UNIVERSITY OF SOUTHAMPTON

FACULTY OF ENGINEERING, SCIENCE & MATHEMATICS

School of Civil and Environmental Engineering

An Investigation of Driver Attitudes towards Road Safety in Kuwait

by

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ABSTRACT

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Statistics show that the fatalities rate per 10,000 vehicles in the State of Kuwait is about three times that in the UK, and the number of traffic accidents in Kuwait is increasing each year. In 1992, there were 16,017 traffic accidents, with 279 killed. By 2005, the number of accidents had increased to 56,235 with 451 fatalities, although the size of the vehicle fleet was only 1,134,042. This thesis presents the findings of a study of a substantial road accident database for Kuwait and a supplementary questionnaire survey to further understand related driver behaviour.

Police accident reports relating to fatality and injury for the year 2002 were collected from the General Investigation Administration at the Ministry of the Interior to obtain an overview of the situation. Human behaviour and driver error were considered to be the main contributory factors, as has been found elsewhere. A questionnaire survey was undertaken to obtain a more in-depth understanding of driver behaviour and attitudes towards traffic regulations, which might relate to road accidents, and the potential acceptability of remedial measures. The questions were developed to suit the traffic environment and culture in Kuwait, and 1,528 questionnaires were completed. Analysis has shown that there are significant associations between accident involvement and other contributory factors. A road accident prediction model was developed, linking behaviour and attitudes with a number of factors such as age, sex, nationality, education level, marital status, driver education, driver training, usual speed on motorways, number of dangerous offences per year, years of driving experience, and drivers' perceptions of the effectiveness of enforcement on total accident rate. The Generalised Linear Model (GLM) approach was used. It was found that driver attitude towards traffic regulations, enforcement, the number of critical traffic violations, nationality and age were significant contributory factors. The results will be used to influence future policy towards driving education, training and enforcement in Kuwait.

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DECLARATION OF AUTHORSHIP

I, **Jamal Al-Matawah**, declare that the thesis entitled:

An Investigation of Driver Attitudes towards Road Safety in Kuwait, and the work presented in the thesis are both my own, and have been generated by me as the result of my own original work. I confirm that:

- this work was done wholly or mainly while in candidature for a research degree at this University;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- where I have consulted the published work of authors, this is always clearly attributed;
- where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
- I have acknowledged all main sources of help;
- where the thesis is based on work done by myself or jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
- none of this work has been published before submission.

Signed: ……………………………………………………………………………….

Date: ………………………………………………………………………………….

ACKNOWLEDGEMENTS

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ABBREVIATIONS USED

AIMC	Arab Interior Minister Council
ANOVA	ANalysis Of VAriance
ATSB	Australian Transport Safety Bureau
BTCE	Bureau of Transport and Communications Economics
CEE	Central and Eastern Europe
CID	Criminal Investigation Department
DBQ	Driver Behaviour Questionnaire
ECMT	European Conference of Ministers of Transportation
ETSC	European Transportation Safety Council
GIA	General Investigation Administration
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GLM	Generalized Linear Model
GNP	Gross National Product
GTD	General Traffic Directorate
HMC	Highly Motorised Countries
IRF	International Road Federation
IRTAD	International Road Traffic and Accident Databases
LAC	Latin/Central America and the Caribbean
LMC	Less Motorised Countries
MAAP	Microcomputer Accident Analysis Package
MENA	Middle East and North Africa
MOI	Ministry Of the Interior
NMV	Non-Motorised Vehicles
PAAET	Public Authority of Applied Education and Training
PDO	Property Damage Only
TRB	Transportation Research Board
TRL	Transportation Research Laboratory
TRRL	Transportation and Road Research Laboratory
UN/ECE	United Nations/Economic Commission for Europe
WHO	World Health Organization

Chapter 1

1 Introduction

1.1 Background

Road accidents are a considerable concern in both developed and developing countries because of their impact on social, economic and health issues. The World Health Organization (WHO, 2004) estimated that over 1 million people had died in road accidents around the world, 70 percent of those accidents occurring in developing countries. Research has shown that many developing and emerging countries have a serious road accident problem and that accident rates are higher than in western industrial countries (Jacobs *et al*., 1981). Hence, there is a great need to focus effort on understanding this phenomenon, especially in developing countries. Kuwait is an emerging nation with a high accident rate.

Traffic accidents in Kuwait are one of the main causes of injury and death. The Kuwait Ministry of Health identified traffic accidents as the third highest cause of death between 1998 to 2002 after circulatory conditions/heart disease and neoplasm (Ministry of Health, 2002). The main factor contributing to road traffic accidents has been found to be human error (90%) (Arab Interior Minister Council, 1998). The number of fatalities rose by 50% over four years, from 300 in 2001 to 451 in 2005. Total reported accident rates (including both casualties and property damage) rose from 13.3 per 1,000 population in 1997 to 18.8 in 2005. Accident figures per 1,000 vehicles rose from 40.3 to 49.6 over the same period. The number of accidents per day rose from 72 in 1997 to 156.2 in 2005, making an average of about six accidents per hour, while the mortality rate over this period was one per day.

Road traffic accidents are a significant but preventable cause of death, disability and economic burden in developing and emerging countries. In order to identify appropriate countermeasures to reduce the number of accidents in a country, two main factors need to be taken into consideration: 1) The physical and human characteristics of a country (and the road/ traffic environment); 2) A good accident data collection/analysis system. After that, it is important to evaluate the potential impacts of the selected remedial measures. The most well-known of these for road safety improvement are based on the '3 Es': Education, Enforcement, and Engineering, with an additional '2 Es' recommended, namely Evaluation and Encouragement. These measures have been applied in different countries (developed and developing), giving an indicator of achievements in changing drivers' attitudes and behaviour, hence reducing the number of accidents and their severity. Emerging countries such as Kuwait should take advantage of the experience of developed countries, although they should also take into consideration differences in developed, developing and emerging countries in behavioural, cultural and economic aspects.

1.2 Objectives

The overall aim of this research was to identify the nature and characteristics of road traffic accidents in Kuwait and associated driver attitudes and behaviours, so as to be able to identify the most appropriate remedial measures. The general hypothesis is that driver attitudes / behaviours are influenced by factors such as social status, age, gender, nationality, education level, etc, and, if properly understood, have a significant impact on the increasing number of accidents in Kuwait.

The principle objectives of this thesis were as follows:

(I) To review the scale and character of road accidents in Kuwait, so as to identify the opportunity for an action plan;

(II) To develop more in-depth understanding of the road accident context in Kuwait as regards driver behaviour and attitudes;

(III) To recommend appropriate remedial measures based on the research results and other international experience.

1.3 Thesis outline

This thesis is divided into nine chapters as shown in Figure 1.1. Following this Chapter, **Section A: Road Safety and Kuwait** consists of three chapters (2, 3, and 4); Chapter two is divided into two parts. The first part presents international road accident reviews in developed and developing countries. This part shows the accident rates, trends and patterns over the years. It also includes road accident definitions, accident contributory factors and accident costs. The second part of the Chapter presents the most common remedial measures, the ‘3E’s’ (Education, Engineering, Enforcement), which could be appropriate in Kuwait.

Chapter 3 is divided into two parts. The first part describes the accident situation in Kuwait, based on general statistical data. The data include recent accident rates and trends, traffic violations and a comparison between the Gulf countries. The second part describes accident data in more detail, based on police reports of accidents. In this part, accident characteristics and causes were analysed using Microsoft Access and Excel.

The potential opportunities for action in Kuwait are presented in Chapter 4. These were based on international accident and remedial measure reviews and initial interpretations of accident data from Kuwait. A key outcome was the identification of a set of surveys and analysis, which would provide additional understandings and add further to the knowledge base.

Section B: Survey and Analysis. This section also consists of four Chapters (5, 6, 7 and 8). Chapter 5 mainly presents two subjects: 1) a descriptive statistical analysis of the questionnaire survey, based on the relations between overall driver aggressive behaviour score with other factors; 2) the association between numbers of accident involvement as a rate with other contributory factors.

A more in-depth application using the multivariate analysis technique (extension of Chapter 5) is described in Chapter 6. The two dependent variables are driver aggressive behaviour score (section **6.2**) and accident involvement rate (Section **6.3**). The independent variables are age, gender and nationality, all of which are important to study.

A development of an accident prediction model is presented in Chapter 7 using the technique of the Generalized Linear Model (GLM), linking the driver behaviour and attitudes with a number of other factors to the total accident rate.

A descriptive analysis of driver acceptability of remedial measures, identified in the early chapters as potentially appropriate to Kuwait, is presented in Chapter 8. It also presents driver opinions of what are the most frequent road safety problems in Kuwait that need to be fully addressed. Overall, it provides an indication of attitudes and potential behavioural responses, which helps inform the suitability of road safety actions.

Section C: Findings and Recommendations, consists of one Chapter (9). It presents Conclusions and Recommendations for remedial measures and future research. It also discusses the limitations of the current work.

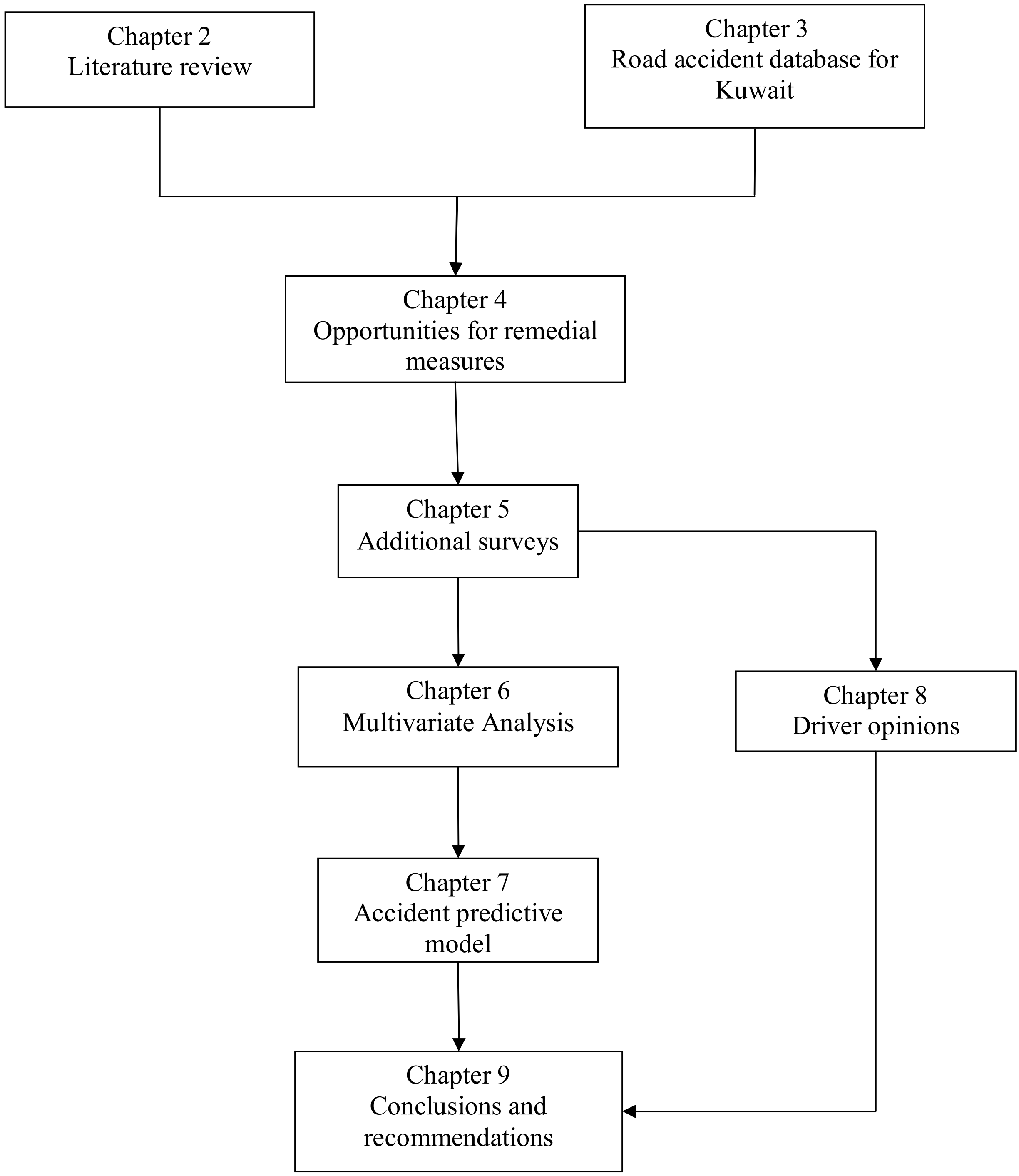

Figure 1.1 Thesis structure

Chapter 2

2 Literature review

2.1 International accident review

2.1.1 Road accidents as a cause of death and injury

Road accidents are a considerable concern in both developed and developing countries because of their impact on social, economic and health issues. Research by the World Health Organization (WHO, 2004) has indicated that the number of people dying annually in road crashes may increase from 1 million to 1.3 million during the next ten to twenty years. In recent years, two major studies of causes of death worldwide have been published in the 'Global Burden of Disease' (1996, WHO, World Bank and Harvard University) and in the 'World Health Report –Making a Difference' (WHO, 2002) cited in http://www.worldbank.org/html/fpd/transport/roads/safety.htm. These studies show that, in 1990, road accidents took ninth place in a total of over 100 separately identified causes of death or disability. However, forecasts have suggested that road accidents will move up to third place, as a cause of death, by the year 2020 with Ischaemic heart disease and Unipolar major depression in first and second place (Figure 2.1).

