International Journal of Transportation Engineering and Traffic System
ISSN-2456-2343 (online)
Vol. 1: Issue 1
www.journalspub.com

Field Investigation on the Use of Mobile Phone While Driving

Saad Issa Sarsam*, Duaa Mouiad Lafta, Nawaf Hani Muslem
Department of Civil Engineering, College of Engineering, University of Baghdad, Iraq

Abstract

While talking through mobile phone, drivers are much less aware of what is happening on the road around them; fail to see road signs, maintain proper lane position and steady speed; react more slowly and take longer to brake. Moreover, drivers are more likely to enter unsafe gaps in traffic, feel more stressed and frustrated, and are more likely to tailgate the vehicle in front. This paper demonstrates field investigation undertaken at Baghdad urban area on selected driver samples of different gender and age groups, (30 of each group). A questionnaire form was designed to obtain data, which includes number of accidents participation, age, and gender. After filling the questionnaire form, the driver samples were subjected to response time test using equipment specially designed for such purpose. The response time has been noted for each driver at two stages, the first stage was at normal condition while the driver concentrates on the green and red light of the equipment, the second one was while answering a ring tone call using mobile phone. Data was analyzed and a mathematical model representing the impact of using mobile phone while driving was obtained for different age groups and gender.

Keywords: *Response time, mobile phone, driver, gender, age group*

Author for Correspondence: *Email ID: saadisasarsam@coeng.uobaghdad.edu.iq*

INTRODUCTION

One of the most popular innovations in automotive travel in the past three decades is the ability to carry on telephone conversations while driving[1,2]. From early 1984, when the first complete systems became operational, the number of cellular phone users has grown to millions. After the mid-90s, cellular service were available throughout most population centers all over the world, the number of subscribers is expected to grow[3]. The road safety community has become increasingly aware of the potential for these mobile phone devices to distract driver and compromise safety. Concerns have been raised that use of a cellular phone while driving increases the risk of traffic collisions, property damage, injuries, and fatalities[4]. Such risk is caused mainly by the mental distraction and divided attention of taking part in a phone conversation at the same time as driving. Traffic regulation must put in place all reasonably practicable measures to manage this risk. The attention processes that must be shared when placing, receiving, or carrying on telephone conversations while driving are known to be vulnerable to age and gender related effects[5].

Mobile phones were first introduced into Iraq market in the mid-2003, and have since experienced dramatic growth. Over the past decade, the mobile phone subscription sales have increased many-fold, ranking it among the fastest growing industries in Iraq. The safety concerns have led policymakers to consider whether the use of a mobile phone while driving should be regulated or even prohibited.

Such bans, at least with respect to use of handheld phones by drivers, have already been enacted in some foreign countries, prior to the widespread diffusion of the technology. Many developed or developing countries including Iraq are now considering restrictions or bans on use of a mobile phone while driving. Since 2014, a traffic fine equivalent to 20 UD Dollars was implemented for the mobile phone violation. Figure 1 demonstrates that the mobile phone usage violation in Baghdad for a typical one day in 2014 at Baghdad urban area was in the range of 3.5–5.5% of the total traffic violation on the day for both traffic sectors (Karkh and Rusafa) which represent the west and east zones of Tigress river banks. Data was obtained from the traffic police morning and evening reports issued daily by the traffic police department. On the other hand, Figure 2 shows the traffic fine pertaining to mobile phone usage for the same typical day. The traffic fine was in the range of 5–35% of the total traffic fine of the day. Such figures reflect the need for revision of the whole traffic education strategies and improvement of safety issues on roadway. In addition, it indicates the high risk facing other drivers and pedestrians on the road.

The objectives of this study are to assess the risk of using a mobile phone while driving; including a discussion of issues relevant to whether the use of a mobile phone while driving should be restricted or prohibited. It is currently difficult for policymakers to reach an informed conclusion, the risks of using a mobile phone while driving, though real, are not large enough to be detected in overall crash/fatality statistics but are potentially large enough to be a legitimate concern of motorists and policymakers. It is essential to support the policymaker with up to date data of the issue through the proposed Mathematical analysis and models which correlates the distraction in response time with driver's characteristics such as age groups, gender, and accident experience.

