shown in Figure 1. There were two types of method involved in this study. First method for participant drivers. There were 36 participant drivers should be involved in this study. Age of participants drivers between 20 years old to 44 years old. Due to Covid-19, only 16 participant drivers who age 20 to 29 years old had managed to complete the drive test at the fieldwork. This location of this study at Bulatan Bistari, Seksyen 2, Shah Alam, Selangor. Data were collected during non-peak hour, 2.30 p.m. until 4.30 p.m. on weekdays. The route of drive test started from Pintu Utama UiTM Shah Alam and end at Pintu Utama UiTM Shah Alam. The procedure took 15 to 20 minutes per driver since each driver need to drive approaching roundabout 3 times, in order to get accurate data. Measurements of blood pressure were taken in mmHg using a digital wrist blood pressure monitor which was placed on the driver's left wrist at heart level before conducted the drive test. The result of systolic blood pressure and diastolic blood pressure were recorded manually before, during and after approaching the roundabout. Speed of the cars also was recorded manually when the reading of blood pressure obtained throughout the journey. Speed of car was measured in km/hr using a car of Perodua Axia. All participant drivers used the same equipments during drive test to eliminate any variation in parameter measurements. There is questionnaire prepared to collect the information data for participant drivers.

As drive test could not able to continue due to covid-19, a new questionnaire had been prepared for non-participant drivers in order to gain more information data about drivers' behavior in different age. There were 70 respondents who involved in this study as non-participant drivers. The questionnaire had been distributed through WhatsApp Messenger application. There were 15 questions which consists of name, age, gender, health condition, history of driving and driver behaviour. The data will be presented in pie chart and bar graph for the better understanding.

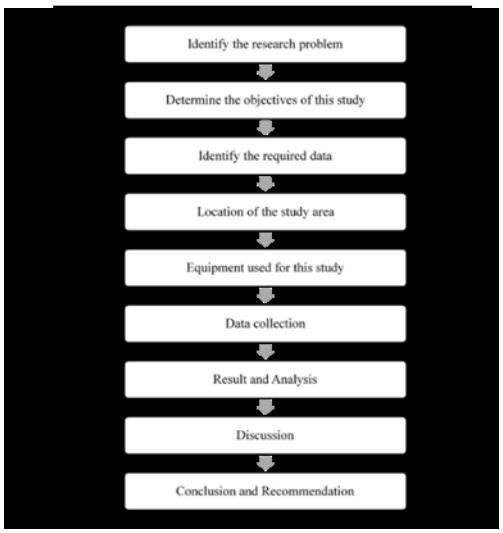

Figure 1. Flowchart of Methodology.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
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Figure 2. Using of blood pressure monitor during drive test.

Result and Discussion

Generally, the overall data were recorded and analyzed to achieve all the objectives in this study. The data obtained were analyzed by using Microsoft Excel in form of table and graph, bar graph and pie chart for better understanding.

Result of participant drivers

This is the first comparative cross-sectional study which tested on blood pressure and speed of drivers in different age before, during and after approaching un-signalized roundabout during non-peak hour in different age of drivers.

Table 1 shows the value of average systolic blood pressure before, during and after approaching roundabout in different age of participant drivers. Most of participant drivers 20-24 years old had average of systolic blood pressure between 100 mmHg to 110 mmHg, meanwhile age 25-29 years old between 110 mmHg to 120 mmHg before approaching roundabout. Next, most of participant drivers who age 20-24 years old had average of systolic blood pressure between 80 mmHg to 105 mmHg, meanwhile age 25-29 years old between 105 mmHg to 120 mmHg during approaching roundabout. Lastly, most of participant drivers who age 20-24 years old had average of systolic blood pressure between 89 mmHg to 110 mmHg, meanwhile age 25-29 years old between 105 mmHg to 115 mmHg after approaching roundabout. From the result obtained, age could be one of the factors for higher reading of blood pressure since participant drivers in group age 25-29 years old have higher blood pressure compared to age 20-24 years old. Older age of driver tends to have higher blood pressure due to the physiologic changes of the vascular system that occur with aging, which is the stiffening of the arteries decreases, thus elevating of blood pressure increase (Bou Samra et al., 2017).