In contrast to the WHO figures above, research in 1999 by TRL (Jacobs *et al*., 2000) estimated more conservatively that about 750,000 to 880,000 people were killed in road accidents globally, but they found a much higher percentage (85 percent) to be occurring in developing countries or emerging nations. Hence there is a great need to focus efforts. The extremely large number of people killed on global road networks would be the equivalent of two thousand fully-laden Boeing 747 Jumbo jet crashes in a single year, that is, an average of eleven completely fatal crashes every two days (Baguley, 2001).

According to Ghee *et al*. (1997), a previous study by TRL in 1990 compared road fatalities with other violent causes of death, such as fire, drowning, suicide, homicide, etc. The study showed that road accidents were in first position in both developed and developing countries.

The under-reporting of injuries constitutes an even greater area than that of fatalities. "Worldwide, at least 30 to 45 people injured for every life lost" (Jacobs *et al*., 2000). A likely minimum and maximum range was established. Based on the International Road Traffic and Accident Databases (IRTAD referred to Jacobs and Aeron-Thomas, 2000) report and earlier studies, it was estimated that approximately 50 percent of road injuries were unreported; it was decided that a ratio of 100 injuries to every fatality would apply to the Highly Motorised Countries (HMC). For Less Motorised Countries (LMC), a ratio of between 20 to 30 was taken to be a minimum estimate. These values produce annual road accident injury estimates for 1999 of at least 11 million in HMC,12 to 23 million in LMC, and a global estimate of between 23 and 34 million road accident injuries per annum. This estimate is approximately twice the other global road injury estimates currently put forward (Jacobs and Aeron-Thomas, 2000).

Another important factor influencing the seriousness of the situation as regards accident victims in developing countries is the low level of medical facilities available to them for treatment. Western Europe has good ambulance services, with road accident casualties taken very quickly to hospital to receive immediate attention. Even before reaching hospital, trained paramedic services mean that expert assistance can be provided at the roadside (Baguley and Jacobs, 2000), and, once in hospital, a high level of surgical expertise, technology and modern techniques, medication, therapy and rehabilitation come into play. Therefore, while victims in developing countries have more accidents, they also have less chance of effective treatment. Such is the seriousness of this situation that policy makers and researchers at the highest levels have to closely examine alternative methods of alleviation, and the most effective way to start is clearly prevention, an aspect that becomes increasingly important, given the current trends.

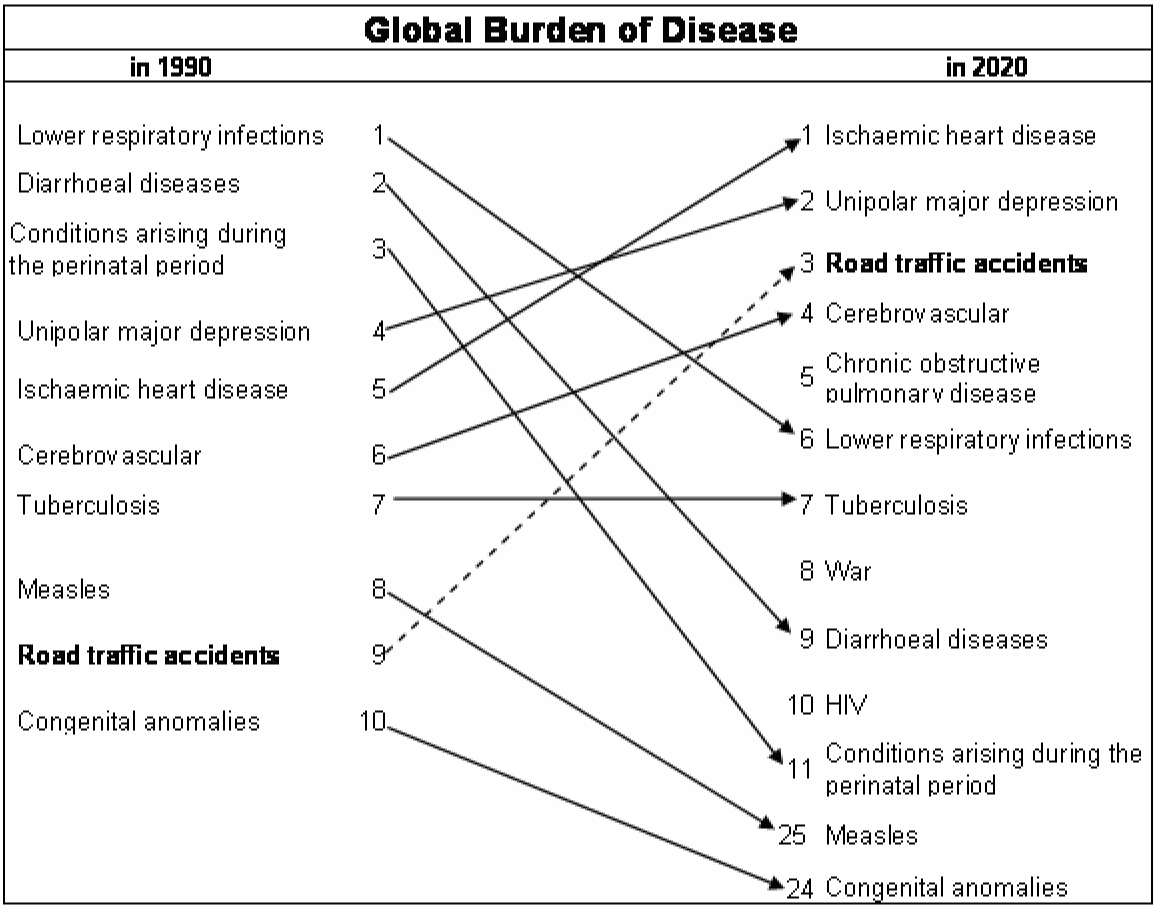

Figure 2.1 Disease burden measured in Disease-Adjusted Life Years

Source: "The Global Burden of Disease: A comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020". Harvard

2.1.2 Accident rates and trends

Simple statistics about numbers of accidents, death and injuries can be misleading, if all the factors around them are not known. An increase of 10% in any total from one year to the next may appear to describe a serious problem. However, if in the same year, the miles travelled increases by 25%, the rise in the number of accidents appears less serious. For this reason, many accident statistics are presented in the form of rates.

Accident rates generally fall into one of two broad categories: population-based and exposure-based rates (McSane *et al.*, 1998). Population-based rates are given as the number of deaths or accidents per 100,000 of a population, per 10,000 registered vehicles or per 10,000 licensed drivers. Exposure-based rates are often given as the number of deaths or accidents per 1,000,000 vehicle-km or per 1,000,000 commencements of journeys.

The European Conference of Ministers of Transportation (ECMT) in 1984 (referred to in Andreassen, 1991) decreed that the number of deaths per 100,000 cars is not an adequate criterion for comparison, and deaths per million of population should be used only for comparisons between countries with similar vehicle ownership ratios. Even for this comparison, the rate does not necessarily mean that any country's road safety policy is better or worse than another's. There are many factors that need to be taken into consideration. The ECMT also stated that the number killed per 1,000 motor vehicles and/or per million vehicle-km is a very poor criterion for inter-country comparison, since the number killed per 1,000 vehicles is falling from year to year in all countries (Andreassen, 1991).

The rate used by TRL to compare the seriousness of road accident problems in different countries throughout the world is the number of deaths from road accidents per annum per 10,000 vehicles licensed. However, this is far from ideal as an indicator of relative safety in different countries. For example, injuries per million vehicle-km travelled per annum may be a much better parameter to use, but unfortunately, the reporting of non-fatal accidents in most Third World countries is poor and few carry out traffic surveys and censuses that provide information on annual travel by different classes of vehicle (Jacobs and Baguley, 1996). This deficiency is one that could be addressed in the future.

2.1.2.1 Global rates and trends

"There is no standard approach to regional groupings used by the different international organisations concerned with road safety" (Jacobs *et al*., 2000). However, in order to aid interpretation of data, a total of 192 countries were assigned to six major regional groups, namely Africa, Asia/Pacific, Central and Eastern Europe (CEE), Latin/Central America and the Caribbean (LAC), the Middle East and North Africa (MENA) and the Highly Motorised Countries (HMC), i.e. North America, Australia, New Zealand, Japan and Western Europe. Less Motorised Countries (LMC) is the collective term used to describe the first five regions (Jacobs *et al*., 2000).

86 per cent of the world's road fatalities occur in LMCs, almost half of those in Asia. Figure 2.2 shows the regional distribution for 750,000 fatalities, the low end of the range suggested for 1999. It should also be borne in mind that fatalities are only the tip of the casualty iceberg and that road safety, especially road safety engineering, is concerned with the reduction of injury in road crashes.

By 1996, most countries had published road fatality data, and these were updated in 1999 (Jacobs *et al*., 2000). Figure 2.3 shows the percentage increases or decreases in road fatality trends over the period 1987 to 1995 for the six groups of countries. While the CEE region reported fatalities peaking in 1990 before dropping, the reverse was reported in the LAC region with fatalities continuing to increase until 1995. HMCs have experienced reducing road fatalities over the same period.

Estimates by TRL of global road crash deaths in 1999 show that fatality rates (deaths per 10,000 vehicles) were lowest in the HMCs whilst the highest were in African countries, particularly Ethiopia, Uganda and Tanzania. Fatality risk (i.e. deaths per 100,000 vehicles) was highest in a disparate group of countries, including Thailand, Malaysia, South Africa and Saudi Arabia.

As might be expected, values in Central and Eastern European countries lay closer to the HMCs than to African, Asian or Latin American countries. The relative regional share of fatalities, population and motor vehicles worldwide is shown in Table 2.1.

Trend data shows that the total number of people killed in road crashes in regions of the developing world is continuing to increase, whereas in the West there has been a steady decrease. For example, between 1987-1995, deaths in the Asia-Pacific region rose by 35 percent, in Africa by 20 percent (excluding South Africa where deaths increased very little) and the Middle East/North Africa region, by over 55 percent. Road deaths doubled in a few Latin American countries, although they rose by only 16 percent in Brazil. Central and Eastern Europe showed wide variation, with fatalities increasing by 31 percent in Poland but decreasing in other countries by about 36 percent. Road deaths in Highly Motorized Countries fell by about 10 percent (Jacobs, 2000). Growth rates are highly sensitive to the time period selected and the analytical method used, but the general trend shows that global road fatalities will increase at a slower rate in the next two decades. Based on trend series data from a limited number of countries (43), fatalities in Africa and Latin America will continue to increase for a few more years before slowing down, while fatalities in Asia and the Middle East are already slowing down. The decrease in fatalities in the West is expected to continue but at a slower rate (Jacobs *et al*., 2000).

In most developed countries, the number of injuries and fatalities is in slow but steady decline, in spite of the natural population growth and the increase in the number of vehicles. In contrast, in developing countries, the number of injuries and fatalities is increasing. The developed countries are continuing research into the problem and have been able to analyse the factors mainly responsible. As a result, they have been able to reduce accident rates and severity.