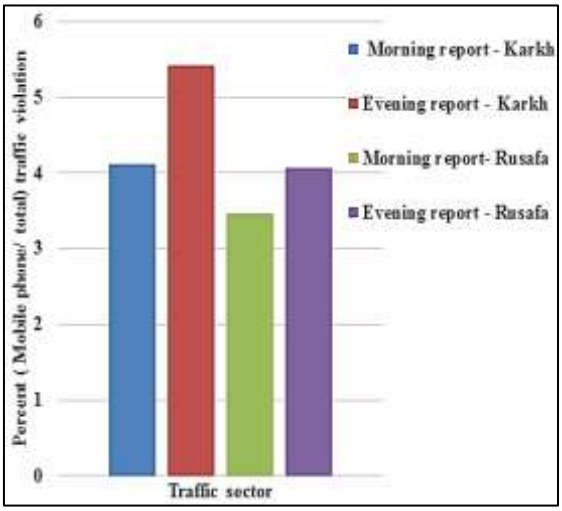

Fig. 1: *Typical One-Day Traffic Violation Report.*

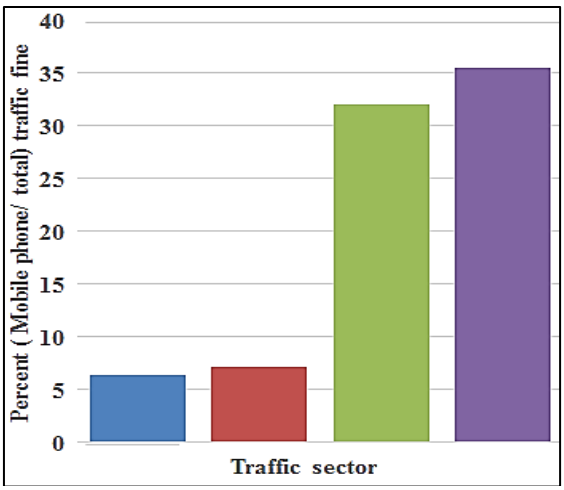

Fig. 2: *Typical One-Day Traffic Fine Report.*

Types of Driver Distraction

There are four different types of driver distraction for example; visual, auditory, cognitive and physical. Visual distractions frequently occur and include the following, looking at a map, reading billboards, checking a cell phone display. Auditory distractions refer to sounds or noises such as music, conversation and traffic. Cognitive distractions are the mental activities such as daydreaming, problem solving and concentrating on conversation. Physical distractions involve touch. They range from eating and

drinking to adjusting climate controls and pushing keys on an electronic device. When we use a mobile phone, we experience all four forms of distraction[6]. There is physical distraction, with the driver usually being required to drive one-handed, either for the total duration of the call if using a hand-held phone or for some part of the call if using a hands-free device. Using either form of phone also involves visual distraction, particularly when starting and completing calls. Mental distraction seems to be the key factor, with the phone serving to divert a driver's attention from the driving task and the road environment. Auditory distraction is arguably the least dangerous form of distraction, perhaps because auditory cues have a minimal association with safe driving. It was stated by Baughan *et al.* that these forms of distraction arising from phone use could result in various decrements in driving performance and lead to a marked increase in crash involvement, with the weight of evidence suggesting approximately a four-fold increase in crash risk[7].

