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Comparative Assessment of Drivers Characteristics at Baghdad Urban and Suburban Area

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Abstract

The importance of road safety demands that the components of safe driving be understood. Variability among people, in terms of gender, age, socio-economic levels, education, health, driving experience, and tradition could have major impacts on the field of vision and the perception reaction time, which seem to be good measures of safe driving. In Baghdad, public efforts have managed to stabilize or decrease accident rates; however, because of the growing number of vehicles and other road users, the absolute number of dead and injured individuals fluctuates with still unaccepted results. In this work, a study of drivers' characteristics and behavior as an important element in the highway system in Baghdad was conducted. A questionnaire was designed to tap the following areas: driver education, experience, exposure (km driven and time), and accident experience. The drivers of suburban areas have been selected at Al Haswa, (45 km south of Baghdad) and Abu-Graib (20 km west of Baghdad). On the other hand, the drivers of the urban area were figured at the main public transportation terminals. A total of 100 driver from suburban area and 200 drivers from urban area have been selected, questioned, and subjected to field of vision (visual acuity and angle of peripheral vision) test. A portable apparatus for the measurement of perception reaction time was specially designed, manufactured at local market, and implemented for the response time test. Such driver's population was carefully selected for representing male and female, different age groups ranging from 17 to 65, different education levels, and different clothing tradition regarding wearing of the head cover. The driver's population was divided into two groups regarding the user or nonuser of spectacles while driving. The test results were analyzed, compared, and related to driver performance and accident background. It was concluded that the present licensing procedures are not sufficiently reliable to be used as a basis for approving or denying the right to drive, visual field test may be incorporated in the procedures. The traffic education level and the understanding of traffic signs were variable among urban and suburban drivers, and their age groups.

Keywords: characteristics, clothing tradition, cone of vision, driver, response time

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INTRODUCTION

The preservation of road safety is the prime consideration in addressing vision requirements for driving. The importance of road safety demands that the components of safe driving be understood, the criteria for evaluating candidates be evidence based, and the tests used be valid predictors of driving ability. The license to drive a car on public roads is a privilege rather than a right. It should not be extended indiscriminately. Nevertheless, in a society where the personal vehicle is the primary, and often the only mode of transportation, cessation of driving results in personal hardship, and licensure should not be withheld without clear justification.

The objective of this work was to study the impact of driver's characteristics such as age, gender, and clothing traditions on the field of vision and response time. The growing number of traffic accidents and the present practice of licensing the drivers, and the dramatic changes in drivers clothing traditions at Baghdad urban and suburban area gave a good and important reason to conduct the present study.[1] Stated that driving is a task that mainly depends on the driver's visual system. The vast majority of information required for driving is obtained through the visual system. Visual acuity and contrast sensitivity decline with age. The decline generally begins slowly after 40, followed by an accelerated decline after the age of 60.[2] Concluded that there is a strong argument that many older drivers compensate for the usually gradual decline in their driving abilities by avoiding driving in darkness, on wet roads, during rush hour, or in other stressful situations. Further, their behavior becomes more conservative: they drive more slowly, seek longer time gaps for merging at intersections and avoid simultaneous activities such as smoking or handling the radio while driving. In balancing mobility and safety, it needs to be recognized that older drivers do not represent an excessive risk to other road users. Relative to other drivers, they are more likely to be their own victims, largely because of their greater physical frailty.[3]

It is demonstrated that in Australia as in most Western societies, young drivers are over-involved in road crashes. Young drivers' high involvement in road crashes is often attributed to a lack of driving skills. Consequently, there is a regular call to make additional driver training mandatory, either before or during the first years of driving. It generally takes some 20 years following licensing to achieve the safest driving levels. Although the issue of young driver over-involvement in road crashes represents a major road safety issue.[4] The research suggests that conventional training programs are unlikely to lead to safety benefits. Other options, such as extension of practice during periods of supervised driving and the further development of graduated licensing schemes are generally viewed as more promising priorities in this area.[5]

Studied the characteristics of driver population at Mosul governorate; his study had focused on the impact of clothing traditions on visual fields in the vertical and horizontal meridians.[6] Assessed the drivers characteristics at Baghdad CBD, his study had focused on cone of vision and response time variations among drivers population at the CBD area.