Figure 3 shows the relationship between average systolic blood pressure before, during and after approaching roundabout and age of participant drivers. From the graph, the value of R^2 before approaching is 0.1197, during approaching is 0.1602 and after approaching is 0.173. Value of R^2 is in range of 0 to 0.1, which is consider as weak relationship (Frost, J., 2018). Therefore, there is a weak positive relationship between blood pressure before, during and after approaching roundabout with different age of participant drivers. Studies that assess relationship involving human behaviour tend to have weaker correlation of coefficient. This is because people are hard to predict (Frost, J., 2018).

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Table 1. Average Systolic Blood Pressure of drivers in different age before, during and after approaching roundabout.

Age of Participant Drivers	Average Systolic Blood Pressure Before Approaching Roundabout (mmHg)	Average Systolic Blood Pressure During Approaching Roundabout (mmHg)	Average Systolic Blood Pressure After Approaching Roundabout (mmHg)
22	104.33	118.67	96.00
23	110.00	121.00	98.00
23	130.33	90.00	125.67
23	93.00	81.67	104.33
23	105.00	104.00	113.00
23	105.67	80.00	89.33
23	108.00	106.33	108.00
24	115.67	118.67	105.67
25	109.67	106.33	106.00
25	114.33	127.67	113.67
25	94.67	103.00	114.67
25	107.00	112.00	107.67
25	110.33	108.00	111.33
26	118.33	114.00	110.67
27	117.33	114.33	112.67
28	119.33	119.33	114.00

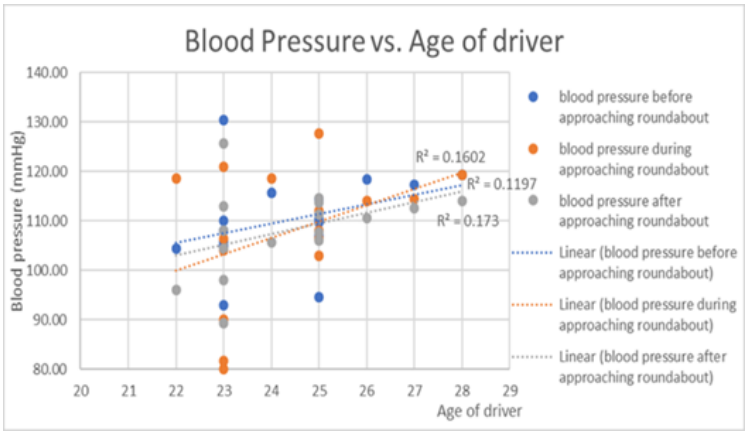

Figure 3. Graph of Systolic Blood Pressure before, during and after approaching roundabout vs Age of driver.

Table 2 shows the value of average speed of car before, during and after approaching roundabout in different age of participant drivers. Most of participant drivers 20-24 years old had average of speed between 36 km/hr to 38 km/hr, meanwhile age 25-29 years old between 38 km/hr to 41 km/hr during approaching roundabout. Speed limit at the roundabout should be less than 48 km/hr (Md Diah et al., 2010). Therefore, all participant drivers had not practise

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
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speeding or aggressive driving during drive test had conducted at the fieldwork during approaching un-signalized roundabout.

Figure 4 shows the relationship between average speed of car before, during and after approaching roundabout and age of participant drivers. From the graph, the value of R^2 before approaching is 0.4525, during approaching is 0.4546 and after approaching is 0.4985. Value of R^2 which in range of 0.4 to 0.6 is consider as moderate relationship (Frost, J., 2018). Therefore, there is a moderate positive relationship between speed before, during and after approaching roundabout with different age of participant drivers. Speed is related to human behaviour because it can change regarding to the situation. According to Frost, J. (2018), studies that explain human behaviour generally have value of R^2 less than 50%.

Table 2. Average Speed of drivers in different age before, during and after approaching roundabout.