Field Measurement of Distraction

The recent mobile phone situation on Finnish roads and the opinions of road users about how the government should deal with this issue through a self-reported usage and opinion data concerned with mobile phones and driving in Finland were described by Lamble *et al.*[8]. It was stated that the goal of the data collection was to monitor the changing situation on Finnish roads, with specific emphasis on age groups, and to find out what the public thought was the appropriate response from their government in regulating mobile phone usage while driving. It was concluded that the analysis of the phone survey data clearly showed the expected increasing trend for drivers to have and use a mobile phone in their vehicle, as well as an increase for time that they used it each day. Transport research laboratory TRL PPR056, suggests that a driver using a mobile phone is around four times more likely to be involved in a collision than a driver who is not using a phone[9]. The research also suggests that the increased risk remains for some time after the call has ended. TRL LF2097 in their study show that the rate of hand-held mobile phone use by car driver had returned by 2005 to the level found by 2003 study before legislation restricting the use of mobile phone took effect[10]. On the other hand, TRL LF2100 has carried out a series of surveys into the use of mobile phones by drivers of cars and other motor vehicles at 30 sites to represent the full range of conditions on British roads[11]. The speed limits varied from 20 to 70 mph. Observers were equipped with an electronic device that detects the microwave radiation emitted by both hand-held and hand-free mobile phones. The observers recorded the total number of drivers, the number who were using hand-held phones and the number who were using hand-free phones. It was concluded that drivers aged fewer than 30 were almost twice as likely to be using a mobile phone as those aged 30 and over.

Schlehofer *et al.* demonstrated that the distracting effect of use of cellular phone among drivers of age 50 is two to three-times as that of younger drivers and encompasses all three aspects of cellular phone use-placing calls and carrying on simple and complex conversations[12]. The effect is to increase non-response by 33–38%. Caird *et al.* stated that hand-held and hands-free phones produced similar reaction time decrements[13]. Overall, a mean increase in reaction time of 0.25 sec was found to all types of phone-related tasks. Observed performance decrements probably underestimate the true behavior of drivers with mobile phones in their own vehicles. In addition, drivers using either phone type do not appreciably compensate by giving greater headway or reducing

speed. The effects of the law of prohibiting use of any mobile communication device by drivers younger than 18, on teenage driver's cell phone use was examined by Foss *et al.*[14]. Interviews were conducted with parents and teenagers both before and after the law took effect. In post-law interviews, teenagers were more likely than parents to say they knew about the cell phone restriction (64 vs. 39%), but support for the ban was greater among parents (95 vs. 74%). Only 22% of teenagers and 13% of parents believed the law was being enforced often or a lot.

Laboratory Measurement of Distraction Using Simulator

A key study in this context was conducted by TRL in 2005, ROSPA in 2002, and ROSPA in 2007[10,15,16]. Twenty experienced drivers were tested on a simulator on two separate occasions, with the independent variables being normal driving, alcohol impaired driving and driving while talking on a hands-free or hand-held mobile phone. Results indicated that the best driving performances (based on a number of constituent measures) were obtained from those driving under normal conditions i.e. alcohol-free and not using a mobile phone. On the other hand, driving under the influence of alcohol (at around a 0.08 BAC level) was significantly worse than normal driving but significantly better than driving when using either form of phone.

Driving while using a hands-free mobile was generally safer than using a hand-held device but conversation remained a major cause of distraction. Schlehofer *et al.* explored psychological predictors of cell phone use while driving[12]. College students (final N=69) completed a survey and predicted their driving performance both with and without a simultaneous phone conversation. Their actual performance on a driving simulator was then assessed. Cell phone use reduced performance on the simulation task.

Impact of using mobile phone on reaction time

David *et al.* compared the effects of texting to other modes of responding on driving performance[17]. While driving simulator participants were instructed to categorize words appearing on billboards. The word categories were reported by texting, phoning in or identifying them aloud. There was significant effect of response mode on measures of driving performance. Drivers in the texting condition showed significantly slower reaction times to peripheral letter targets. They exhibited greater variance in their lane position, drove slowly, and took their eyes off the road more often as compared to either in the cell phone condition or the verbal condition. Drivers in the cell phone condition often performed more poorly than in the verbal response condition. SWOV in 2010 stated that a telephone conversation causes considerably slower reactions to the traffic environment[5]. The increase in reaction time while phoning turns out to be 0.25 sec on average, and is even higher while dialing a telephone number (0.36 sec). Figures from 2008 study indicate that 48% of Dutch drivers with a driving license for passenger cars phone from their cars at least once a week. Around 30% of this group indicates that they use a hand-held phone occasionally. This percentage is higher for drivers of leased cars: 39%. Men turn out to use hand-held phones more often than women (34 vs. 26%) do. Also younger drivers (25–34 years) turn out to use hand-held phones more often in comparison (40%). Al-Hinnawi *et al.* designed a test based on carrying Ravens progressive matrices response time, 13 young males drivers went into the experiment, while the drivers were engaged with a telephone conversation[18]. He concluded that a significant delay in response time ranged from 3 to 6 sec depending on the difficulties of the task given to drivers could be detected.