DESIGN OF QUESTIONNAIRE

To measure and characterize the behavior of drivers, a questionnaire was designed. The questionnaires used by refs.[5–10] provided an important background for the present design. The purpose of the questionnaire was to capture information regarding the traffic education level and the tradition of the tested driver's age groups, so that their impact on driver's behavior could be understood.

The first four questions in the questionnaire deal with the general characteristics of the driver such as gender, age, and driving background (years of driving experience, driver education), while the fifth question will be filled by the tester after examining the driver for knowledge of traffic signs. The rest of the questions will also be filled by the tester including response time and field of vision in static visual acuity condition. Table 1 shows the questionnaire form. The age group of the driver's population was selected based on the fact that the licensing of drivers was suspended since 2003, and the young drivers of age group up to 26 are currently driving their vehicles without having the driving license, and with no official confirmation that they are qualified

to drive. On the other hand, other driver's age groups have the driving license.

Selection of Test Drivers

The main locations for driver selection process were public transportation terminals at Baghdad urban and suburban area, and private sector tourist companies. Drivers were selected on aggregate bases, sampling had taken place for various communities (public transport drivers, commercial truck drivers, taxi, and private saloon car drivers) with different sex, age, and education level, with and without wearing the traditional head cover usually used by people in the country, with and without using spectacles. It was felt that this makes a fair representative sample of the present driving population and may be extended to future drivers.

Table 1. *The Questionnaire Form.*

Age group	**< 18**	**19–25**	**26–50**	**> 50**
Gender	Male / Female	Male / Female	Male / Female	Male / Female
Education level	Primary; secondary; university	Primary; secondary; university	Primary; secondary; university	Primary; secondary; university
Having a driving license	Yes / No	Yes / No	Yes / No	Yes / No
Traffic education	Good; fair; unsatisfactory	Good; fair; unsatisfactory	Good; fair; unsatisfactory	Good; fair; unsatisfactory
Accident participation	Yes / No	Yes / No	Yes / No	Yes / No
Response time(seconds)				
Angle of clear vision (°)				
Angle of peripheral vision (°)				
Spectacles	Yes / No	Yes / No	Yes / No	Yes / No
Head cover	Yes / No	Yes / No	Yes / No	Yes / No

Age group	**< 18**	**19-25**	**26-50**	**> 50**
Gender	Male / Female	Male / Female	Male / Female	Male / Female
Education level	Primary; secondary; university	Primary; secondary; university	Primary; secondary; university	Primary; secondary; university
Having a driving license	Yes / No	Yes / No	Yes / No	Yes / No
Traffic education	Good; fair; unsatisfactory	Good; fair; unsatisfactory	Good; fair; unsatisfactory	Good; fair; unsatisfactory
Accident participation	Yes / No	Yes / No	Yes / No	Yes / No
Response time(seconds)				
Angle of clear vision (°)				
Angle of peripheral vision (°)				
Spectacles	Yes / No	Yes / No	Yes / No	Yes / No

Head cover	Yes / No	Yes / No	Yes / No	Yes / No

Table 2 illustrates the age groups of tested drivers. The significance of considering such driver various characteristics in the study could be the dramatic changes of the driver's population and clothing tradition due to the suspension of licensing took place in the country since the invention on 2003. Table 3 demonstrates the driving license condition of the investigated drivers. On the other hand, Figure 1 illustrates the tested drivers with different clothing traditions.

Table 2. *Age Groups of Tested Drivers.*

Age Group	**Drivers from urban area**			**Drivers from suburban area**		
	% Male	**% Female**	**% Total**	**% Male**	**% Female**	**% Total**
<18	2	1.5	3.5	3	1	4
19–25	16	9	25	43	8	51
26–50	38.5	13	51.5	34	8	42
>50	12	8	20	2	1	3

Table 3. *Driving License Condition of Tested Drivers.*

Variables	**Drivers from urban area**		**Drivers from suburban area**	
	Male	Female	Male	Female
% Drivers gender variation	80	20	82	18
% Having driving license	95.6	100	60.5	29.1

Because the driving population is drawn from the overall population, it can be assumed that they are similar in many psychological and physical attributes.