Age of Participant Drivers	Average Speed Before Approaching Roundabout (km/hr)	Average Speed During Approaching Roundabout (km/hr)	Average Speed After Approaching Roundabout (km/hr)
22	48.67	36.67	41.67
23	50.00	38.00	43.00
23	48.00	37.67	43.00
23	50.33	38.33	44.00
23	51.67	38.33	42.00
23	50.33	38.00	43.67
23	52.67	37.00	42.67
24	48.67	38.33	44.00
25	54.33	39.67	46.67
25	53.67	40.00	43.33
25	51.33	43.00	46.00
25	53.67	38.00	43.67
25	51.33	36.33	44.33
26	52.00	39.67	43.67
27	53.33	41.33	46.00
28	53.67	41.00	45.33

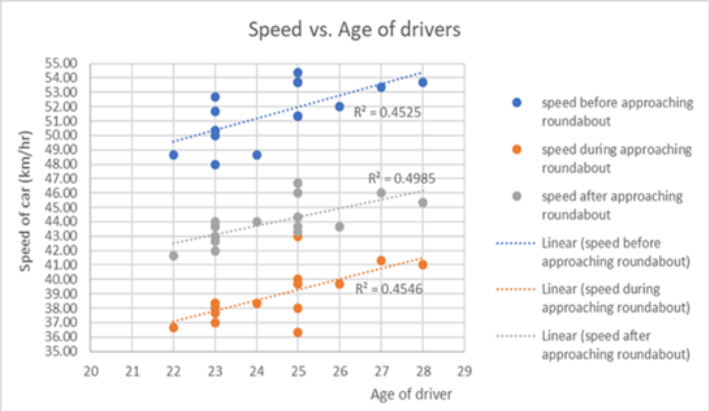

Figure 4. Graph of Speed before, during and after approaching roundabout vs Age of driver.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
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Result of non-participant drivers

Figure 5. Result of non-participant drivers.

Figure in 5(a) shows group age of respondents from 20-44 years old. There were 20% of respondents who age from 20 years old until 44 years old. This study tested on different group age because age could be one of the factors of higher reading of blood pressure (Bou Samra et al., 2017). Figure in 5(b) shows the percentage of respondents for non-participant drivers who had go to the hospital to check blood pressure. Most of middle-age drivers (30-44 years old) were aware with the reading of blood pressure compared to young drivers (20-24 years old). Figure in 5(c) shows that most of non-participant drivers knew that driver behaviour such as speeding, aggressive driving and stress during driving can increase the reading of blood pressure during driving.

Figure in 5(d) shows that most of respondents are experience drivers. Drivers with more than five years of driving licenses are classified as experienced drivers, meanwhile, the other are classified as inexperienced drivers (Jin et al., 2011). Figure in 5(e) shows frequency of respondents for non-participant drivers who practise speeding or aggressive driving at un-signalized roundabout during non-peak hour. Young drivers (20-29 years old) are the most who had practise aggressive driving. Driving aggressively will increase the muscle tension and blood pressure of the drivers during driving (Malta et al., 2001). Lastly, Figure in 5(f) shows that most of respondents choose driver-related factor, such as speeding or aggressive driving as the main factor of road accidents at un-signalized roundabout during non-peak hour in Malaysia.

Conclusion

This study successfully investigated physiological responses of driver with different age who was driving during non-peak hour traffic at the roundabout. From the result, none of participant

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Advances in Transportation and Logistics Research
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drivers had practice speeding and age could be one of the factors of the higher reading in blood pressure. In addition, the strength of relationship naturally depends on specific pair of variables. Then, most of young non-participant drivers (20-29 years old) had practise speeding or aggressive driving at un-signalized roundabout during non-peak hour compared to middle-age drivers (30-44 years old). Therefore, young drivers tend to have higher blood pressure compared to middle-age drivers. Galovski et al. (2003) stated that drivers who practise aggressive driving or speeding tend to have higher blood pressure compared to normal drivers.

From the result obtained for participant drivers and non-participant drivers, age of drivers and driver behaviour such as speeding or aggressive driving could be the factors for the higher reading of blood pressure during driving. Further studies are needed in order to bring a better understanding of the factor that influencing the reading of blood pressure during driving, especially at the un-signalized roundabout. For future study, blood pressure monitor should be placed on the arm instead of wrist because it would have a higher accuracy in measurement of blood pressure. In addition, the study can be done at two different location, such as intersection and roundabout. This is because driver behaviour always change due to situation.

Acknowledgement

The authors would like to thank the staff and an organization of MiTRANS and Faculty of Civil Engineering, Universiti Teknologi MARA (UiTM) for the significant contribution and full guidance along the process in completing this paper. Words of gratitude are also extended to all individuals and others organizations that have made this study possible.

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