EXPERIMENTAL PROGRAM

The experimental program was divided into two stages, at the first one, the design of questionnaire and the drivers sampling technique were conducted, while at the second stage, the response time apparatus was designed and manufactured at local market, and used for testing driver's response time.

Study Sample

To study the relationship between mobile phone use and the driver's ability to respond to the demands of the highway traffic environment, sample of 30 drivers for each variable (gender, accident participation, and age group) that was generally representative of the driving population at Baghdad urban area has been selected. The only requirements for entry into the testing program were experience in driving, participation in traffic accident, age, gender, and the use of mobile phone while driving information. A questionnaire form was designed to obtain data, which includes the variables mentioned above. Female drivers represent 65, 30 and 50% of young, adult and elder drivers respectively. On the other hand, 44% of the tested drivers were involved in previous traffic accidents.

Measurement of Response Time

Each of the selected drivers has practiced the response time determination; the portable response time device, which was manufactured at local market for such purpose has been implemented. The driver was seated on a chair so that his eye line of sight was 1.8 m above the ground level, and 1.5 m away from the apparatus. It was felt that it represents the normal case for passenger vehicle, the monitoring red and green light box was facing his line of sight, and the driver was asked to be relaxed on his seat watching the green light, which represents the clear condition on the road. The green light then changed to red through the monitor, and the timer start counting the elapsed time, in fractions of seconds, taken by the driver to respond to such action, by pressing the brake pedal of the apparatus mounted on the ground. The time was recorded as response time. Figure 3 shows the response time apparatus implemented in the test, while Figure 4 demonstrates the response time test setup.

Fig. 3: *Response Time Apparatus Implemented.*

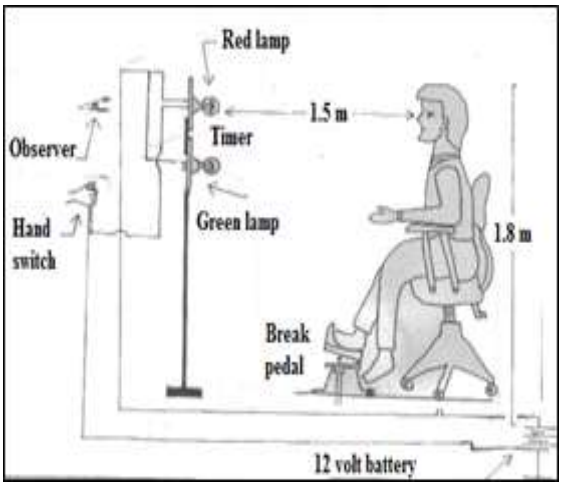

Fig. 4: *Response Time Test Setup.*

The same procedure was repeated for each driver after supplying the driver with a mobile phone. A ring tone was send to the driver's mobile phone through the monitor at the exact time when the light changes from green to red. The elapsed time was recorded again as the response time. Figure 5 shows the study sample details.

Figure 6 presents the variation in percent distraction of response time among age group while using mobile phone, the histogram indicates that young drivers of 16–29 years old exhibit the least distraction in response time of 78% while using mobile phone among other age groups. This may be attributed to the fact that although young drivers have lower driving experience, they are more alert and quick in their response, while young drivers of age group 30–49 show the higher distraction in response time of 86% while using mobile phone. Elder drivers of 50 years old and more shows 82% distraction in response time, this could be attributed to their long experience in driving.