Testing of the Drivers

As a consequence, only those tests were selected which are easily and quickly administrated and which based on previous studies. Other tests were not chosen because a summary of previous research indicated these tests to be least likely to be related to driving performance.[5,11–13] The selected tests are the visual field and the response time, while the excluded tests are those requiring the use of traffic simulator.

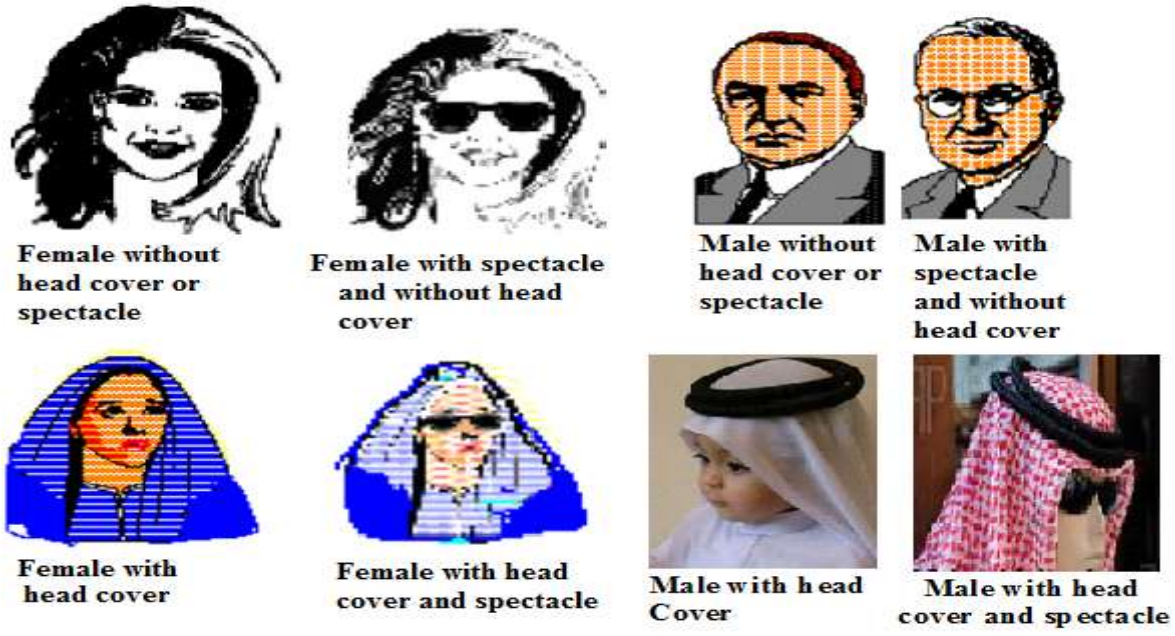

Fig. 1. *Tested Drivers With Different Clothing Tradition.*

The drivers from each group were selected in random order and were not informed as to why they were selected beyond telling them that the purpose of the investigation was to study drivers of various driving ages and experiences. Table 4 demonstrates the tested drivers by traditional condition at urban and suburban areas. At the beginning of the test, each driver was asked to fill the questionnaire giving age, gender, type of car driven, accident experience, and driving hours daily, then the drivers were subjected to the following test.

The selected groups of driver's for both male and female were assumed to represent the driver's population at urban and suburban area. It was felt that the use of spectacles or head cover by male or female while driving could have an impact on visual field, while the variation in age groups would have an impact on response time. Such impression was obtained from previous work.[1,5,6,10]

Table 4. *The Tested Driver Population at Baghdad Urban and Suburban Area.*

Driver traditional condition	**Urban area**				**Suburban area**			
	Male		**Female**		**Male**		**Female**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Without head cover	121	75.6	14	65	70	85	10	55
With head cover	39	24	26	35	12	15	8	44
Without spectacles	116	72.5	31	77.5	64	78	15	83
With spectacles	44	27.5	9	22.5	18	22	3	16.6
With head cover and spectacles	4	2.5	2	5	4	4.8	1	5.5
Total number of drivers	160		40		82		18	

Response Time Test

Each driver was subjected to response time test using a portable apparatus, manufactured at local market, and illustrated in Figure 2. It is similar to the one used by refs.[5,6,14] It consists of brake pedal and red and green light bulbs and a control switch. The driver is seated on a chair so that his eye is 1–1.2 m above the ground level which represents the actual field condition in the vehicle. The green light bulb is set on, and the driver's right foot is resting on the ground, then when the red light bulb is set on, the driver will move his foot and depress the brake pedal and the green light bulb goes off. The time in fractions of second to complete this process is measured through an electronic timer. This process was repeated at least three times for each driver, and since the driver was excited and pays his great attention to the light bulb, the mean value of the measured elapsed time is reported as the response time.

