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Characteristics and mitigation strategies for cell phone use while driving among young drivers in Qatar

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ABSTRACT

There is no doubt that cell phone use while driving can lead to a higher probability of driver error, which increases the likelihood of more crashes. In Qatar, the high rate of cell phone use while driving among young drivers is a major traffic safety concern. The objectives of this study are to identify the factors affecting this hazardous behavior and to suggest practical solutions to deter this specific category of drivers from driving while distracted. The study combined stated and revealed preference questions to design a detailed survey questionnaire. Data were collected from a sample of 403 young drivers. The structural equation modeling results showed that, for the revealed preference, conducting public campaigns may provide a suitable solution to reduce cell phone usage while driving. On the other hand, increasing enforcement did not seem to have a significant effect on reducing this type of behavior. For the stated preference, young drivers who had a crash history resulting from cell phone usage tend to use their cell phones less than those who did not have a cell phone related crash. Furthermore, the driving experience and safe duration of distraction had a significant effect on the cell phone usage. Based on the results, it is recommended to provide road safety campaigns to educate young drivers on the risk associated with such behavior. This information is valuable to legislators and traffic safety experts dealing with this problem in Qatar and other countries in the region.

1. Introduction

Distracted driving happens when the driver is engaged in an activity that distracts him/her from the main task of driving. This distraction can occur in three forms. The first is known as the visual processing distraction and occurs when drivers remove their eyes off the road. The second is known as the manual interference and happens when drivers remove their hands off the steering wheel while driving. The last method, cognitive, occurs when drivers are distracted from information processing needed to operate their vehicle. More than one of these types of distraction can occur at one time (Strayer et al., 2013). A study showed that less than a third of road users are distracted by cell phones, whereas almost three-quarters are distracted by other behaviors, (Ortiz et al., 2016). Cell phones have evolved over the years from a device used for making a phone call or sending a text message to a “smartphone” that can be used for multiple purposes, including but not limited to sending/receiving emails, Internet browsing, music, camera, games, a navigation system, scheduling, and many other purposes depending upon the applications installed. This indicates that the impairment due to cell phone usage might have increased over the years. These types of behaviors can have negative effects on drivers. A study found that driver distraction in the form of mobile phone use and conversation with the passenger can affect the driving

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performance (Yannis et al., 2015). Another study showed that using the cell phone while driving increases the reaction time for drivers, especially among female and older drivers (Papantoniou et al., 2015). This distraction leads to a higher probability of driver error, which increases the likelihood of a crash (Wilson et al., 2015; Ige et al., 2016). According to a National Highway Safety Administration (NHTSA) report, cell phone use was the cause of 445 fatalities in one year in the United States (NHTSA, 2015). Studies also show that young drivers are relatively responsible for more crashes than old drivers are (Jones, 2015a, 2015b). A study from the United States has shown that, at the time of the crash, approximately 8% of drivers were distracted. For young drivers, the average was higher (11.7%) (Stutts and Hunter, 2003). Another study found that younger drivers tend to have a high involvement in crashes caused by driver distraction (Klauer et al., 2006). Previous research has shown that these types of behaviors occur among young drivers due to being unaware of the impact of distracted driving on the driving performance (Horrey et al., 2008; Lesch and Hancock, 2004) or being aware but still engage in this type of activity (Walsh et al., 2008; Vanlaar et al., 2008).