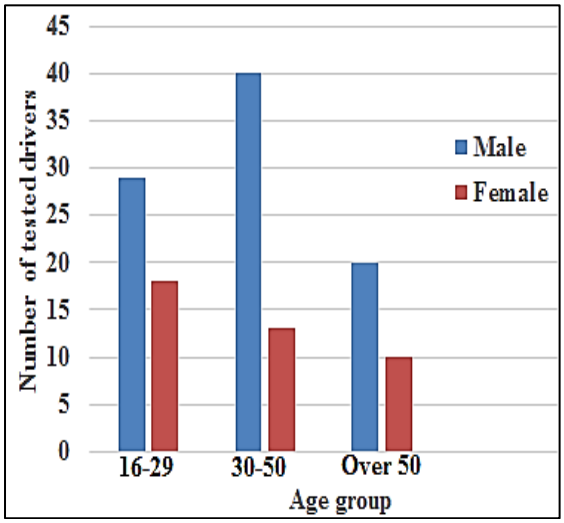

Fig. 5: *Tested Driver's Sample.*

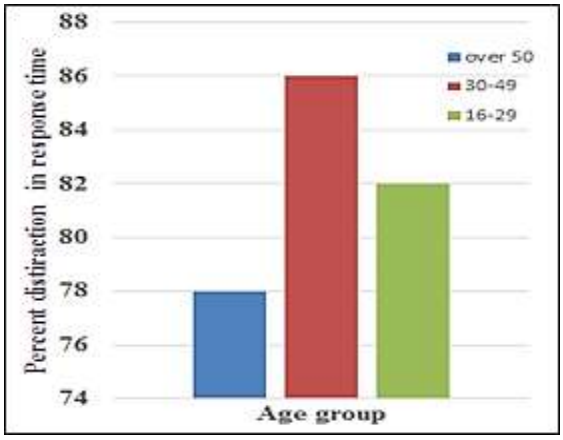

Fig. 6: *Distraction in Response Time for Age Group.*

DISCUSSION OF TEST RESULTS

Data were plotted to find a mathematical correlation between the two conditions of response time measurements. A mathematical model was obtained for measurement of the impact of using mobile phone while driving.

Figure 7 shows that all of the response time data measured while using mobile phone are located above the 45° line, indicating the significant negative impact of the issue, this was further supported by the high coefficient of determination of 0.85.

Similar findings were observed by Sarsam *et al.*, Caird *et al.*, and ROSPA in 2007 [4, 13,16]. Figure 8 demonstrates the impact of accident participation background of drivers on response time, the figure shows a high trend of increment of response time for drivers with accident participation background as compared to the other drivers; this may indicate lower concentration and driving skills of such drivers.

Table 1 summarizes the quality of collected response time data.