Fig. 2. *Response Time Apparatus Implemented in the Study.*

Field of Vision Test

After finishing the reaction time test, each driver was subjected to the field of vision test. His eyes were tested in the static visual acuity condition using simple range rods and tape as illustrated in Figure 3.

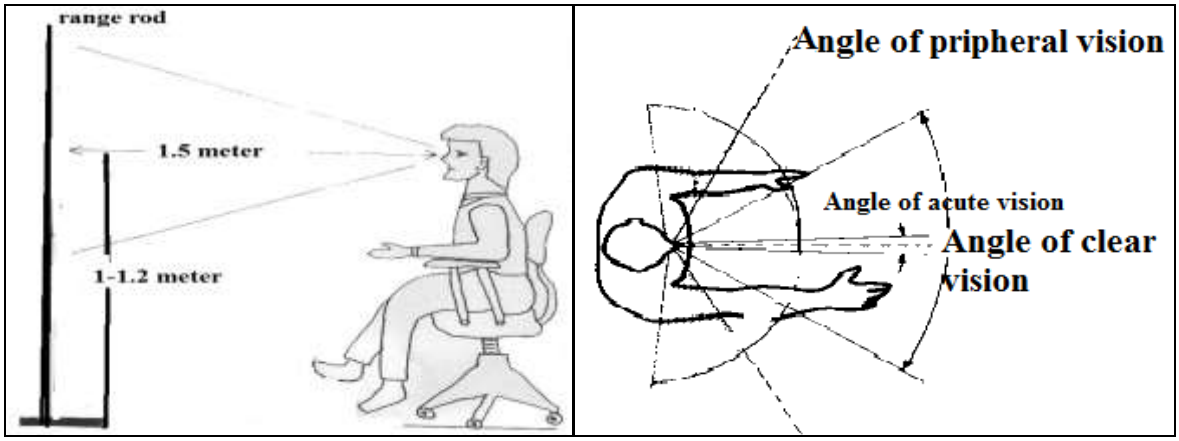

Fig. 3. *Cone of Vision Test Setup.*

An attempt has been made to restrict the driver's vision to one fixation position to measure the angle of peripheral vision which is the ability of the eye to see beyond the cone of clearest vision. The lateral clear vision field, which is the extent of the observer's side vision to recognize the details of an object when he is looking straight ahead, was measured. The drivers eyes were tested along the horizontal meridians of the visual field for both of the above conditions and the horizontal angles of clear and peripheral visions were measured. The driver stays in his position seated on the chair and looking forward to a horizontal range rods of 3m length positioned in front of his eye sight and away from him by 1.5m in the horizontal direction; it was felt that this may represent the field condition. Two colored range rods starts moving slowly at reversible horizontal directions from the center of the original position, and the driver is asked for the clear vision of both of the range rods to fix, then asked for the extent at which the driver could feel the existence of both of the range rods to fix the peripheral visual field. Table 5 shows the range of the obtained visual field parameters of the tested drivers.

Table 5. *The Cone of Vision Parameters of Tested Drivers.*

Driver Traditional Condition	Urban Area				Suburban Area			
	Angle of Clear Vision (°)		Angle of Peripheral Vision (°)		Angle of Clear Vision (°)		Angle of Peripheral Vision (°)	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Without head cover or spectacles	25.9	11.3	134	110	29.8	11.4	137.6	100.3
With head cover	11.3	5.4	126	93	18.8	7.6	119	90
With spectacles	14	5.7	121	98	22.6	9.4	121.6	97.1
With head cover and spectacles	11.1	3.1	101	90	14	7.6	97	88
Number of tested drivers	200				100			

ANALYSES OF TEST RESULTS

Data were transferred to computer, analyzed, and related to driver performance and accident background.