The objectives of this study were to understand the different cell phone use habits among young drivers in Qatar, understand their awareness about the danger of these habits, and investigate the factors affecting their behavior using a self-report questionnaire. Qatar is a high-income developing country located in the Middle East. The population rapidly increased from 613,969 in 2000 to 1,832,903 in 2012. During the same period, the number of daily trips increased by 209%, and the number of vehicles increased by 206%. This huge increase caused a significant increase in the number of traffic crashes. From 2001 to 2011, crashes have almost tripled from 57,951 to 160,557 in Qatar (Shaaban and Hassan, 2014; Shaaban and Kim, 2016). Traffic crashes are one of the top causes of deaths in Qatar with 15.2 deaths per 100,000 population. In Qatar, the 18 to 25 years age group formed 32.6% of the total fatalities, 29.3% of the total major injuries, and 26.9% of the total minor injuries in 2011. These percentages are considered the highest among the different age categories and identify a significant issue among the young drivers' category (Shaaban and Hassan, 2017). Another study in Qatar revealed that young drivers have the lowest compliance rate among drivers at minor-street stop-controlled intersections (Shaaban et al., 2017). Furthermore, an observational study in Qatar revealed that young drivers use their cell phones while driving at a much higher rate (20.2%) than middle-aged drivers (10.5%), and older drivers (8.0%) (Shaaban, 2013). The study aims to improve the understanding of young driver behavior when distracted by cell phones being a higher-risk group compared to the other age groups. The study also aims to analyze the impacts of these attitudes on road safety while also exploring potential countermeasures from the perspective of drivers themselves. More specifically, the study identifies how this group of drivers uses their cell phones while driving, what they think are the most appropriate practices for this behavior, how risky they feel about such behavior, and what they are willing to do to resolve this problem. The outcomes from this research would enable policymakers to assess the impacts of past policies on cell phone distracted driving activities while also assisting officials in looking for more effective policies when dealing with such offenders.

2. Background

Researchers have utilized different approaches to investigate the effect of cell phone usage as a driving distraction on the driving behaviors of motorists. Survey questionnaires based on driving simulator experiments were extensively used to investigate the effect of cell phone usage on driving behaviors (Rumschlag et al., 2015; Yannis et al., 2014, 2016). These studies might provide a reflection of the revealed preference of participants as it is based on a driving simulator experience. However, the large degree of control using driving simulators would make the applicability of the results to real life more difficult. Other studies used naturalistic driving data to examine the impact of cell phones usage on driving (Precht et al., 2017; Xiong et al., 2015; Ye et al., 2017). Long study time, uncontrolled environment, and subjectivity in observations could be considered as disadvantages for the naturalistic studies. Other studies utilized survey questionnaires in conducting studies related to distraction resulting from cell phone usage (Beck et al., 2007; Gao et al., 2014; Zhao et al., 2013). One of the main limitations of the self-reporting questionnaires is how accurate the stated preference of the participants reflects their actual driving behaviors.

Different methodologies were used in analyzing data obtained from survey questionnaires. Quasi-induced exposure was used to estimate the relative risk for cell phone use while driving. The results showed that an increase in accident risk was found for hand-held cell phones and for hand-held and hands-free phones together. In addition, a non-significant increased risk for hands-free cell phones was detected (Backer-Grøndahl and Sagberg, 2011). Another study used logistic regression to predict cell phone usage while driving as a function of demographic factors. The results showed that the significant predictors for cell phone usage in Alberta, Canada, were gender, age, employment status, home ownership, household income, immigrant status, and risk perceptions (Nurullah et al., 2013). Waddell et al. used hierarchical multiple regression analyses to examine psychosocial influences on drivers' intentions to use a hand-held cell phone, investigate the effect of the descriptive norm on the predictive ability of the theory of planned behavior model, and to examine drivers' behavior for initiating and responding to cell- phones while driving. The results showed that attitude, subjective norm, perceived behavioral control, and descriptive norm were of drivers' intentions to engage in both initiating and responding behavior (Waddell and Wiener, 2014). Furthermore, repeated measures ANOVA tests were used to investigate the effects of the phone use conditions and driver demographics on driving performance. The results showed a significant decrement in the driving performance while conducting texting tasks. The results also showed a reduction in driving ability when having a conversation or texting on the phone while driving. Sufficient attention to the road ahead, responding to sudden traffic events, and controlling the vehicle were significantly affected when using cell phones while driving (Choudhary and Velaga, 2017).

This paper investigates the factors affecting cell phone distracted driving in Qatar and explores the potential solutions for the problem. The data used in this study was collected through face-to-face interviews conducted in Qatar. The survey was directed at young people between 18 and 25 years old with a valid driver license from both genders with different ages and nationalities, who regularly drive a car and reside in Qatar. The analysis in this study was conducted using a structural equation modeling technique.