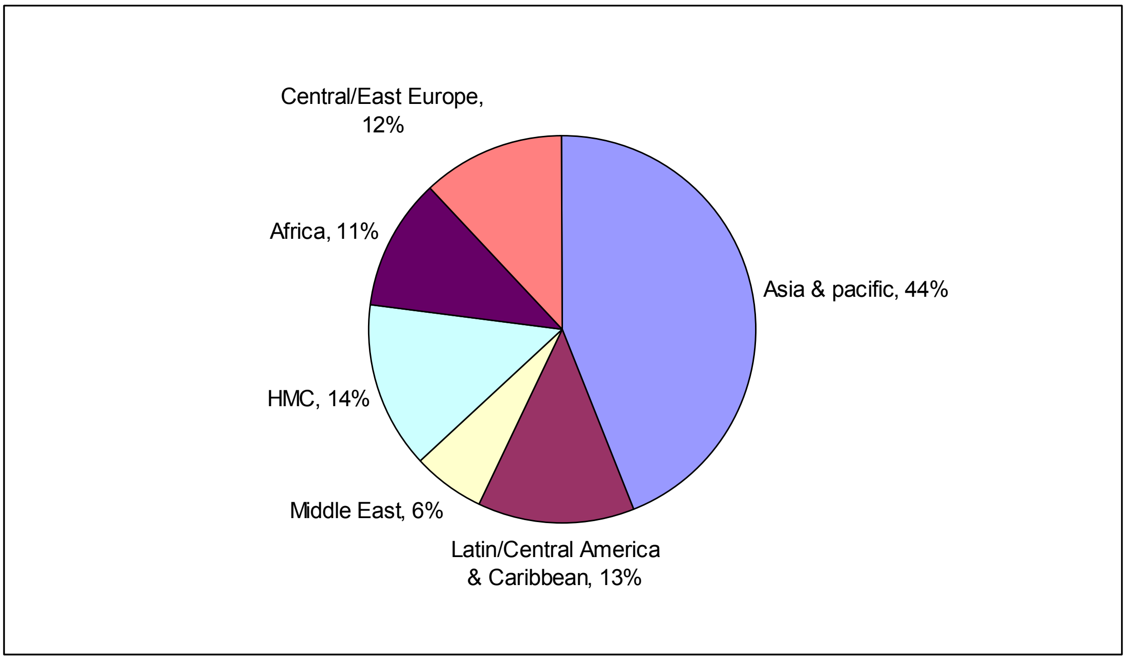

Figure 2.2 Estimated road fatalities, regional distribution (1999)

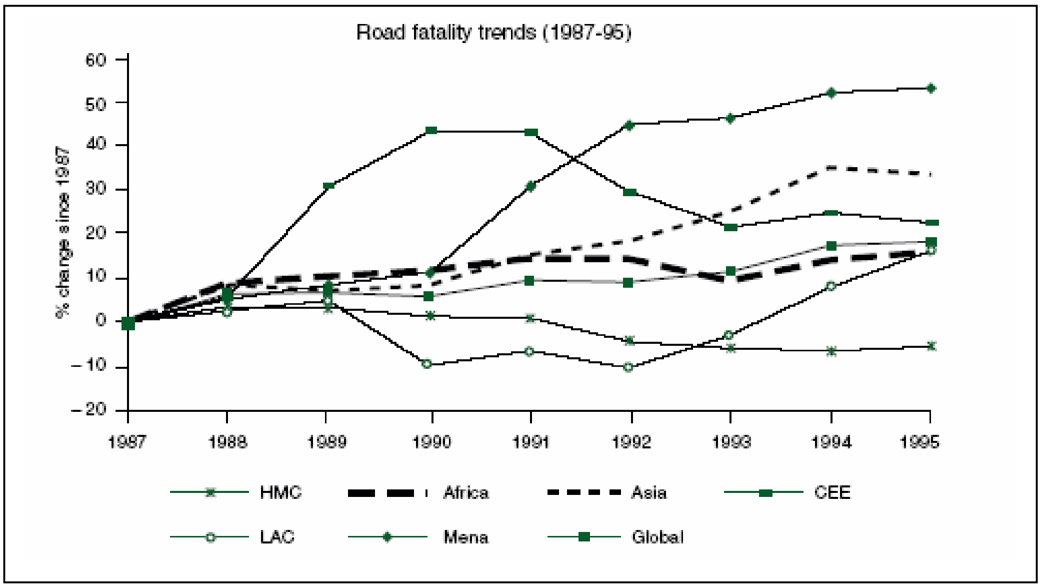

Figure 2.3 Regional fatality trends

Table 2.1 Distribution of road fatalities, motor vehicles and population

Regions	Fatalities (%)	Motor vehicles (%)	Population (%)
HMC	14	60	15
Asia/Pacific	44	15	54
Central and Eastern Europe	12	6	7
Latin America and Caribbean	13	13	8
Africa	11	4	11
Middle East and Northern Africa	6	2	5

2.1.3 Accident patterns

Many detailed characteristics need to be taken into consideration when studying road accidents, such as road user types, age, gender, road type, vehicle type, etc. This will enable more detailed understandings of road accidents.

It has been estimated that 65 percent of deaths worldwide involve pedestrians and 35 percent of pedestrian deaths are children. The majority of road crash victims (injuries and fatalities) in developing countries are not the vehicle occupants, but pedestrians, motorcyclists, cyclists and Non-Motorised Vehicle (NMV) occupants (The World Bank Group, 2002).

According to Downing *et al*. (1991), "some accident characteristics are common to a number of developing countries but somewhat different from those in developed countries”. For example, in the Third World (see Fig 2.4 and Table 2.2), a relatively high proportion of fatalities are pedestrians and children aged under 16 years, and many fatal accidents involve trucks, buses and other public service vehicles.

In many cases, these higher percentages are an obvious consequence of the differences between the traffic and population characteristics of developed and developing countries. For example, the average percentage of the population aged 5 to 14 years in a sample of 16 developing countries was 28 per cent, compared with 15 percent for 9 developed countries (Downing and Sayer, 1982). Pedestrians, children and professional drivers constitute such a large proportion of the accident problem in Third World countries that it is clear that priority has to be given to improving the safety of these three groups (Baguley and Jacobs, 2000).

2.1.3.1 Global accident patterns

The majority of people killed in HMCs are car drivers and passengers, but about 20 percent are pedestrians. A very different situation is recorded in Asian countries. For example, in Hong Kong, almost 70 percent of those killed are pedestrians and about 50 percent in Korea. In China, Malaysia and Thailand, pedestrian deaths were surprisingly low at around 10-15 percent of the total. In Singapore, Taiwan and Malaysia over 50 percent of fatalities were motorcyclists.

In African countries, pedestrian fatalities were again one of the main categories. Pedestrian deaths also featured strongly in Middle Eastern countries (usually over 50 percent of all deaths).

An analysis of deaths by gender showed wide variation between countries (even within regions). The overall tendency, however, was for females to be more involved in non-fatal crashes than in fatal. This may be associated with lower speeds. The overall tendency was for there to be proportionately more females involved in both fatal and non-fatal crashes in the higher income countries. An analysis of casualties and fatalities by age showed that young people are involved in proportionately more crashes in Africa, Asia and the Middle East than in HMCs. In general the data from all regions indicated that crashes involving the economically active males in the age group 25-40 make up the largest proportion of reported victims of road crashes (Jacobs *et al*., 2000).

In 1999, TRL studies found that children in developing countries tend to be more at risk than in the developed world. However, they account for a relatively small percentage of reported road crash casualties. Female fatalities appear to increase with motorization. It should be noted that women in Less Motorised Countries may currently have a low accident risk, which is a good point for them. However, their rights if they lose their husband in an accident as widows are often disregarded and this can result in the break-up of families (Jacobs *et al*., 2000)

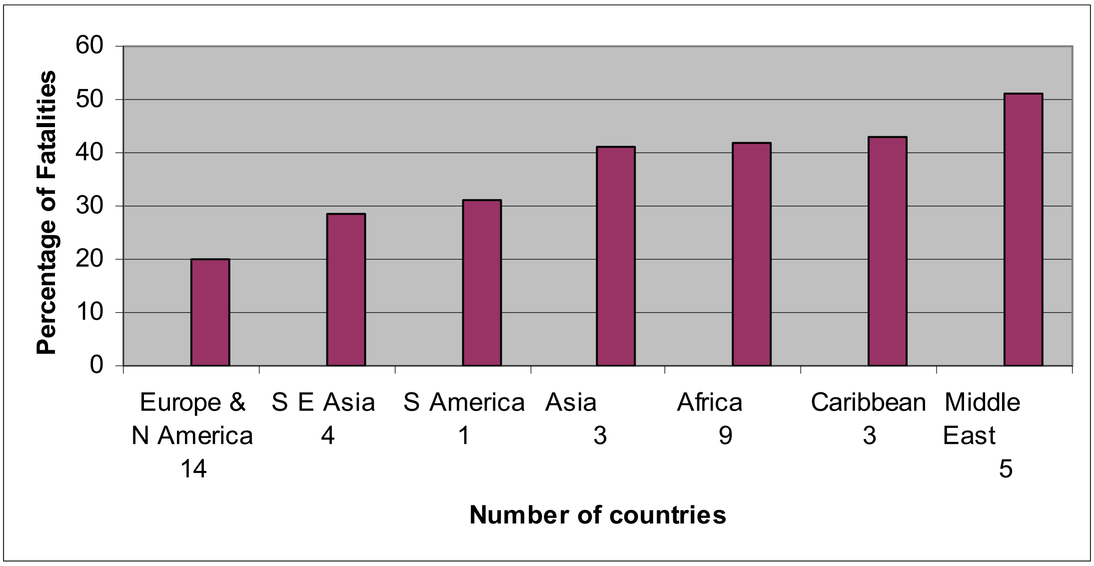

Figure 2.4 Pedestrian fatalities as a percentage of all road accident fatalities

Table 2.2 Characteristics of fatal accidents

Country	Percentage of fatalities	
	Children under 16 years	Involving trucks and buses
Botswana	16	25
Egypt	12	37
Ghana	28	50
Pakistan Karachi	14	44
Guinea	20	37
Zimbabwe	11	45
United Kingdom	9	21

2.1.4 Road accident definitions

Road accidents have been defined and classified in different ways around the world. The general accident definition is ‘‘A rare, random, multi-factor event which is always preceded by a situation in which one or more road users have failed to cope with their environment” (Baguley, 2001). The most common classification of road accident comprises fatal accidents, serious injury accidents, slight injury accidents, and damage-only accidents.

Most countries follow the standard definition of fatal accidents given by UN/ECE, as defined by the Road Traffic Convention (Vienna, 1968). A fatality is described as a person who is killed outright or who dies within 30 days as a result of an accident.

Some countries use a different time period such as 24 hours, 48 hours, 3 days, 7 days, etc. (IRTAD 1998). Most Western European countries define serious injury accidents, slight injury accident and damage-only accidents as follows:

A serious injury accident is one in which there are no deaths but one or more persons are seriously injured. A serious injury in the UK involves a person being detained in hospital as an in-patient or one sustaining any of the following injuries: fractures, concussion, internal injuries, crushing, severe cuts and lacerations, or severe general shock requiring medical treatment.

A serious injury in Austria involves a person being ‘hospitalised’ and not able to work for at least 24 days. Some countries do not include the term hospitalisation in their definition of a serious injury.

A slight injury accident is an accident in which there are no fatalities or serious injuries but a person is slightly injured. A slight injury is defined in the UK as an injury of a minor character, such as sprains, bruises or cuts. In Portugal, slight injury is defined as needing medical treatment without hospitalisation (see table Appendix B for detail).

A damage-only accident is one in which no-one is injured but damage to vehicles and/or property is sustained (Jacobs, 1995).

2.1.5 Contributing factors

While road incidents require remedial action, the most important consideration for the long term is to carry out diagnosis of the main problems contributing to accidents and to search for effective solutions.

The main contributory factors to accidents are expected or known to be: 1) Road user errors and distraction (either driver or pedestrian); 2) Road and environmental deficiencies, such as poor quality of road surface and hazards; 3) Vehicle defects. Each of these factors may be subdivided into several items, or combined.