Response Time

Table 5 shows the obtained variation of response time for age groups, the young drivers have response time of 0.96 seconds for urban, and 0.82 seconds for suburban area drivers; this may be attributed to the lower level of driving experience. As the driver age increases, the reaction time decreases to a minimum of 0.79 and 0.8 seconds for urban and suburban drivers, respectively, for the age group of 19–25 years.

With increasing age, driver reflexes slow and certain physical abilities diminish, and the reaction time increases again. This agrees well with other research findings.[6,8,10] The maximum allowable response time as per the highway capacity manual[15] is 2.5 and 1.0 seconds for rural and urban area drivers, respectively. Table 6 demonstrates that the response time among various drivers population is within the required limitations. The average variation in response time between male and female was significant and ranged between 10.7 and 31 % for urban and suburban area, respectively, as illustrated in Table 6. It may be concluded that the lower response time for male could be attributed to their longer driving hours which gives more experience. However, at the old age group of over 50, such variation was in reverse order, and the female driver had lower response time as compared by male driver, such variation was in the range of 5–6% for urban and suburban area. This may be attributed to the increased experience of old female drivers and to the adaptation and overconfidence of old male drivers.

Table 6. *Variations in Response Time with Age Group*

Age group	Average Response Time (seconds)			
	Urban		Suburban	
	Male	Female	Male	Female
<18	0.82	1.1	0.81	0.83
19–25	0.77	0.81	0.8	0.81
26–50	1.0	1.2	1.5	1.7
>50	1.5	1.4	2.0	1.9

Field of Vision

As demonstrated in Table 7, and from the scientific point of view, the isolation of visual input by using either spectacle or head cover or both is important, since the input information used by the driver sets off an action sequence which affects driving decision making such as steering, breaking, and acceleration of the vehicle. For urban area drivers, the angle of clear

vision changes from 29.8°–14° as the cone of vision was restricted by head cover and spectacles for young drivers. On the other hand, the angle of peripheral vision changes from 137.6°–101° on restriction of cone of vision for the same age group. For suburban area, similar effect could be recognized. The clear vision angle in the horizontal meridian decreases from 11.2°–3.1° when an old driver from urban area uses both of head cover and spectacle, while this angle decreases from 11°–3.5° for old driver from suburban area at the same condition as illustrated in Tables 7 and 8. The global standard for angle of clear vision is 10°–12°.[4,5,14] The tables show a significant variation in the angle of clear vision after implementation of head cover or spectacles.

Table 7. *Average Variations of Cone of Vision with Age Group and Clothing Tradition of Urban Area Drivers*

Age Group	**<18**	**19–25**	**26–50**	**>50**	**Condition**
Angle of clear vision	29.8	23.3	27.5	11.3	No head cover, no spectacles
Angle of peripheral vision	137.6	126.6	119	110.3	
Angle of clear vision	18.8	17.3	16	5.4	With head cover, no spectacles
Angle of peripheral vision	126	121.6	116	90	
Angle of clear vision	22.6	19.1	14.3	7.0	No head cover, with spectacles
Angle of peripheral vision	121.6	116.5	115	97.1	
Angle of clear vision	14	12	11.6	3.1	With head cover, with spectacles
Angle of peripheral vision	101	100	91.6	88	

The peripheral vision angle in the horizontal meridian decreases from 110.3° to 88° for old driver from urban area, and decreases from 100.3° to 96.7° for old driver from suburban area at the same testing condition. Similar variations could be detected for other age groups.[11] Stated that 30° and 140° nasal and temporal fields are required. The global accepted standard for the angle of peripheral vision is 120°–180°.[6,10,15] Tables 7 and 8 show the destruction in the angle of peripheral vision due to implementation of head cover and or spectacles; it was felt that such destruction could impair safety.

Table 8. *Average Variations of Cone of Vision with Age Group and Clothing Tradition of Suburban Area Drivers*

Age Group	**<18**	**19–25**	**26–50**	**>50**	**Condition**
Angle of clear vision	28	25.2	27	11	No head cover, no spectacles
Angle of peripheral vision	136	126.5	126.2	100.3	
Angle of clear vision	17	14	18.5	5	With head cover, no spectacles
Angle of peripheral vision	125	112.5	105.6	93	
Angle of clear vision	21	18	13	5.7	No head cover, with spectacles
Angle of peripheral vision	118	115	110	98	
Angle of clear vision	14	13	8.4	3.5	With head cover, with spectacles
Angle of peripheral vision	101	98	96	96.7	

Tables 9 and 10 illustrate the impact of using head cover or spectacles on cone of vision. By decreasing the lateral visual field, the essential information cannot be seen at once, so the driver is forced to obtain his information in separate visual fixations.