More information regarding the analysis method is provided in the methodology section.

3. Data collection

3.1. Survey questions

The survey form contained questions related to the demographics, driving history, and cell phone use while driving. The demographics section captured the information related the participants' gender, age, and nationality in addition to marital status, current education, and occupation. The survey included stated and revealed preference questions. The stated preference questions contained the driving history section, which elaborates on driving experience and exposure, namely; the vehicle type, years of driving experience, and driving frequency. In the cell phone use while driving section, the drivers were asked whether they owned hands-free equipment/accessories such as earphones, car Bluetooth, and/or AUX, and how often they used them. Participants were also asked about circumstances where they would never use their cell phone to make/answer a call or send a message while driving. Responses regarding how often participants were involved in different activities with their cell phone while driving were also collected. To investigate the participants' revealed preference, they were asked about the effect of talking, texting, and emailing while driving. They were also asked for their opinion about the length of time a driver could safely keep their eyes off the road. Finally, participants got a chance to express their opinion regarding countermeasures effective in dealing with cell phone distraction while driving. After completing the initial version of the survey, it was necessary to check the clarity of the questions. The questions needed to be easy to understand, written in simple English/Arabic, and as short as possible to be able to complete it in a reasonable time. The initial version was tested on a sample of 30 young drivers to ensure that it was clear and not misleading in order to ensure a realistic and solid data. The pilot survey revealed some issues with the translation of some words, some difficult technical terms, and a weak sentence structure in describing some situations. These issues were resolved, incorporated into the questionnaire, and the final version was prepared.

3.2. Final survey

The minimum sample was estimated based on assuming a 95% confidence level ($Z = 1.96$) and a 5% significance interval ($C = .05$) resulting in a minimum sample size of 385. A total of 500 survey forms were printed and distributed. Interviewers explained the questions to the young drivers in person and asked the respondents to complete the survey form by hand in front of the interviewers and return them then and there. The participants were informed that this study is conducted only for the purpose of research and will not be used to implement or change any existing or proposed policy in the future. This explanation was necessary to discourage the participants from strategically answering questions based on how they would like to see a policy implemented, changed, or removed, or from giving answers that they think the interviewer expects. They were also given the chance to ask any questions during the process if any part of the forms was not clear. All survey forms were distributed. A total of 403 forms were deemed complete. The remaining forms had either more than 30% missing responses, or they were not returned, and hence they were disregarded. A summary of the demographics of the respondents is shown in Table 1.

The participants ranged in age from 18–25 years, with slightly more than half (50.4%, 203) being males and 49.6% (200) being females. Of the survey participants, 13.6% were Asian, 50.6% were non-Qatari Arab, 27.3% were Qatari, and the remaining was of other nationalities. To determine if there any significant differences among the characteristics of cell phone users and non-users, an analysis of variance (ANOVA) was used at the 95% level of significance. Findings suggest that gender ($p = 0.364$), age ($p = 0.224$), nationality ($p = 0.120$), and house location ($p = 0.448$) did not significantly affect the cell phone use among the participants.

Most of the participants (90.8%) admitted using their cell phone while driving. More than half of the cell phone users (65.8%) owned hands-free kits. Only 57.7% of these participants used their hands-free kit while driving regularly. The participants were asked about their first course of action when they received a phone call. The majority of the participants (73.2%) mentioned that they answer the phone and continue driving, 11.2% mentioned that they pull over first then answering the phone, and 9% stated that they answer first then pull over. When participants were asked about how talking over the phone affected their driving, 20.5% of respondents mentioned that talking while driving did not affect their driving performance. The remaining stated that their driving was affected in many forms, including slower driving and drifting in and out of lanes. For other activities such as emailing and texting, only 10.1% of respondents stated that these activities did not affect their driving performance.