1) Road user errors

Road user errors are caused by distraction, perceptual errors, misjudgement of distances and all-round traffic situations, going too fast for the road conditions, turning or overtaking at inappropriate places, following too closely, failing to give way and passing red traffic lights. Driving under the influence of alcohol, drugs or illness is another factor to be considered, and involves lack of knowledge of safety regulations and driving rules and a lack of respect of traffic laws and legislation.

2) Road and environment deficiencies

There are a number of hazards caused by deficiencies in the design, construction and maintenance of roads, leading to a large number of accidents, which could otherwise have been avoided. Sometimes bends in roads are too sharp and narrow, and narrowness at the brow of a hill is also dangerous. The danger is compounded by, for example, flooding, signs and road markings that are difficult to read, road works, inadequate pedestrian facilities and children playing on the road.

3) Vehicle defects

The most common mechanical faults arise from poor vehicle maintenance, defective brakes, bald tyres, faulty lights, indicators, and defective windscreen wipers.

Broken seat belts and the lack of passenger restraints increase accident severity. Another problem is overloading on goods vehicles (Road Safety Engineering Manual, 1992).

An in-depth study by Sabey and Staughton (TRRL) in 1970-1974 showed that road user errors contributed 65 percent to the total number of accidents. Road user error together with road conditions contributed a further 24 percent, and a combination of road user, road conditions, and vehicle almost 6 percent. In other words, road user error contributed, alone or in combination with other factors, to 95 percent of accidents, the remainder being divided between road and vehicle (see Table 2.3 below) (TRRL, Sabey, 1980).

Table 2.3 Interaction between contributory factors

Contributing factors	Percent
Human factors alone	65%
Human and Road	24%
Human and Vehicle	4.50%
Human, Road, and Vehicle	1.25%
Road factors alone	2.50%
Road and Vehicle	0.25%
Vehicle factors alone	2.50%

A comparison of British and US in-depth studies found that road users alone were responsible for 65 and 57 percent of the accidents in Britain and the US respectively, that the road environment alone was responsible for 2 and 3 percent respectively, and that the vehicles themselves were solely responsible for only 2 percent of accidents. Road users and the road environment together were found to have caused 24/27 percent of accidents respectively, road users and vehicles together for only 4/6 percent, and those errors by road users were a contributing factor in 95 and 94 percent of the crashes, respectively (see Figure 2.5) (World Bank, 1997).

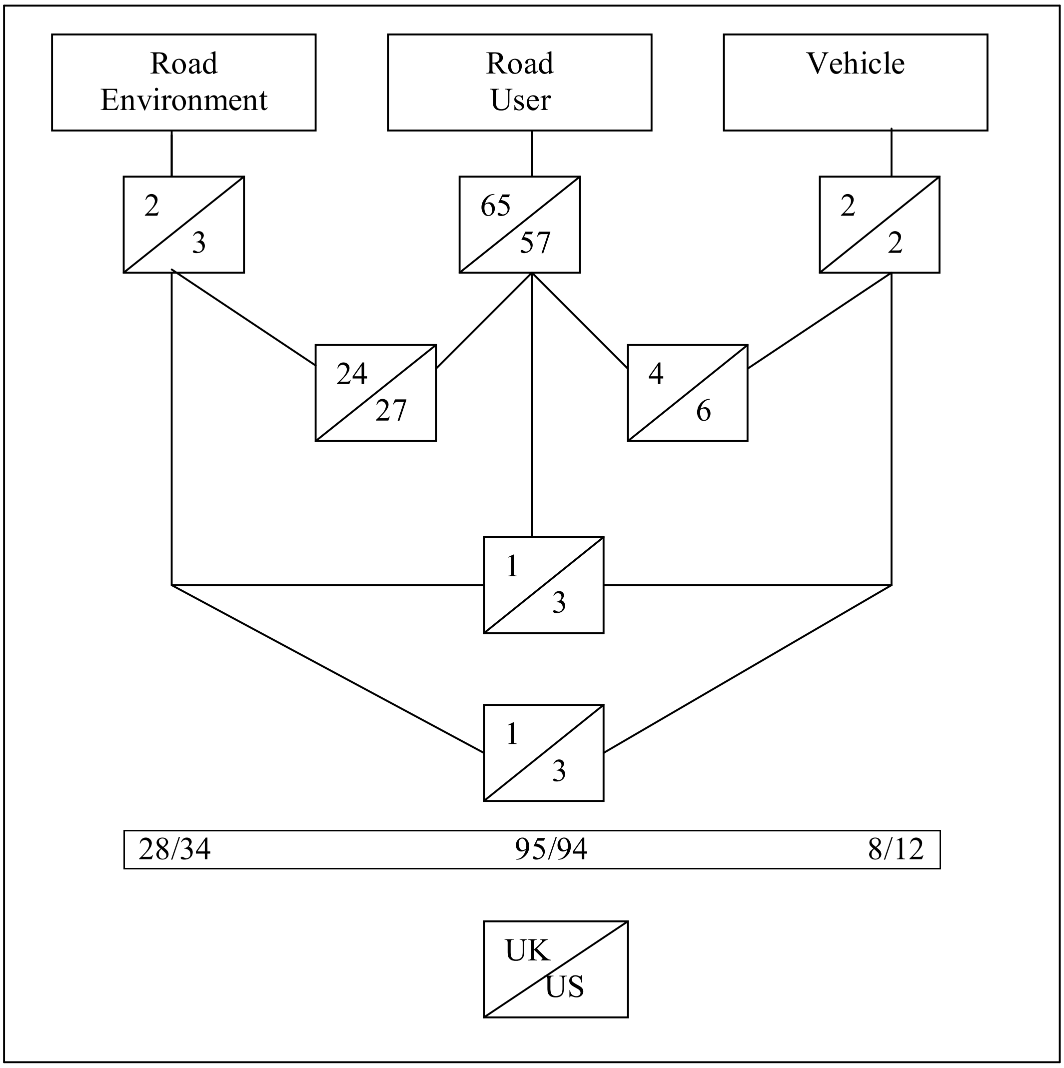

Figure 2.5 Percent contributions to traffic crashes as obtained in UK and US
Source: World Bank, 1997

Other studies were carried out by TRL based on police statistics in some developing countries (see Table 2.4). These studies have to be treated with some caution, as the police investigating the accidents are unlikely to have been trained as engineers or scientists, and they may therefore underestimate the contribution made by road engineering problems, their main aim being usually to determine whether there was a traffic violation. Therefore, they tend to emphasise whether or not human error is likely to be blamed (Downing *et al*., 1991).

It can be seen from the table that the high rate of road user errors in developing countries may indicate an underestimation of the impact of the road environment. However, it is clear from the statistics in all countries that road user error is by far the overriding issue, although the figures for Iran and Afghanistan are somewhat lower.

Table 2.4 Causes of road accidents as determined by police in developing countries

Country	Main Cause of Accident (%)			
	Road user error	Vehicle defects	Road and environment deficiencies	Other
Afghanistan (1984)	74	17	9	-
Botswana (1982)	94	2	1	3
Cyprus (1982)	94	1	5	-
Ethiopia (1982)	81	5	-	14
India (1980)	80	7	1	12
Iran (1984)	64	16	20	-
Pakistan (1984)	91	4	5	-
Philippines (1984)	85	8	7	-
Malaysia (1985)	87	2	4	7
Zimbabwe (1979)	89	5	1	5
UK, 1978-81 (Sabey,1983)	95	5	18	-

2.1.6 Under-reporting

Scientific and analytical approaches to data collection, storage and analysis are essential in dealing with road safety problems. Police accident records in the large majority of countries form the main (and sometimes the only) source of crash data. However, it has long been recognized that a problem exists with under-reporting of road crashes, particularly those which are non-fatal (James, 1991).

The problem of under-reporting has not been properly investigated in many countries. No proper assessment of under-reporting has been carried out in the EU 15, with the exception of the Netherlands, the United Kingdom, Belgium and Spain. "This is surprising, since most countries consider under-reporting to be a limitation regarding reliable accident data and consequently upon the analysis of road accidents"

(European Transport Safety Council, 2006). Of New Member States, only Hungary has carried out an under-reporting study (during the mid 1990s). According to estimates reported by the European Transport Safety Council (2006), "the under-reporting of death varies from 5% to 8% (Germany and Netherlands, based on national research reports) to 12% (France, based on an INRETS study for the region of Lyon) and 26% (Italy, based on a comparison of road deaths in the WHO-database of hospital reports of deaths per country with the Italian statistics of police-reported road deaths). At the same time, under-reporting of hospitalised casualties is estimated to vary between 30% and 60%" (IRTAD, 1994).

2.1.6.1 Fatality to injury ratios

In some regions there is apparently massive under-reporting of non-fatal crashes. In 1995, only 2 injuries per fatality were reported (71,000 road deaths), in China and in India only 5 injuries per fatality (about 60,000 road deaths). In comparison, in the UK and the USA, about 80 injuries per fatality were reported (Aeron-Thomas, 2000).

The ratios of fatalities to injuries vary from country to country and from continent to continent (see Table 2.5, below). For example, in 1996, the ratio in highly industrialised countries (HIC) was 1:64, while in the Middle East it was 1:12 (Aeron-Thomas, 2000). Thus, accidents on some continents appear to be a much more dangerous occurrence, as indicated by a measure called the fatality index (the percentage of fatalities among total casualties). However, the issue of such ratios is complicated by the phenomenon of under-reporting. The reason is that the reporting of a fatality is almost sure to happen, whereas injuries can go unreported. Under-reporting therefore affects the fatality to injury ratio, even in HIC's, though to a lesser extent.

In a study of under-reporting of road crashes in low income countries, (Aeron-Thomas 2000), a comparison is made of the ratio of reported fatalities to casualties in different regions of the world. The results were as follows:

Table 2.5 Regional injuries to fatalities ratio

Region	Average Ratio of Injuries to Fatalities
Highly industrialised countries	64
Latin America/Caribbean	12
Middle East and North Africa	12
Central and Eastern Europe	8
Africa	8
Asia and Pacific	5

There are numerous limitations with regard to the accuracy of road accident data, which restrict the ability to make sharp comparisons at both national and international levels. The first problem in national road accident data is that "not all injury accidents are reported to and recorded by the Police". Accident severity, vehicle type and casualty age are factors in under-reporting variance, especially in single-vehicle accidents, pedestrian accidents and accidents involving two-wheeled vehicles (particularly bicycles), and under-reporting is highest for accidents that are characterised by combinations of these aspects (European Transport Safety Council, 2006).

2.1.6.2 Reasons of under-reporting

An IRTDAD review of international road crashes included the following reasons for under-reporting:

- Unawareness of any obligation to report the incident to the police
- Injuries regarded as so minor that reporting was not considered necessary
- Injuries were not apparent at the time the incident took place
- Forgetting to report the incident
- Unwillingness to report the accident for personal reasons
- A lack of reporting agreements between the police, hospital and ambulance teams (ITRAD, 1994).

Under-reporting by the police can occur in two distinct ways. Firstly, an incident reported to the police may not be included in official statistics. This could be due to the fact that the police only consider a fatality if it occurs at the roadside and not later.

In the case of casualties, the police report form is completed quickly at roadside and may not include injuries reported later. Secondly, there may be many crashes involving injury that are not reported to the police at all. This could be due to lack of police manpower.

One factor in under-reporting PDO accidents in particular is 'loss of no-claims bonus' (Laapotti and Keskinen, 2004). A no-claims bonus means a better insurance premium for drivers who have not made any claim on their insurance. There is a strong reason for them not to make a small claim, and that adds to the amount of under-reporting. Accidents involving drink driving are also under-reported, as insurance companies will not pay out on them.

2.1.7 Road accident costs

Road accidents cause pain, grief and suffering to individuals, and also economic loss to all countries. Fouracre and Jacobs (1976) estimated that road accidents cost on average 1 percent of Gross National Product (GNP) for any country, while the World Bank and others put accident costs at a higher rate (up to 3 percent of the GNP). The TRL and Ross Silcock Ltd. estimated the global cost of road accidents in 1996 at $ 230 billion, 16 percent of which ($36 billion) was in developing countries. There is, therefore, a definite need for spending on traffic safety programmes. A study by the TRL showed that a programme of investment in road safety engineering, traffic law enforcement, education and training in a particular country would cost about £100,000, but would reduce the national cost of road accidents by 5 percent each year. In this country, with an estimated accident cost of £20 million, a saving of £1 million would be made each year, a yield on the investment of 10:1 (Jacobs, 1995). Another study conducted by the Bureau of Transport and Communications Economics (BTCE), Report 90 "Evaluation of the Black Spot Program" 1995, reported that the community benefited by $4 for every dollar spent on each treated black spot (Tziotis *et al*., 2002).