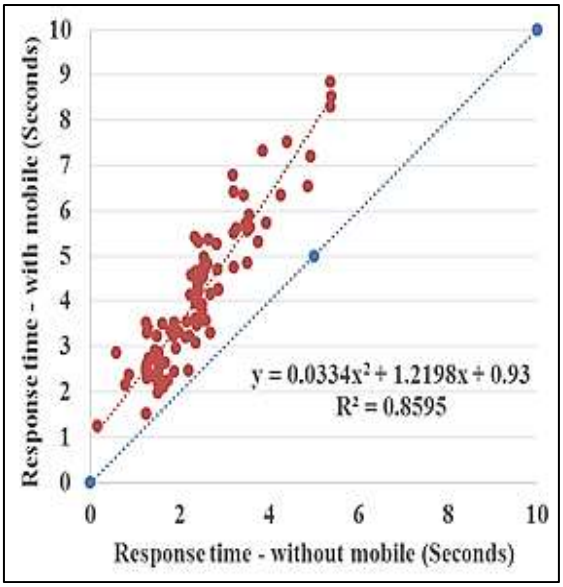

Fig. 7: *Impact of using Mobile Phone on Response Time for the Whole Sample.*

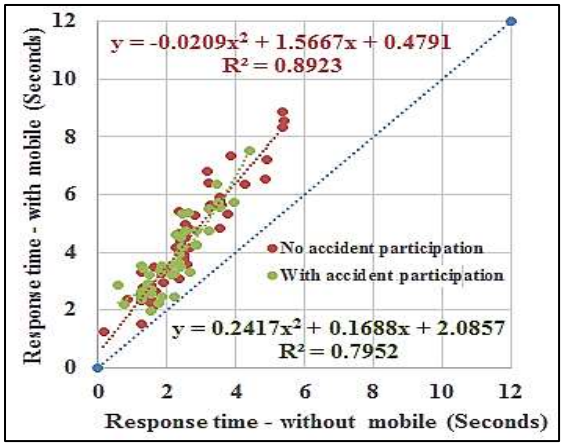

Fig. 8: *Impact of Accident Participation Background on Response Time for the Whole Sample.*

Figure 9 illustrates the mathematical models obtained for different age groups, the models exhibits high coefficient of determination. The young age group 16–29 exhibit more scatter of data around the trend line as compared with other age groups.

Figure 10 shows the variation of response time with gender, male drivers exhibit more scatter of data around the trend line as compared to female drivers, which shows higher coefficient of determination of 0.92 than that of male drivers. On the other hand, Figure 11 demonstrates the variation of percent distraction in response time due to mobile phone usage for gender and age group. It clearly indicates that the variation between elder male and female drivers is not significant. On the other hand, young and adult male drivers' shows significant variation in the distraction of response time when compared to female drivers[4,19,20]. Table 2 summarizes the mathematical models obtained for the various variables studied.

Table 1: *Summary of Response Time Data.*

Variable	Age group	Male Driver		Female Driver	
		Maximum	Minimum	Maximum	Minimum
Response time without mobile phone (sec)	16–29	3.58	1.16	3.56	1.28
	30–49	4.26	0.59	3.94	1.62
	50 and over	5.40	1.54	5.38	2.26
Response time with mobile phone (sec)	16–29	6.34	1.26	5.91	1.96
	30–49	7.32	1.53	5.73	3.50
	50 and over	8.32	2.87	8.86	4.53