The impact of head cover is more pronounced on angle of clear vision and it is many folds of that of the impact on peripheral vision. Based upon vehicle and human restrictions, a cone of vision has been developed in which the traffic signal faces should be located. Such findings may be considered in the positioning and erection of traffic signs and signals since the SUDAS design manual[16] requires that at least one and preferably two signal faces shall be located within this cone of vision. Tables 8 and 9 show that, the spectacles could have the second adverse effect on cone of vision after head cover. On the other hand, when the driver uses both of head cover and spectacles, the loss of angle of clear vision will be in the range of 48–72.5% for urban drivers, and 48.4–68.8% for suburban drivers. The impact increases for elder drivers as compared to the case of young drivers.

Table 9. *Average Impact of Spectacles and Head Cover on Con of Vision of Urban Area Drivers*

Condition	**Percent Decrease in Angle of Clear Vision**				**Percent Decrease in Angle of Peripheral Vision**			
Age group	<18	19–25	26–50	>50	<18	19-25	26–50	>50
Head cover	36.9	25.7	41.8	52.2	8.4	3.9	2.5	18.4
Spectacles	24.1	18	48	38	11.6	7.9	3.3	11.9
Head cover and spectacles	53	48.5	57.8	72.5	26.6	21	23	20.2

Table 10. *Average Impact of Spectacles and Head Cover on Con of Vision of Suburban Area Drivers*

Condition	**Percent Decrease in Angle of Clear Vision**				**Percent Decrease in Angle of Peripheral Vision**			
Age group	<18	19–25	26–50	>50	<18	19–25	26–50	>50
Head cover	39.2	44.4	31.4	54.5	8	11	16.3	7.2
Spectacles	25	28.5	51.8	48.1	13.2	9	12.8	2.3
Head cover and spectacles	50	48.4	68.8	68.1	25.7	22.5	23.9	3.5

As far as angle of peripheral vision is concerned, the negative impact of using both of spectacles and head cover on cone of vision was in the range of 20.2–26.6% for urban area drivers, and 3.5–25.7% for suburban area drivers. The variation among urban and suburban elder drivers of impact on peripheral vision may be attributed to their style of life and adaption of using head cover. When drivers gender is considered, it shows similar trend of variation of cone of vision except that female driver shows a 5% wider field of vision when compared to male driver at most of the driver condition tested in horizontal meridians of the angle of vision, this could be attributed to the fact that female has a larger nasal and temporal fields of vision than male. Similar results were observed by refs.[5,12] Based on the data obtained, it was felt that the driver's population with head cover should be considered in designing the geometric features, traffic sign position and installation of road furniture components. The data obtained regarding the tested drivers sample, and the socio-economic aspects were small and only indicate trends without statistical verification, and could not be implemented in correlations or modeling, the use of larger sample may permit for detailed statistical analysis and stringent recommendations to improve road safety.

CONCLUSIONS AND RECOMMENDATIONS

Based on the fieldwork and testing conducted, the following conclusions may be drawn:

(1) The present licensing testing procedures are not sufficiently reliable to be used as a basis for approving or denying the right to drive, visual field test and response time may be incorporated in the procedures.
(2) The response time tested was within the standards requirement for the tested drivers of various age groups, geographic location, and gender.
(3) The impact of head cover is more pronounced on angle of clear vision and it is many folds of that of the impact on peripheral vision.
(4) The use of head cover and spectacle have a negative effect on visual field, it decreases the angle of peripheral vision in the horizontal meridians by 20.2–26.6% for different age groups for urban area drivers, and a range of 3.5–25.7% for suburban area drivers.
(5) The impact of using spectacles and head cover on angle of clear vision was in the range of 48.5–72.5% for urban, and 48.8–68.1% for suburban drivers.
(6) The tested drivers sample was small and only indicates trends without statistical verification, the use of larger sample is recommended to permit sufficient data for detailed statistical analysis.

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