4. Methodology and data analysis

Structural Equation Model (SEM) is one of the recently adopted statistical techniques in analyzing survey questionnaire datasets. It combines two statistical methods; confirmatory factor analysis (CFA) and path model analysis, which is known as simultaneous equation models. SEM has several advantages in analyzing datasets. It can handle indirect, multiple, and reverse relationships by having exogenous or endogenous variables (Kervick et al., 2015). Complex relationships among variables could be processed using SEM, where some variables can be unobserved (latent variables). Moreover, the significance of a particular relationship could be assessed in the context of the full model, as coefficients obtained from SEM are estimated simultaneously. Furthermore, more valid estimates are obtained as measurement error is eliminated using SEM. Finally, SEM accounts for multi-collinearity among variables (Dion, 2008).

Table 1
The Demographics of the Respondents.

		Cell Phone Non-User	Cell Phone User	Total
Gender	Male	16	187	203
		43.2%	51.1%	50.4%
	Female	21	179	200
		56.8%	48.9%	49.6%
Age	20 or less	8	92	100
		21.6%	25.1%	24.8%
	21	5	71	76
		13.5%	19.4%	18.9%
	22	9	68	77
		24.3%	18.6%	19.1%
	23	3	68	71
		8.1%	18.6%	17.6%
	24 or more	12	67	79
		32.4%	18.3%	19.6%
Nationality	Qatari	8	102	110
		21.6%	27.9%	27.3%
	Non-Qatari Arab	16	188	204
		43.2%	51.4%	50.6%
	Asian	9	46	55
		24.3%	12.6%	13.6%
	Others	4	30	34
		10.8%	8.2%	8.4%
House Location	Inside Doha	27	287	314
		73.0%	78.4%	77.9%
	Outside Doha	10	79	89
		27.0%	21.6%	22.1%
Total		37	366	403

4.1. Survey validation using explanatory factor analysis

Explanatory factor analysis (EFA) was conducted during this study to validate the survey. It shows whether the survey succeeded in quantifying and measuring the factors affecting the driving behavior of the young driver in Qatar and their cell phone usage while driving. EFA identifies the number of unobserved constructs (latent variables) that produce the variability in the collected/observed

Table 2
EFA Results and the Obtained Constructs.

Variable Question	Factor Loading			
Dialing a phone call while driving_Q25A	.641			
Answering a phone call while driving_Q25B	.524			
Reading short messages or emails while driving_Q25C	.645			
Sending messages or emails while driving_Q25D	.775			
Browsing the internet while driving_Q25E	.534			
Increasing cell phone enforcement_ Q39D		.462		
Introducing automated cameras to ticket phone users while driving_Q39E		.703		
Increasing the fine amount for using phone while driving_Q39F		.791		
In addition to the fine, add points to the penalty_Q39G		.613		
Providing workshops for schools, universities and the public to increase awarness_Q39J			.513	
Increasing media campaigns in movie theaters, TV, and radio_Q39K			.734	
Increasing media campaigns on the internet and social networks_Q39L			.758	
Increasing images and posters media campaigns on the road_Q39M			.722	
Including related teaching material in schools_Q39N			.506	
Discussing in debate groups_Q39O			.458	
Increasing awareness in driving schools_Q39P			.595	
Having a crash while using a cell phone_Q31				.881
What is the type of crash_Q32				.869
Way of using the cell when having the crash_Q33				.981
Reason of using the cell phone when having the crash_Q34				.894

#of factors	**Construct**	**Question #**
Factor #1	Cell phone usage for young drivers	Q25 (A, B, C, D, and E)
Factor #2	Increase enforcement to reduce the risk associated with phone usage while driving	Q29 (D, E, F, and G)
Factor #3	Increasing public campaigns to reduce the risk associated with phone usage while driving	Q39 (J, K, L, M, N, O, & P)
Factor #4	Cell phone crash history	Q (31, 32, 33, and 34)

data. Several trials were conducted to obtain the final factors to avoid over factored variables and uninterpretable factors. The Kaiser-Meyer-Olkin value (KMO) was found to be 0.696, which is a measure of sample adequacy. A KMO value above 0.5 is considered acceptable as it indicates that the data were well factored. Generalized Least Squares (GLS) was the extraction method considered for the analysis. GLS weights correlation coefficients differentially and treats highly communal variables as more important variables providing better data fitting. A total of four interpretable factors were obtained using a cutoff for the factor loading of 0.4 with Varimax orthogonal rotation (O'Rourke and Hatcher, 2013).