The Transport Research Laboratory (TRL) in the United Kingdom has identified six methods or approaches to estimate road accident costs: 1) gross output, 2) net output, 3) life-insurance, 4) count award, 5) implicit public sector valuation, 6) willingness to pay. The TRL recommended two preferred approaches, namely "gross output" and "willingness to pay."

Gross Output is appropriate for maximising the wealth of a country; the cost is the sum of the following:

1) Cost of vehicle and property damage
2) Cost of police administration
3) Cost of medical treatment
4) The loss of the value of the output
5) The cost in terms of human pain, grief and suffering.

The second recommended method, "willingness to pay", is particularly appropriate for social welfare maximisation and for use in cost-benefit analysis. In this approach, the sum is the total amount that all those affected by traffic accidents would have been willing to pay for the reduction in risk provided by the safety improvements.

It should be emphasised that all six methods put different cost values on road accidents. The appropriate method depends on the objectives being pursued in particular countries by those planners and economists responsible for investment planning. The willingness-to-pay approach has been adopted in some developed countries, such as the UK, the USA, New Zealand and Sweden, in spite of the difficulties of making empirical estimates. On the other hand, the gross output approach has been recommended for use in developing countries, where estimates are even more difficult to make.

2.2 Remedial measures

2.2.1 Introduction

In order to identify appropriate countermeasures to reduce the number of accidents in a country, two main factors need to be taken into consideration: (1) the physical and human characteristics of a country (and road/ traffic environment); (2) a good accident data collection/analysis system. After that, it is important to evaluate the selected remedial measures. The most well-known remedial measures for road safety improvement are based on the '3 Es' (Education, Enforcement, and

Engineering, with an additional 2 Es recommended, namely Evaluation and Encouragement). These measures have been applied in different countries (developed and developing), giving an indicator of achievements in changing drivers' attitudes and behaviour, hence reducing the number of accidents and their severity. Emerging countries such as Kuwait should take advantage of the experience of the developed countries by taking into consideration differences in behavioural, cultural and economic aspects. Some countermeasures are effective in developed countries but may not be as effective in developing or emerging countries. For example, a stop signal, which is a self-enforcement device, will be effective in a country with good driver discipline and hence could be expected to have a considerable effect on reducing accidents, but if the same measure is implemented in a country with poor driver discipline, the overall effect will be less. So, it is better to compare what has been done in developed countries and what has been achieved in some developing and emerging countries taking into consideration behavioural, cultural and economic aspects, in order to predict appropriate remedial measures (for example in Kuwait). It should also be taken into consideration that there is no one remedy to improve driver behaviour or attitudes. All of them (the 3Es and 2 additional Es) work together in order to reduce accidents.

2.2.2 Education and Training

Although many factors cause road accidents, it seems that human error can contribute to almost 95% of accidents (Sabey and Taylor, 1980). Driver behaviour in Kuwait is the main contributory factor to road accidents (Arab Interior Minister Council, 1998). Thus, efforts have to be targeted at driver education and training in order to eliminate at least some driver-related accidents. Some indication exists that education and training could affect drivers' attitudes and behaviour. Improved courses for high-school drivers in the United States resulted in fewer accidents and violations (Stock *et al*., 1983). After school-based training given to novice drivers in Virginia, USA, it was found that school-trained drivers had fewer crashes than commercially-trained ones (Ohlson and Stoke, 1986). An evaluation study of the effect on accident risk on changes in driver education was undertaken by the Danish Transport Research Institute. It was found that, after the change in driver education, the number of accidents involving 18-19 year-olds had decreased more than among mature drivers (Carstensen, 2002). It was also found that drivers who received training in a number of basic requirements in the new education programme had lower accident risk than those whose education did not meet these requirements. It was also found that there was a decrease in the number of multiple-vehicle accidents and manoeuvring accidents after the 1986-curriculum of driver education, which focused on manoeuvring exercises as a basis of practical driving, defensive driving skills, and increased knowledge of the behaviour and risks connected with other road users. Gregerson *et al*. (1996) presented a study measuring reduced accident involvement through changed driver behaviour. The measures were driver training, group discussion, campaigns, and bonuses for accident-free driving for the 900 drivers employed by the Swedish telephone company. The results showed a significant reduction in accident risk in the group which had discussions, driver training, and bonuses for accident-free driving compared to the control group, but no significant reduction in the campaign method. Also, the accident cost was reduced from about SEK 800 per 10,000 km before to SEK 300 per 10,000 km after. On the other hand, some studies showed that there is no significant effect of driver education or training in reducing road accident involvement (Vernick *et al*., 1999). They implied that education and training courses should be carefully evaluated. Others recommend that education and training courses should be integrated with campaigns and enforcement (Downing, 1989); others again believe that driver education at in early age could encourage teenagers to obtain a driving licence and start sooner. At the moment, teenagers have a higher risk of road accidents than other age groups (Achara *et al*., 2001).

2.2.3 Campaigns and publicity

Road safety campaigns and publicity play an important role in raising driver awareness and hence help to change the attitudes and behaviours that cause accidents. They are carried by radio and television, newspapers and magazines, on the backs of buses, in pamphlets, promotions by merchants, etc. Mass media advertising is often the most visible component of a campaign. A television campaign on the wearing of seat belts in Australia had a good impact on changing driver and passenger behaviour (Johnston and Cameron, 1979). Also a study conducted by Glendon and Cernecca (2003) on young Australian and New Zealand drivers (participants) showed that the participants were more likely to report reducing speeding after viewing anti-speed messages. Many researchers have concluded that the mass media supporting road safety campaigns can improve knowledge and attitudes, but there is little evidence that behaviour changes in the absence of accompanying enforcement (Donovan *et al*., 1999). Jacob and Sayer (1984) claimed that there was a drop of 19% in fatalities and 50% in serious injuries due to the combined effects of publicity and enforcement in Singapore.

The use of seat belts in Kuwait became compulsory in January 1994, backed up by a comprehensive media campaign. The use of seat belts increased from 2.8 to 100% during the first week when the law was implemented. After that, the use of seat belts decreased to 54.9% during the year because of a relaxation in enforcement (Koushki *et al*., 1996). The results also showed that seat belt use has had a positive effect in reducing both fatalities and multiple injuries (Koushki *et al*., 2003). A multimedia campaign in Victoria, Canada, was targeted at encouraging drivers turning left to yield to pedestrians crossing the road in front of them, as most of the pedestrian accidents occurred in this situation. Five signalised intersections were monitored before and after the campaign. The findings of the study indicated a significant improvement in yielding behaviour, and further predicted that this media campaign would produce a long-term effect of increasing drivers' yielding behaviour (Koening and Wu, 1994). The drawback to this study is that campaigns need to identify the targeted behaviour. So, it is necessary to consider where the targeted road users might be from the accident data or observations. Also, the message needs to motivate the audience (road users) in such a way as to change the specified attitude and behaviour. Also, the message must be clear, meaningful, short, well-designed and seen or (heard) by the audience using appropriate media tools, such as TV, radio or newspaper, etc. For example, newspapers and magazines might not be as effective as television and radio in a country where a considerable proportion of the audience is illiterate. Finally, the campaigns should be evaluated through a pre- and post-campaign survey to measure behavioural changes, such as improving seat-belt wearing or reducing speed, taking into consideration the timing of the evaluation after the campaign to be sure that the message is delivered to the audience.

2.2.4 Enforcement

Education and engineering play a beneficial role in safety in the long term, but it is effective enforcement that leads to the most rapid reduction in deaths and injury (ETSC, 2004). This has been clearly recognised in Europe (ETSC, 2005).

Many studies in developed countries have shown that an effective enforcement system has led to improvements in driver behaviour (Downing *et al*., 1991). Hutabarat and Lam (TRB, 2005) indicate that "enforcement efforts were very effective in changing driver behaviour and improving safety, especially when combined with education and media campaigns". Many drivers involved in road accidents do not comply with speed limits, blood-alcohol limits, and seat-belt usage. These factors contribute to most of the traffic deaths and injuries in Europe (ETSC, 2004). However, blood-alcohol level is not a significant cause in Muslim countries such as Kuwait, where alcohol is prohibited. Some enforcement studies in developing countries show a positive impact on accident reduction and changing driver behaviour. Egyptian studies report the benefit of increased patrols, heavier penalties and speed radar, with a significant impact on accidents on two major inter-urban roads. On one of these roads, there has been a reduction of over 50% in the total number of accidents (Gaber and Yerrell, 1983). In most developing countries, traffic police are not so well trained and equipped, which may negatively influence the effectiveness of the enforcement system. Improved training and deployment of traffic police resulted in a reduction in moving violations (98% in Islamabad in Pakistan). Following the introduction of highway patrols on intercity roads, a 6% reduction in accidents was achieved in Pakistan (Downing, 1985). In Saudi Arabia, in December 2000, the seat belt became compulsory for all drivers and front-seat drivers. The percentage of drivers using seat belts before the seat belt law was only 2.9%. On average, the results of a study showed that 60% of drivers and 22.7% of front-seat passengers had begun to use seatbelts in two Riyadh suburbs in the first few months after the seat-belt law. The results also show that there was a significant drop in certain types of injuries due to traffic accidents after the enactment of the seat-belt law (Bendak, 2005). Automated enforcement, such as speed cameras and red-light-running cameras were also highly effective in reducing driver errors (Hutabarat and Lam, 2005). In Kuwait there was a significant reduction of 15% in total fatalities seven months after the installation of speed cameras and red-light-running cameras in

November, 2001. The analysis of violation data obtained from camera sites also showed a significant reduction of 41% in both speed and red-light running (Aljassar and Ali, TRB, 2004).

Enforcement should be comprehensive because of the variety of violations, and the enforcement strategies should be designed to target high-risk behaviour and observed accident locations. An evaluation of a comprehensive enforcement project was applied in Israel, begun in April 1997. The National Traffic Police in Israel concentrated general enforcement on 700 km of interurban roads, where 60% of all rural accidents and 50% of severe accidents occurred. The project aimed to reduce accidents by 10% for one year and influence driver behaviour and attitudes on eight behaviour types: 1) turning performance; 2) signalling while turning; 3) compliance with stop signals and (4) yield signs; 5) safety belt use by drivers and (6) front-seat passengers; 7) keeping to the right on dual carriageways, and (8) not crossing the white separating line on single carriageways. There was a general reduction in violation rates for most behaviour during the project, except for compliance with stop signs and signalling. A significant reduction in severe accidents and severe casualties also occurred, although the number of accidents was increased (Hakkert *et al*., 2001). Some researchers have suggested that fines should be increased to make drivers more cautious, since the main aim of effective enforcement is not control; it is about increasing the risk of being caught as perceived by the driver. But it should be taken into consideration that high fines may be disproportionate for low-income offenders. Therefore, penalties other than fines should be introduced. Another issue is that the enforcement should be updated for any new phenomenon that causes violations or accidents, such as using a mobile phone while driving.

2.2.5 Engineering and planning

As poor road quality is one of the significant contributory factors leading to accidents, engineering improvements can reduce road accident rates and ultimately help to improve road user behaviour, making errors less likely to occur. According to Downing, “Research in many countries has shown that road planning, design and engineering countermeasures can lead to significant accident reductions and provide a more forgiving environment, thus reducing the severity of injuries” (Downing and

Iskander 1997). Thus, there has been a growth in emphasis on engineering and planning countermeasures since the 1980s in Europe and North America.

There are two main strategies to improve road safety engineering:

Accident prevention: This refers to the planning and design improvement of new road schemes such as establishment of road hierarchy within road networks, with emphasis on speed management.

Accident reduction: Low-cost remedial measures will further be enabled by reducing the number and severity of accidents on existing roads.

There are four basic strategies for accident reduction through the use of countermeasures:

- Single site (black spot) - the treatment of specific types of accident at single locations
- Mass action plans - the application of a known remedy to locations with common accident factors, such as darkness, skidding, excessive speed, head-on collision and failure to give way
- Route action plans - the application of known remedies along a route with a high accident rate
- Area with schemes - the applications of various treatments over a wide area of towns/cities, i.e. including traffic management and traffic calming.