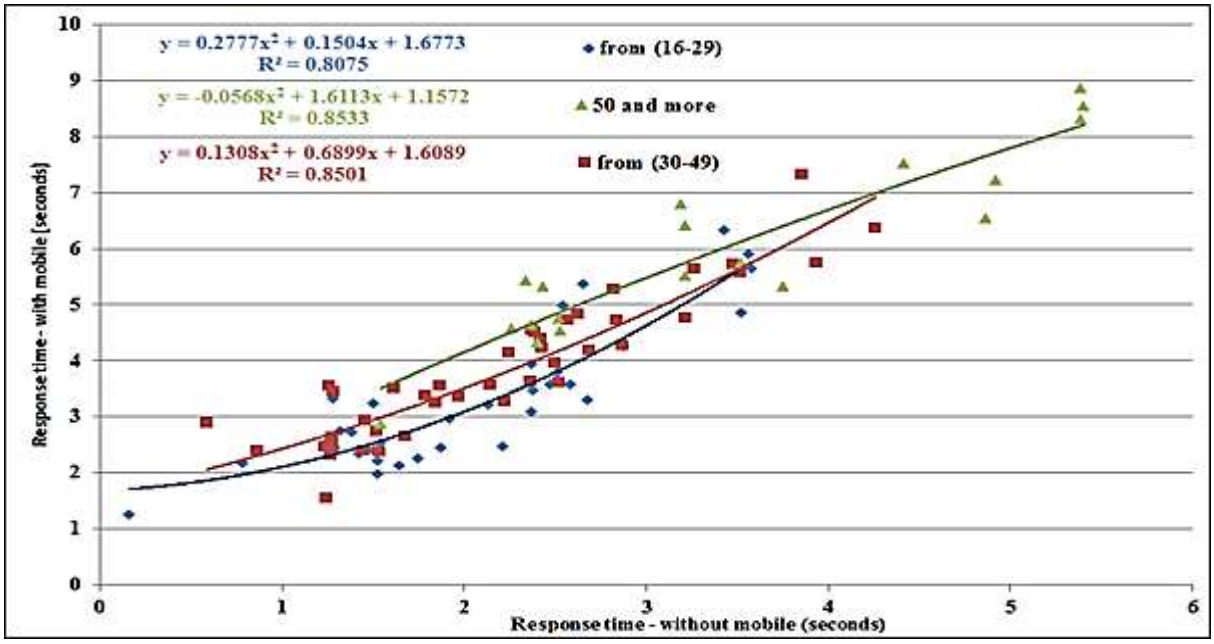

Fig. 9: *The Impact of Age Group on Response Time.*

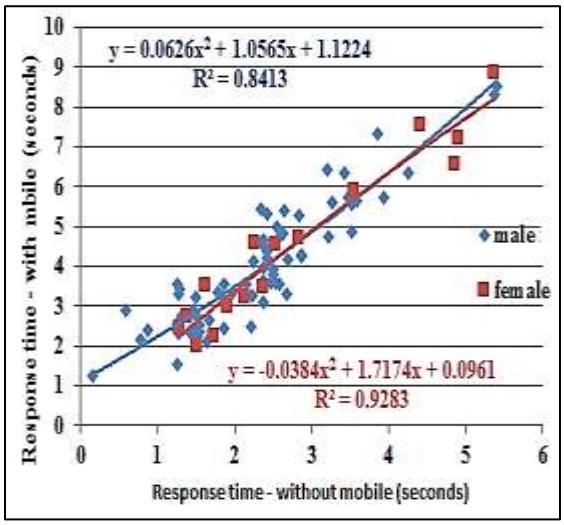

Fig. 10: *Variation of Response Time with Gender.*

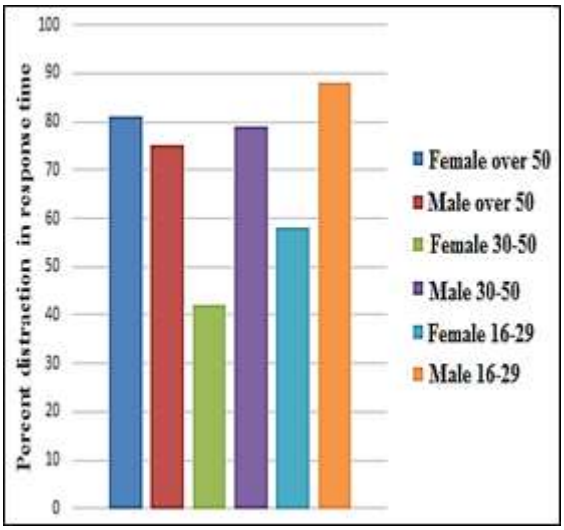

Fig. 11: *Percent Distraction in Response Time for Gender and Age Group.*

Table 2: *Summary of the Mathematical Models Obtained.*

Variable	Model	Coefficient of Determination R^2
Whole tested drivers sample	$Y=0.0334x^2+1.2198x+0.93$	0.8595
Driver with no accident participation	$Y=0.0209x^2+1.567x+0.4791$	0.8923
Driver with accident participation	$Y=0.2417x^2+0.1688+2.0857$	0.7952
Young drivers (16–29) age group	$Y=0.2777x^2+0.1504x+1.6773$	0.8075
Adult drivers (30–49) age group	$Y=0.1308x^2+0.6899x+1.608$	0.8501
Elder drivers (50 and over) age group	$Y=0.0568x^2+1.6113x+1.157$	0.8533
Whole tested Male drivers	$Y=0.0626x^2+1.0565x+1.1224$	0.8413
Whole tested Female drivers	$Y=0.0384x^2+1.7174x+0.0961$	0.9286
Where: Y= Response time while using mobile phone. x= Response time without using mobile phone.		