Table 2 shows the obtained factors and loaded variables that have cut off greater than 0.4. The first construct expresses the usage of cell phones while driving. Question 25 expresses this construct as it showed how frequently did young drivers use their cell phones in calling, answering calls, texting, reading text messages, and web browsing while driving. The second and third constructs showed solutions to increase the public awareness of the risk associated with cell phone usage while driving. The second construct focuses on increasing the traffic enforcement to reduce the usage of cell phones while driving, and the third constructs emphasizes on increasing awareness by providing public campaigns. The fourth and final construct showed cell phone crash history, where skip logic questions were used to inquire information about the occurred crash. The main objective of conducting the survey was to understand what young drivers in Qatar do and think about using cell phones while driving. It also investigated how to increase the awareness of the risk associated with using cell phones while driving. The four obtained constructs from the EFA succeeded in explaining the main context of the survey.

4.2. Survey analysis using SEM

SEM is a statistical technique which can process endogenous and exogenous variables for observed and latent variables. It consists of two main components; 1) CFA, and 2) path model analysis, where variables in the model are linked forming simultaneous equations (Hassan, 2011). SEM is considered a large sample technique (Fuller et al., 2014). Kaplan, 2000 defined SEM as "*structural equation modeling can perhaps best be defined as a class of methodologies that seeks to represent hypotheses about the means, variances and covariances of observed data in terms of a smaller number of 'structural' parameters defined by a hypothesized underlying model*" (Kaplan, 2008).

SEM is conducted in this research using the SAS software (version 9.4) procedure CALIS, which stands for Covariance Analysis of Linear Structural Equations. CFA is the first step to conducting the SEM. It is mainly used to obtain an adequate measurement model. Although it describes the relationship between the observed and latent variables, it does not identify any causal relationships between the latent variables. In the path model analysis, which is the second step in the SEM, the model path is modified to investigate the direct relationships between the latent variables producing a causal model. Eqs. (1), and (2) represent the measurement and the structural model used in this study (Kim et al., 2011).

$$v_i = \lambda_i F_i + e_i \tag{1}$$

$$F_i^{**} = B_i F_i^{*} + \Gamma_i F_i + r_i \tag{2}$$

Where:

v_i: Vector of observed variables,

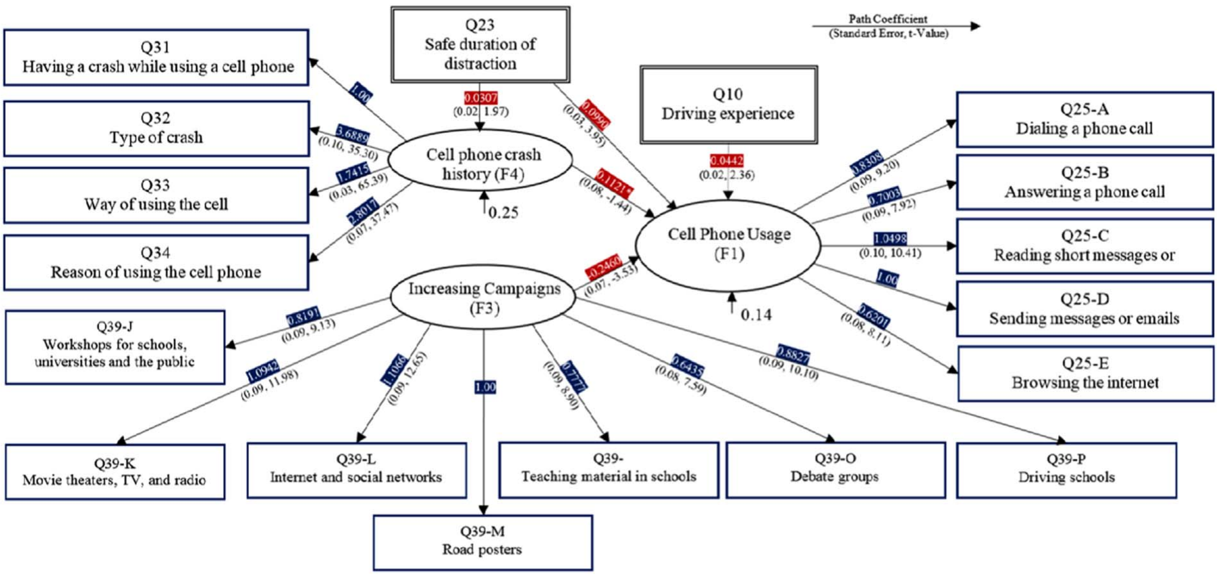

Fig. 1. Structural equation model of young drivers in Qatar. *Significant at 85% confidence level.

λ_i: Vector of parameters,
F_i: Vector of latent constructs,
e_i: Vector of measurement errors,
F_i^{**}: Endogenous variables,
B_i: Parameter vector,
F_i^{*}: Mediating variables,
Γ_i: Parameter vector,
F_i: Exogenous variables, and
r_i: Residuals term.

SEM was utilized in order to understand what young drivers (between ages 18 and 25) in Qatar do and think about using cell phones while driving. It also investigated how to increase the awareness of the risk associated with using cell phones while driving.

4.3. SEM results

Byrne stated that at least three indicator variables should be factored in each construct to avoid identification and convergence problems (Byrne, 2013). It is also advised that the total number of indicator variables should be less than 30 to avoid inability of fitting the model (O'Rourke and Hatcher, 2013). Considering the previously mentioned limitations, the EFA results, and investigating several SEM paths, a final SEM path was obtained, which quantifies and understands what young drivers (between ages 18 and 25) in Qatar do and think about using cell phones while driving. It also quantifies how to increase the awareness of the risk associated with using cell phones while driving.

Fig. 1 shows the obtained path model results for the SEM. To read the path model easily, cell phone usage is considered the dependent variable, as all arrows are lastly pointing to it. An arrow connecting two variables refers to a direct relationship between them. For instance, cell phone crash history, increasing campaigns, and driving experience have a direct relationship with cell phone usage. Safe duration of distraction has both a direct and an indirect effect on cell phone usage. This indicated that the perception of safe distraction duration indirectly affects cell phone usage by first affecting cell phone crash history.

Latent variables are non-measured variables that are represented by several measured variables. They have no unit of measurement. In order to define a unit measure for a latent variable, one of the observed variables, which represents the latent variable, is assigned a coefficient of one to serve as a reference variable. Latent variables are represented using elliptical shapes, measured independent variables are represented using rectangular shapes with double lines, measured variable representing the latent variables are presented using a rectangle with a blue single line, and the arrows show the direction of the SEM model.

The investigated path model focused on the relationships between the produced latent variables with the frequency of cell phones usage while driving. As previously mentioned the designed survey had a stated and a revealed preference. From the revealed preference perspective, it was found that providing more traffic enforcement would not significantly affect the cell phone usage. Also, increasing the public awareness of the risk associated with using a cell phone while driving will help in decreasing the frequency of cell phone usage at 95% confidence level. Moreover, the more years of experience a young male driver has will increase the usage of cell phones at 95% significance level. This could be interpreted as getting more used to driving would enhance the ability to perform a secondary task while driving. For the stated preference perspective, it was found that having a crash history resulting from using cell phones would affect cell phone usage while driving at 85% confidence level. The final variables which turned out to be significant in both latent variables, cell phone usage and cell phone crash history, were the perception of the safe duration of distraction. The more perceived duration, the more cell phone crashes occurred, and the more usage of cell phones is accompanied. Perception of the safe duration of distraction significantly affects the latent variables at 95% confidence level.

4.4. Goodness of Fit for SEM

Hooper et al. provided guidelines to determine model fit for SEM (Hooper et al., 2008). They stated that there are golden rules for assessment of model fit. However, reporting the several commonly used indices to assess the SEM model fit is utilized as each index reflect a different aspect of model fit. Table 3 shows the different indices used to evaluate the model fit and the threshold for each index. The obtained model did have the lowest Akaike Information Criterion (AIC) among all the tested models. However, all the goodness of fit indices did not meet the commonly used thresholds provided in Table 3; they are considered providing an acceptable

Table 3
Model Fit Indices Summary for the Obtained SEM.