Road planners and engineers in developed countries have learnt from mistakes made in the past, and realise the potential of safety-conscious planning and design. The UK and New Zealand experiences suggest that engineering improvement can provide an overall reduction of about 15% of total accidents (Baguley and Mustafa, 1995). (Some studies have suggested more)

Urban safety projects undertaken by the TRL in Nelson, Bradford, Sheffield, Reading and Bristol showed area-wide reductions in accidents of between 4% and 32%, with an overall average of 13% for the five towns. Accidents involving pedestrians, cyclists and motor-cyclists decreased by 5%, 33%, and 16% respectively. An average 40% of the overall reduction in accidents was made possible by making right turns illegal (Road Safety Engineering Manual, 1992).

In 1991, the TRL produced a road safety guide for planners and engineers for developing countries entitled “Towards safer roads in developing countries” (reprinted 1994), which covers engineering and planning approaches for the reduction and prevention of accidents.

The Overseas Unit of the Transport and Road Research Laboratory in the United Kingdom conducted research on the use of engineering countermeasures in some developing countries. In Malaysia, there were nine sites identified as black spots. After the installation of a certain type of engineering treatment, six sites showed a significant reduction in accidents per year; on the other hand, three other sites showed an increase in accidents per year, but an overall reduction in injuries (by about 24%) (Baguley and Mustafa, 1995). It was found in Papua New Guinea that the introduction of roundabouts at uncontrolled major/minor junctions halved the average injury accident rate (Hills *et al*., 1991). Another study conducted by Bangalore University in India concerned the effect of introducing median barricades as a traffic management measure at accident-prone locations. The results were obtained using the Microcomputer Accident Analysis Package (MAAP), and showed the following: 1) Fatal accidents decreased by 15%; 2) Injury accidents decreased by 37%; 3) Property damage in accidents decreased by 12%; 4) The average benefit-cost ratio was found to be 1,082.72 (Veeraragavan and Venkatesh, 2000).

2.2.5.1 Traffic calming

Speed has been determined as one of the most common contributing factors in road accidents and severe injuries in both developed and developing countries. A study conducted by Sabey (1983) suggested that excessive speed contributed to 10-15% of all accidents. It has also been established that if the mean speeds of vehicles can be reduced by 1 km/h, accidents and injuries will be reduced by about 3-5%. Thus, the emphasis is on reducing accidents by reducing mean speeds along routes, in residential areas, city centres, and near schools, to reduce fatalities and injuries.

Traffic calming measures such as rumble strips and speed humps were found to be effective on Ghanaian roads, where pedestrians are the main victims of road traffic injuries and the speed factor accounts for more than 50% of road accidents. Rumble strips installed on the main Accra-Kumasi highway, at the Suhum Junction, reduced accidents by about 35% and fatalities by 55% over a short period of 16 months from January 2000 to April 2001 (Afukaar, 2003). The more effective approach to traffic calming is to develop a comprehensive programme by choosing the appropriate traffic calming devices for areas with higher speed limits and higher severity of accidents. Area-wide urban traffic calming schemes are typically implemented in residential areas in order to reduce the environmental and safety problems caused by road traffic (Elvik, 2001). In Denmark, 600 traffic calming schemes have resulted in an average 45% reduction in casualties. In Germany also, there were casualty reductions of 27% in 30 km/h zones in Hamburg, and 44% in Heidelburg (Road Safety Engineering Manual, 1992). A trial period for any traffic calming measures should be taken into consideration, using a pilot scheme to monitor performance before implementation on a large scale.

2.2.6 Vehicle safety

Improvements in vehicle design, occupant protection and vehicle maintenance have made a significant contribution to crash reduction in industrialised countries (The World Bank Group, 2002). Vehicles should be designed in such a way that drivers are able to see in all directions, are able to signal clearly their intentions to go forward, stop, overtake, etc. Vehicles should also be designed to offer good protection for occupants and minimise injuries to them as well as to pedestrians in the vicinity of the vehicles. One of the most effective approaches to increase safety for car occupants is the use of restraint systems and protective devices, such as seat-belts, headrests, air bags, helmets, child restraints, and padded dashboards.

Recent vehicle models have proven much safer, in terms of occupants' safety. Lie and Larsson (1996) found that older models (pre-1991) in Sweden had a 50% higher risk of severe/fatal injuries than post-1991 cars. A recent study of crashes in Australia by MUARC (Haley, 1997) came to similar conclusions: the risk of severe injury, as a result of crashes, decreased steadily by year of manufacture. On average, cars manufactured in 1982 carried a 30% higher risk than those manufactured in 1992. Cars manufactured in 1972 carried double the risk.

Proper maintenance of vehicle components, such as lights and wiring, windscreen, mirrors and windows, bodywork, steering, suspension, wheels, tyres, brakes, engine, driveline, fuel systems and exhaust, is necessary to keep the vehicle roadworthy. This can be achieved by annual vehicle inspections, combined with frequent random checking of vehicles on the road. Similar considerations should be made for the case of heavy goods vehicles, especially as the problems of all-round vision and the responsiveness of the vehicles to changing factors in the immediate vicinity are more complicated than with small vehicles. Overloading of heavy goods vehicles is also a serious safety hazard for all road users.

Chapter 3

3 Road Accidents in Kuwait

3.1 Annual accident trends and related current issues

3.1.1 Introduction

Kuwait has an estimated population of about three million (2,991,189 in 2005) and an area of 17,818 km^2, the population density being 168/km^2. The average annual growth rate between 1995 and 2005 was 5%. According to the 2002 Census, 60% of the population is male and 40% female, but only 37% of the population is Kuwaiti (Ministry of Planning, 2003). The state of Kuwait is administratively divided into six Governorates, covering government functions such as security, municipality, health, and traffic regulation.

These Governorates are:

The Capital, with a resident population of 411,477 persons (in 2002);

Hawalli, with a population of 513,643 persons (in 2002);

Farwaniya, with a population of 620,565 persons (in 2002);

Mubarak Alkabeer with a population of 159,848 persons (in 2002);

Jahra, with a population of 300,374 persons (in 2002);

Ahmadi, with a population of 399,740 persons (in 2002).

3.1.2 Location and Climate

Kuwait is situated in the north-western corner of the Arabian Gulf between latitudes 28.30° and 30.06° north of the equator and between longitudes 46.30° and 48.30° east of Greenwich. Its eastern coast stretches over 195 kilometres of the Arabian Gulf, and shares borders to the north and northwest with Iraq over 240 kilometres, and to the west and south with the Kingdom of Saudi Arabia for 250 kilometres (see Figure3.1). The desert climate is dry and hot to very hot in summer, the temperature ranging between 29° to 45° Celsius. In winter, it is cooler, with a temperature range of 8° to 18° Celsius.

Figure 3.1 Map of Kuwait
Source: (Anon, n.d. a) :http://www.lib.utexas.edu/maps/middle_east_and_asia/kuwait_rel96.jpg

3.1.3 The economy

Kuwait is considered to be one of the leading oil producing countries in the world and the local economy relies on oil as the main source of income. It was estimated that Kuwaiti Gross National Product (GNP) was US $39.125 billion (11.7375 billion KD) in 2002, equivalent to $16,000 per capita (4,800 KD).

3.1.4 Vehicle ownership

The high standard of living in Kuwait and the high temperature during the summer months (from May to November) encourages private vehicle ownership (one of the highest in the world and almost the same as the UK). Table 3.1 shows the growth in vehicle ownership over the past nine years (1997-2005). In 2005, vehicle ownership (vehicle/ population) was almost 0.38 (380Veh. /1000 Pop.).

Table 3.1 Annual statistics for road accidents[1]

Years	Population	Total vehicles registered	Vehicle ownership	Accidents	Fatalities	Injuries
1997	1979689	654667	0.33	26426	360	1681
1998	2027103	708881	0.35	27456	334	1690
1999	2107195	754500	0.36	26635	333	1743
2000	2189668	767807	0.35	27696	331	1125
2001	2274980	875620	0.38	31028	300	1566
2002	2411008	947382	0.39	37650	315	2249
2003	2546684	954978	0.38	45376	372	1332
2004	2753656	1042617	0.38	54878	398	824
2005	2991189	1134042	0.38	56235	451	863

Source: Annual Statistics, General Traffic Directorate, the Ministry of Interior, State of Kuwait

3.1.5 Traffic composition

The information in Table 3.2 on vehicle composition highlights the high proportion of private (passenger) cars at 83.5% (21.5% are station wagons (estate cars)). Pick-ups represent a further 8.8%, trucks 4.6% and buses 1.4%.

Passenger cars predominate due to the preference to avoid public transport (buses only in Kuwait) and the long waiting periods associated with bus travel during the hot summer months. Another reason for using private cars is the low price of fuel in Kuwait.

Table 3.2 Vehicle Types in 2002

Vehicle Types	%	# Of Veh.
Saloon (passenger car)	62	587,377
Station wagon (passenger car)	21.5	203,687
Pick-ups	8.8	83,369
Trucks	4.6	43,579
Tankers	0.1	948
Buses	1.4	13,264
Construction vehicles	0.7	6,632
Motorcycles	0.3	2,842
Others	0.6	5,684
Total	100	947,382

[1]Issues of massive under-reporting are discussed in Section 3.1.9.

3.1.6 Accident data and reporting

Accident data in Kuwait are available in the form of monthly accident summaries provided by police stations in each governorate, including accident location in terms of the police station name, accident type (collision, pedestrian accident, overturning, other), casualty type (death, serious, slight) and accident cause (lack of attention, passing red traffic light, speeding, other).

The General Department of Planning & Development at the Ministry of the Interior issues annual statistics based on the monthly accident summaries, which do not provide adequate data for in-depth investigation.

Detailed accident reports take place under the supervision of the General Investigation Administration (GIA) in the Ministry of the Interior. Standard accident reports are completed by the investigating officers at individual accidents. The reports provide details of time, date, day of the week, weather conditions, road type and location. The driver of each vehicle involved is identified by name, nationality, age and gender. The report also includes accident severity and the position of all those involved at the time of the accident (drivers, passengers, pedestrians, etc). On the reverse side of the report form, the police investigator has space to give a brief description of the accident and a sketch showing the movement of vehicles and the site of collision (see the police accident form, appendix A). Information about the police accident reports and any inadequacies in them is provided in the next section (3.2).

3.1.7 Accident rates and trends in Kuwait

Traffic accidents in Kuwait are one of the main causes of injury and death. According to the Kuwaiti Ministry of Health's classification, road accidents were the third ranked cause of death between 1998 to 2002 (after diseases of the circulatory system (circulatory system & heart disease, and neoplasm) which contributed to 7.14% of the total deaths in Kuwait (4,342) (Ministry of Health, 2002; see Table 3.3). The World Health Organization (WHO, 2002) gave a different classification of causes of death in Kuwait in which road accidents came seventh in 2002, because circulatory system diseases are listed separately and many of them still outrank road accidents (see Table 3.4). Overall the WHO road death figures show nearly the same percentage, 6.61% of road accident out of total deaths. The differences can be accounted for because the total number of deaths given by the WHO (4,691) is slightly higher as they include deaths such as from communicable prenatal conditions. The same base statistics might be used by both bodies, but their classification of them is slightly different. However whatever classification is used, road accidents are one of the most important causes of death in Kuwait, and the same bodies seem to agree on that.

These figures are considerably higher than Western European standards due to the higher accident fatality rate in developing and emerging countries and the effect of different age distribution with, for example, a higher proportion of young people in Kuwait, as the birth rate is high compared to the U.K. According to the Human Development Report (2001), birth rates per 1,000 population were about half as much again (18.4 versus 12.9 in the UK). Another reason is that a large proportion of non-Kuwaitis are guest workers, who usually return to their native countries to retire when their contracts are completed. In addition, there are variations in the classification of causes of death and different illnesses around the world and the ways in which they are recorded. The percentage of the population of Kuwait that die each year is currently low (0.18%) compared with figures in Britain (nearly 1%) (Human Development Report 2001).