CONCLUSIONS

Based on the limited testing program, the following conclusions may be drawn:

1. The response time was distracted by a range of 78–86% based on age groups when using mobile phone.
2. The mathematical model obtained explains 79–92% of the variation in response time due to mobile phone usage.
3. High trend of increment of response time for drivers involved in previous traffic accidents as compared to the other drivers, indicating lower concentration and driving skills.
4. Young age group 16–29 exhibit more scatter of data around the trend line as compared with other age groups, while male drivers exhibit more scatter of data around the trend line as compared to female drivers,
5. The variation in percent distraction of response time between elder male and female drivers is not significant. On the other hand, young and adult male drivers' shows significant variation in the distraction of response time when compared to female drivers.
6. The traffic education strategies should be revised, and enforcement on using mobile phone while driving should be strictly implemented.

REFERENCES

1. OMC. *Cellular Phone Use and Driving: A Dangerous Combination*. Ontario Medical Association. Sep 2008.
2. McCarty A., Hellinga L., Braitman K. Cell Phones and Driving: Review of Research. *Traffic Injury Prevention*. 2006; 7: 89–106p.

3. Cotter S, Hopkin J, Wood K. *A Code of Practice for Developing Advanced Driver Assistance System: Final Report on Work in the Response 3 Project*. TRL Limited, PPR-175, England. 2007.
4. Sarsam S.I. Assessing Safety Issues when using Mobile Phone while Driving. *Proceedings, 6th Traffic Safety Conference*, Amman, Jordan. 19–20 Nov 2012.
5. SWOV. *Use of Mobile Phone while Driving*. Institute of Road Safety Research. SWOV, Leidschendam, the Netherlands. Aug 2010.
6. Mcknight J., Mcknight S. *The Effect of Cellular Phone upon Driver Attention*. AAA Foundation, National Public Service Research Institute for Traffic Safety. 2008.
7. Baughan C.J., Sexton B., Maycock G., *et al. Novice Driver Safety and the British Driving Test*. TRL Report 652. Transportation Research Laboratory, England. 2006.
8. Lamble D., Rajalin S., Summala H. Mobile Phone Use while Driving: Public Opinions on Restrictions. *Transportation*. 2002; 29: 223–36p.
9. TRL Limited. *The Innovatory Analysis of Road Traffic Accident Data*. PPR056. Jul 2004.
10. TRL. *Mobile Phone Use by Drivers: 2003–2005*. LF2097. Sep 2005.
11. TRL. *Mobile Phone Use by Drivers: 2004–2006*. LF2100. Aug 2006.
12. Schlehofer M., Thompson S., Thompson S., *et al.* Psychological Predictors of College Students, Cell Phone Use While Driving. *Accident Analysis and Prevention*. July 2010; 42(4): 1107–12p.
13. Caird J.K, Willness C.R., Steel P., *et al.* A Meta-Analysis of the Effects of Cell Phones on Driver Performance. *Accident Analysis & Prevention*. 2008; 40(4): 1282–93p.
14. Foss R., Goodwin A., McCartt A., *et al.* Short-Term Effects of a Teenage Driver Cell Phone Restriction. *Accident Analysis & Prevention*. May 2009; 41(3): 419–24p.
15. ROSPA. *The Risk of Using Mobile Phone while Driving*. The Royal Society for the Prevention of Accidents. DTLR, Birmingham, England. 2002.
16. ROSPA. *Mobile Phones and Driving*. The Royal Society for the Prevention of Accidents. DTLR, Birmingham, England. Feb 2007.
17. David L., Alex C. Text Messaging versus Talking on a Cell Phone: A Comparison of their Effects on Driving Performance. *Proceedings, Human Factors and Ergonomics Society Annual Meeting*. 2009; 53(18): 1353–7p.
18. Al-Hinnawi M. Using Mobile Phone while Driving Could Become a Criminal Act. *Damascus University Journal*. 2009; 25(1).
19. Bener A., Lajunen T., Ozkan T., *et al. The Effect of Mobile Phone Use on Driving Style and Driving Skills*. Crash IJ. Vol.11 No. 4, Woodhead Publishing Ltd. 2006.
20. Brace C., Kristie L., Regan A. *Analysis of Literature: The Use of Mobile Phones while Driving*. Monash University Accident Research Centre. Publication No.35. 2007.