Model Fit Index	Best Obtained Values	Threshold Values
Standardized RMR (SRMR)	0.06	< 0.05
Goodness of Fit Index (GFI)	0.85	> 0.9
Parsimony Index - Adjusted GFI (AGFI)	0.80	> 0.9
RMSEA Estimate	0.08	< 0.05
Akaike Information Criterion (AIC)	948.02	Lower value
Bentler Comparative Fit Index (CFI)	0.85	> 0.9

fit as they were all too close to the minimum/maximum limits. The standardized root mean squared residuals (SRMR) value of 0.06 was obtained. Hu et al. stated that a value below 0.08 for the SRMR is used to conclude a good model fit (Hu and Bentler, 1999). The Goodness of Fit Index (GFI) was 0.85, which is nearly approaching the threshold of 0.9 indicating a good model fit. Also, the root mean square error of approximation (RMSEA) in the obtained SEM was 0.08. However, Hu et al. stated that RMSEA is less preferable to be used as a goodness of fit index when having relatively small sample sizes as it tends to reject good model fit (Hu and Bentler, 1999). Finally, the Comparative Fit Index (CFI) value of 0.85 was obtained, which is too close to the threshold value.

5. Conclusions and discussions

This paper explores the factors affecting cell phone distracted driving among young drivers in Qatar and the potential solutions to overcome the problem. The objectives included understanding how the demographics of the driving population affect their usage of cell phones, identifying factors that influence driver perception of the level of risk involved while driving and using a cell phone, understanding how the demographics of drivers and the perception of risk relate to a driver's record of accident involvement, and investigating young drivers' opinions towards different enforcement policies and campaign strategies. This helps identify effective countermeasures to deal with cell phone distracted driving. The paper uses data from surveys conducted at several locations around the country through which 403 valid responses were collected. Participants were young drivers aged from 18-to-25 who held a valid Qatari driving license.

Descriptive statistics of the data were first used to establish insights into cell phone distracted driving. Most of the respondents reported using the cell while driving (90.8%), with a slightly higher percentage for males (92.1%) compared to females (89.5%). These percentages are considered high compared to previous research, especially among young drivers. A questionnaire conducted in Australia showed that 61% of the respondents used their cell phone while driving. Male and younger age groups were found using their cell phone more than females and older drives (Petroulias, 2009). In Finland, a questionnaire revealed that 68% of the participants use a cell phone while driving. Yet again, the study confirmed that the young driver's' group had the highest percentage of using a cell phone while driving (Lamble et al., 2002). A questionnaire survey, completed in New Zealand, showed that 57.3% of the respondents used their cell phone while driving. Male and younger age groups were found using their cell phone while driving more than females and older drivers (Sullman and Baas, 2004). Some studies focused only on young drivers. A study conducted in the United States among college students showed that 87% of participants reported having a cell phone, and 86% of the cell phone owners reported that they used their cell phones at least occasionally while driving. In the same study, female students were found more likely to use a cell phone while driving than male students (Seo and Torabi, 2004). Although, all previous studies showed a trend of a higher cell phone use rate among young drivers and identified this age group as a higher-risk group, the results from this study show higher percentages than most previous studies. As far as using hands-free equipment, more than half of respondents (67.2%) owned them but only 50.4% of this group used them while driving. The results were higher than a similar study among young drivers in the United States where 15% of participants reported they used hands-free equipment while driving (Sullman and Baas, 2004), and another study conducted among university students in Malaysia showed where 31.4% of participants reported using hands-free devices (Isa et al., 2012).