It can be seen from Table 3.5 that the birth rate in the Gulf countries is higher and the death rate lower. Most of the workforce from abroad return to retire in their home countries, so that the death rate from the larger population is diminished, and is therefore less in comparison to the U.K, Sweden, the USA and Japan. To take the example of Kuwait, the proportion of foreign residents is almost double that of the local population. A large majority of the former will return home, leaving a low total death rate for the country. It can be noted that the population proportions in Bahrain and Saudi Arabia are different from those in Kuwait and the UAE, which will have a related effect on their death rates.

Table 3.3 Causes of death in Kuwait (Ministry of Public Health – Kuwait 2002)

Causes	No. of deaths	%	rank
Diseases of the circulatory system	1,713	39.45	1
Neoplasm	553	12.74	2
Road accidents	**315**	**7.14**	**3**
Consequence of road accident	**55**	**1.38**	**13**
Other accident	**274**	**6.31**	**4**
Certain infectious and parasitic disease	117	2.69	10
Diseases of blood and blood forming organs & immunity disorder	21	0.48	14
Endocrine, nutritional & metabolic disease	259	5.96	5
Mental & behavioural disorders	9	0.21	15
Disease of nervous system	78	1.80	10
Disease of respiratory system	222	5.11	7
Disease of digestive system	111	2.56	11
Disease of skin & subcutaneous tissue	7	0.16	17
Disease of musculoskeletal & connective tissue	2	0.05	18
Disease of genitourinary system	71	1.64	12
Complications of pregnancy, childbirth and *puerperium*	7	0.16	16
Certain causes of prenatal morbidity and mortality	172	3.96	8
Congenital anomalies	231	5.32	6
Symptoms, signs & abnormal clinical and laboratory findings, not elsewhere classified	125	2.88	9
Total Deaths	4,342	100.00	

Table 3.4 Causes of death in Kuwait (WHO, 2002)

Causes	No. of deaths	%	Rank
Malignant neoplasms	548	11.68	4
C. Diabetes (mellitus)	252	5.37	9
H. Respiratory diseases	86	1.83	11
Other Group II NCD	688	14.67	2
Rheumatic heart disease	6	0.13	14
Hypertensive heart disease	491	10.47	5
Ischemic heart disease	846	18.03	1
Cerebrovascular disease	205	4.37	10
Inflammatory heart diseases	14	0.30	13
Other cardiovascular diseases	253	5.39	8
Communicable, maternal, prenatal and nutritional conditions	612	13.05	3
Road accidents	**315**	**6.61**	**7**
Consequence of road accident	**55**	**1.28**	**12**
Other Injuries	**320**	**6.82**	**6**
Total Deaths	4,691	100.00	

Table 3.5 Birth and death rates in Gulf countries, U.K, Sweden, the USA and Japan

Country	birth rate	death rate	Local population	Foreign population
Kuwait	1.84	0.18	35	65
Bahrain	2.13	0.31	65	35
Saudi Arabia	3.1	0.3	75	25
United Arab Emirates	1.55	0.16	19	81
UK	1.29	1.04		
Sweden	1.36	1.04		
USA	1.47	0.83		
Japan	1.05	0.83		

Source: Human Development Report 2001

A preliminary analysis of road accident costs in the state of Kuwait was 115 million KD (approximately $385 million), about two percent of Gross Domestic Product (GDP) (Jadaan, 1986). This cost does not include emotional and related costs on families and disabled victims. The main factor contributing to accidents is human error (90 %) (Arabic Interior Ministers Council, 1998).

Accident rates rose in the period from 1997 to 2005 from 13.3 per 1,000 population in 1997 to 18.8 in 2005. Accident figures per 1000 vehicles rose from 40.3 to 50 in the same period. Figures 3.2 and 3.3 represent graphically the general trends of accidents related to vehicles and population.

It should also be added that the number of accidents per day rose from 72 in 1997 to 154 in 2005, an average of about seven accidents per hour, while the fatality rate over this period was one per day.

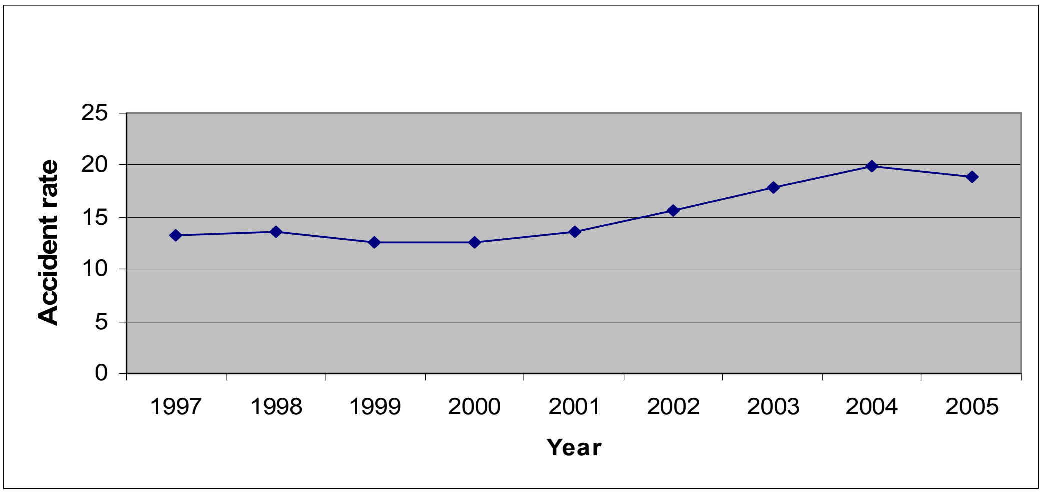

Figure 3.2 Accident/1000 populations

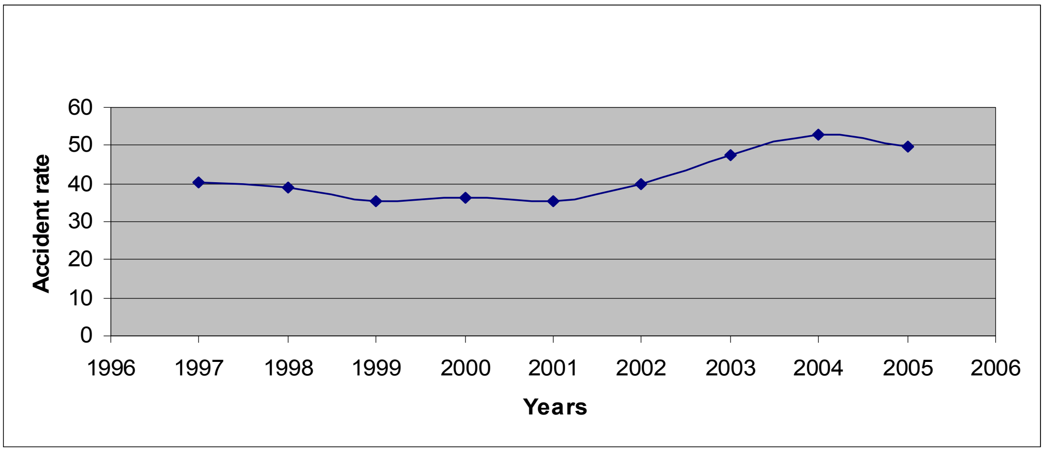

Figure 3.3 Accidents per 1000 vehicles

3.1.8 Fatality rate

Figure 3.4 and Table 3.6 show the number of fatalities in relation to vehicles registered, population and the number of accidents. The number of fatalities per 10,000 populations and per 10,000 vehicles fell during the late 1990s/ early 2000s, but later rose. This could be due to the fact that in this period speed and red light cameras were introduced, leading for a time to a decrease in the fatality rate, but subsequently it is possible that drivers became familiar with the camera locations. In addition, after 2003, the Iraq war had ended, which led to more traffic activity between Kuwait and Iraq, which could be another reason why the fatality rate increased.

The number of fatalities per 1,000 accidents is shown to have decreased from 1997 to 2005. This is not an indication of road safety improvements, but it is because the number of fatalities did not increase at the same rate (or fluctuated) as the number of accidents, which appeared to increase sharply in recent years. Also, the number of fatalities did increase in 2005 (451 persons).

Table 3.6 fatality rates

Years	Accidents	Fatalities	Injuries	Fatality Index	Fatalities/ 10,000 Veh.	Fatalities/ 100,000 pop.	Fatalities/ 1,000 acc.
1997	26426	360	1681	17.64	5.5	18.18	13.621
1998	27456	334	1690	16.58	4.7	16.47	12.16
1999	26635	333	1743	16.04	4.4	15.8	12.5
2000	27696	331	1125	22.73	4.3	15.12	11.95
2001	31028	300	1566	16.08	3.4	13.19	9.67
2002	37650	315	2249	12.28	3.3	13.06	8.37
2003	45376	372	1332	21.83	3.9	14.61	8.2
2004	54878	398	824	32.57	3.8	14.45	7.25
2005	56235	451	863	34.32	4	15.08	8.02

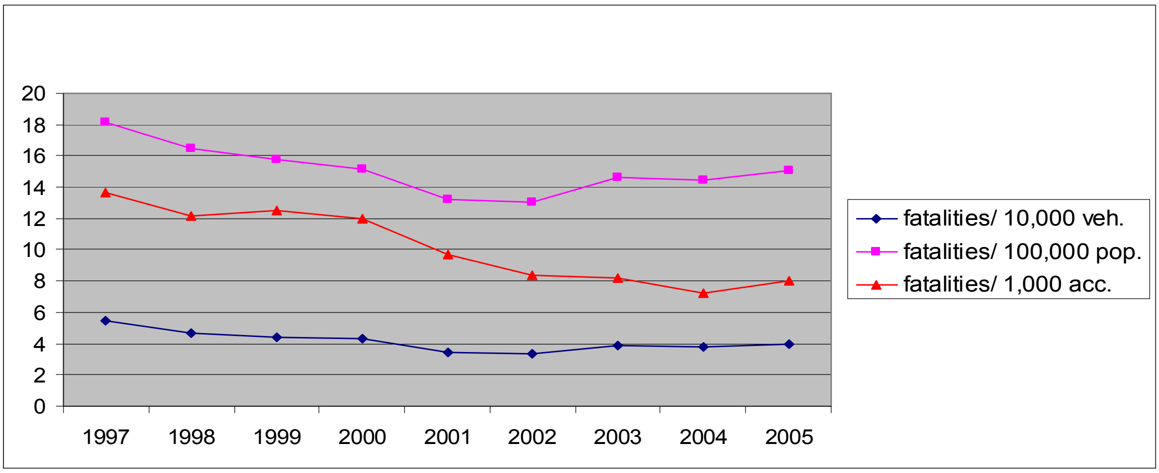

Figure 3.4 Fatality rates in Kuwait 1997-2005

3.1.9 Fatality index

The percentage of fatalities to total casualties in Kuwait is considered high, and was especially high in 2004 and 2005 (35.57% and 34.32% respectively, see Figure 3.5). Confidential information recently revealed that there is some lack of coordination between the authorities, which might account for some under-reporting. The reason may relate to drivers' attitudes on speeding leading to dangerous (fatal) accidents in Kuwait. In addition, the injury accidents have decreased recently and the fatal accidents increased which makes the fatality index higher and could relate to under-reporting of the slight injury accidents.

The differences between reported accidents and figures obtained from hospital records have been the subject of study in some European and low income countries, as explained in Section 2.1.6 in the Literature Review. Such studies have not been conducted in Kuwait, and no information is available in that area from any source. However, according to Figure 3.5, the fatalities/casualties ratio increased over several recent years, which suggests that there has been increased under-reporting. There is no published evidence on why this might be. It could be that victims agree to receive private compensation for minor injuries from the driver who caused the injury, rather than spend time on legal processes. Another factor is that hospital treatment is free for Kuwaiti citizens, so that insurance claims are not necessary. Car insurance is compulsory (and cheap to purchase), but insurance against personal injury is not common. Furthermore, the police are concerned more about the occurrence of infringement than the extent of injury incurred.

The current fatal to injury ratio in Kuwait is about 1:5 (excluding 2004 and 2005 - see the confidential document). This compares poorly with, say, the U.K., where it is around 1:80 while it is 1:12 for the Middle East and North Africa (see Table 2.5). With under-reporting taken into consideration, the ratio in Kuwait could be much higher, though no study has been carried out yet in the country to ascertain this. The ratio is not in any case as high as those in HIC's, indicating that the fatality index is higher.