Many mitigation strategies were recommended or proved to be successful for this hazardous behavior. In addition to law enforcement efforts (McCartt et al., 2003; McCartt and Geary, 2004), some studies recommended focusing on the design of new technologies related to vehicles and cell phones in order to provide warnings to drivers and help them to focus more on the road (Zhou et al., 2012) or technologies to prevent drivers from receiving a signal while driving (Shabeer and Wahidabanu, 2012). Other studies suggested increasing the awareness of people by educating them through the media and other measures such as showing them scenes of accidents (Zhou et al., 2012). Several studies recommended that public agencies and decision-makers should develop programs that target risky drivers. These programs should focus on education and public awareness for the purpose of educating the public about the risk associated with this habit and reduce the percentage of use among these risky drivers (Isa et al., 2012; Luke et al., 2005; Shaaban, 2017). Based on these mitigations, the respondents were asked for their opinion on the best solution when dealing with cell phone distraction.

EFA was conducted in this study to validate the survey questionnaire. The results showed that four factors were obtained from the analysis, which quantified and measured the factors affecting the driving behavior of the young drivers in Qatar and their cell phone usage while driving. Cell phone usage, increasing enforcement, conducting public campaigns, and cell phone crash history were the four obtained factors. SEM Analysis was conducted to obtain the causality relationship between the latent and the indicator variables. The results showed that individuals with a crash history related to cell phone distraction are more prone to use their cell phones while driving, which was in accordance with Márquez et al. The results depicted that campaigns could be a potential solution to decrease cell phone usage while driving on roadways (Márquez et al., 2015). Results from this study showed that increasing enforcement to reduce the risk associated with phone usage while driving was not a significant construct in the analysis. This was consistent with Nelson et al. as they stated that patterns of cell phone usage might not be changed with laws banning cell phone usage (Nelson et al., 2009). Risk perception is among the most investigated variables in this research area. The results from this study showed that the perception of safe duration of distraction, which could be a measure of risk-taking, increases the cell phone usage while driving. This means that the longer distraction duration a driver perceives to be safe the more likely to use cell phones, which was in line with previous studies (Engelberg et al., 2015; Kleinbaum et al., 2013). Consistent with Engelberg et al., the driving experience was found to be a significant factor in increasing the cell phone usage (Engelberg et al., 2015). From the SEM results, it is recommended to provide and focus on road safety campaigns to educate young drivers on the risk associated with using cell phones while driving (calling, answering, texting, browsing, etc.).

5.1. Limitations

While this study reveals significant information about the impacts of cell phone distracted driving as well as the potential countermeasures to overcome the problem, the study has a few limitations. One of the main limitations of the self-reporting questionnaires is how accurate the stated preference of the participants reflects their actual driving behaviors. While some people might answer calls while driving or might not believe that a cell phone is distracting, they may be reluctant to admit it in the survey. Fortunately, this does not seem to be a major issue in this study with over 90% of participants admitting to using the cell phone while driving. Another possible limitation of the study is targeting only a proportion of drivers which limits the levels of some of the variables such as age and education level. Although this was necessary since the study focused on the behavior of young cell phone users, future research might consider conducting a holistic analysis of all drivers. Furthermore, in order to have reliable results from the SEM, sample size needs to be large to reach a certain level of power. Researchers suggested a threshold of 300 observations would be appropriate to conduct SEM (O'Rourke and Hatcher, 2013; Floyd and Widaman, 1995). The sample size in this study is considered adequate for the analysis but does not meet the Nachtigall et al. condition, which recommends the sample size to be more than 25 times the number of estimated parameters (Nachtigall et al.).

Finally, the generalizability of this study is limited by the characteristics of the study participants. The study population was made up of young male and female drivers, who drive in Qatar. The participants were between the ages of 18–25 years old, so it may be reasonable to generalize the results to other young drivers in Qatar; however, it may not be possible to generalize the results to drivers from other countries. There are many factors that make young drivers in this region different from young drivers in other regions, including differences in demographics, culture, social habits, and driver education. These differences may limit the generalizability of the study to other populations. However, the results are likely to be similar and important to other countries in the region such as Saudi Arabia, United Arab Emirates, Bahrain, Kuwait, and Oman. Despite the limitations discussed, the results from the study can help and guide policymakers in determining how to promote and enforce more effective strategies when dealing with cell phone distracted driving based on the opinions of cell phone users themselves.

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