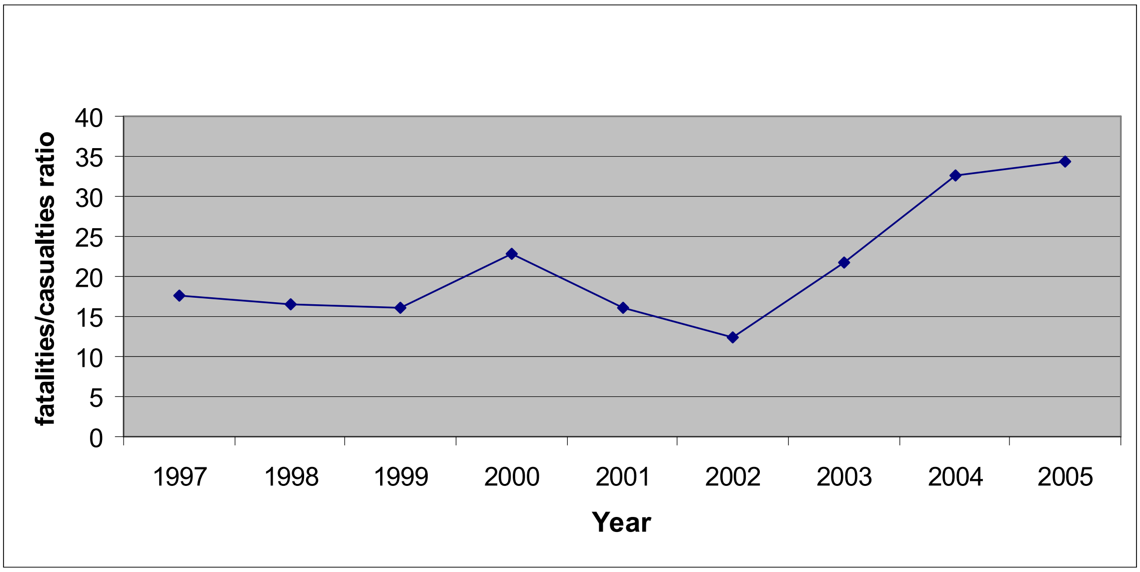

Figure 3.5 Fatality Index

3.1.10 Comparison between Kuwait and other countries

For better understanding of road accidents in Kuwait, it is necessary to compare statistical data with other developed, developing or emerging countries; in addition, it is relevant to make a comparison with surrounding countries of similar status. Table 3.7 and Figures 3.6, 3.7, and 3.8 show recent statistical data on accidents, injury and fatalities in a number of Arabian Gulf Countries which share the same culture as Kuwait. It can be seen from the table that Qatar has the highest vehicle ownership, with almost 525 vehicles/1,000 population. Kuwait, Saudi Arabia, and Bahrain follow, with approximately 400 vehicles/1,000 population. Kuwait's fatality rate per 1,000 population is the second lowest after Bahrain. Even in comparisons with countries of the same culture, the figures are influenced by many factors including fatality definition and car ownership. For example, the Criminal

Investigation Department in the Ministry of the Interior claimed that Kuwaiti fatal accident accounts include persons dying within 30 days of an accident, while Saudi Arabia counts only those killed at the accident scene (Ali *et al*., 1997). Also the topography in each country could have an impact on accident rates. For example, the total land areas of Kuwait, Qatar, and Bahrain are relatively small compared to the Emirates and Oman, whereas Saudi Arabia is much greater than all of them. There is some rolling and mountainous terrain in Oman and Saudi Arabia, whilst Kuwait, Qatar and Bahrain have mostly level terrain (desert landscape).

Low vehicle ownership in Oman means that it is not meaningful to record fatalities per thousand vehicles, but fatalities per veh-km may give a reliable account. The fatality per 100 million vehicle-kilometres travelled in Kuwait was estimated to be 4.2 in 1994 (Koushki *et al*., 1996). Table 3.8 and Figure 3.9 show that Kuwait had a much higher rate than European countries, the U.S or Japan.

Table 3.7 Road accident statistics in Arabian Gulf Countries

Country	Year	Total Accidents	Injury	Death	Casualties	Total Reg. Vehicles	Population
Kuwait	2003	45,376	1,332	372	1,704	954,978	2,546,684
	2004	54,878	824	398	1,222	1,042,617	2,753,656
	2005	56,235	863	451	1,314	1,134,042	2,991,189
Saudi Arabia	2001	280,401	30,040	4,419	34,459	8,466,973	20,976,222
	2002	305,649	28,379	3,913	32,292	9,009,111	21,491,160
	2003	223,816	28,372	4,161	32,533	9,484,891	22,007,753
Bahrain	2003	45,996	2,044	71	2,115	273,230	689,418
	2004	50,991	2,004	60	2,064	295,484	707,160
	2005	55,264	1,941	78	2,019	315,893	724,645
Emirates	2003	8,652	10,604	873	11,477	782,984	3,685,000
	2004	8,269	10,233	824	11,057	1,100,765	4,320,000
	2005	8,254	10,194	830	11,024	1,149,304	4,655,000
Qatar	2002	68,550	1,418	114	1,532	352,901	682,434
	2003	75,688	1,291	150	1,441	370,785	717,766
	2004	80,160	1,371	164	1,535	406,626	744,026
Oman	2003	10,197	6,735	578	7,313	444,500	2,340,515
	2004	9,460	6,636	637	7,273	486,500	2,415,576
	2005	9,247	6,658	689	7,347	559,500	2,508,837

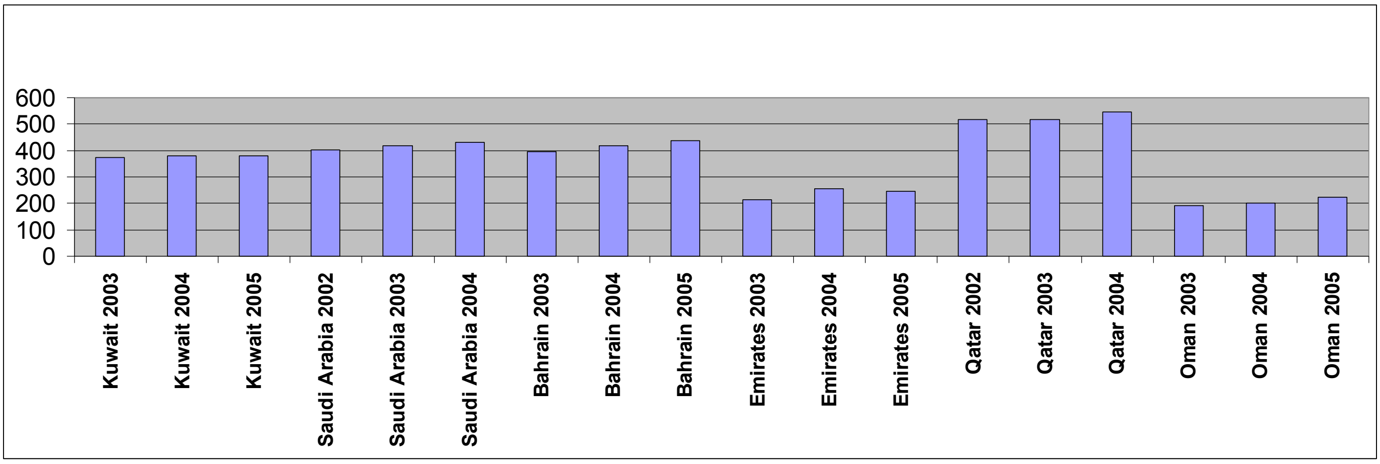

Figure 3.6 Vehicle Ownership (vehicles/1000 populations)

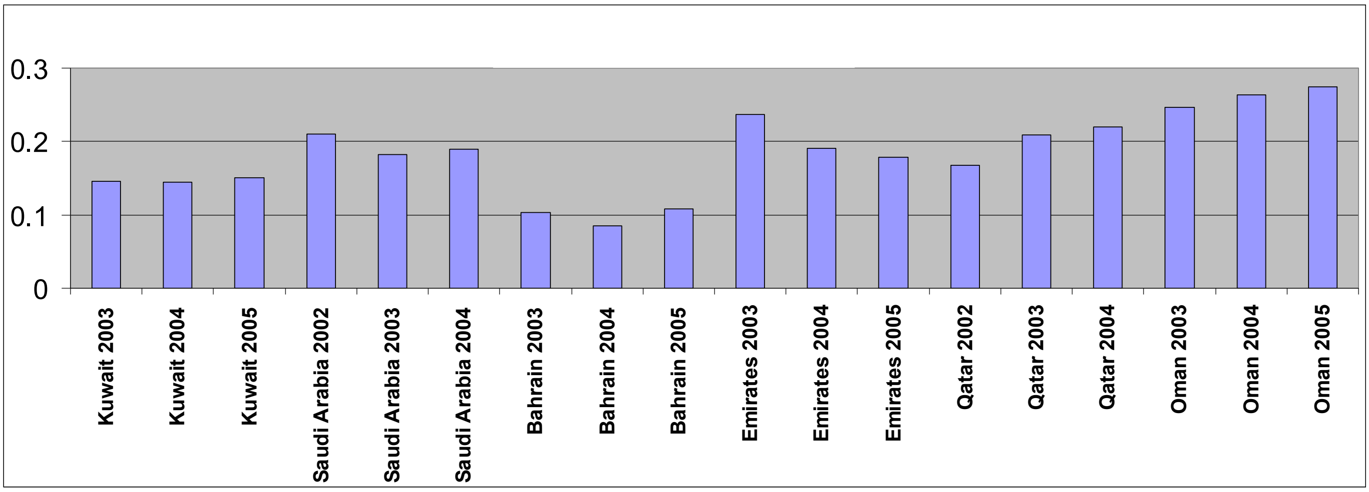

Figure 3.7 Fatality/1000 populations

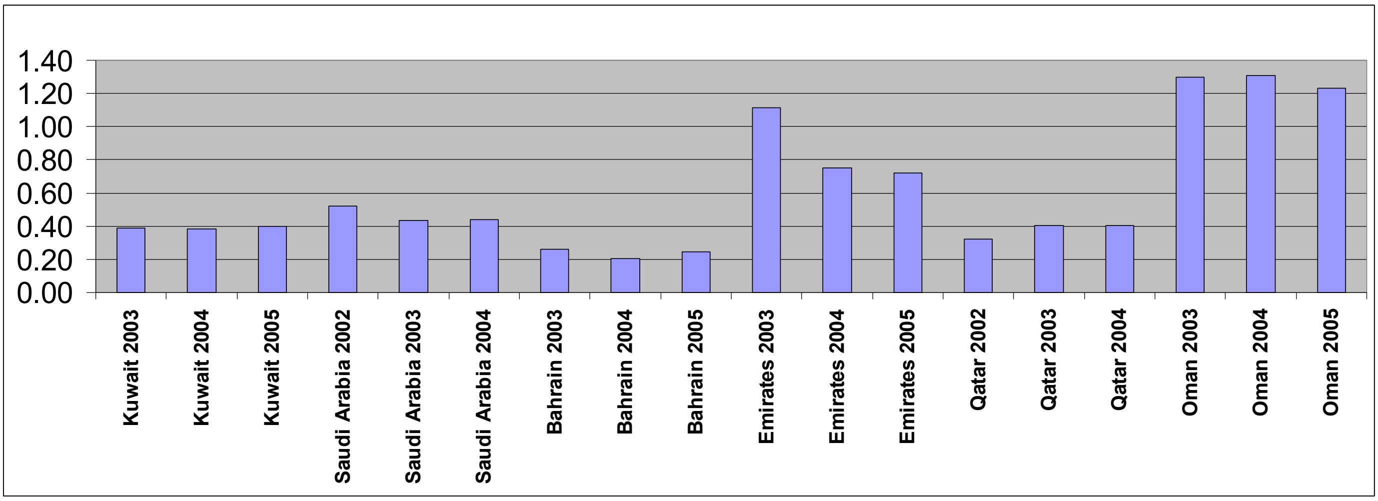

Figure 3.8 Fatality/1000 vehicles

Table 3.8 Fatalities per100 million vehicle-kilometres

Country	veh-km
Austria (1994)	2.1
Belgium (1994)	2.1
Denmark (1994)	1.4
Finland (1994)	1.1
France (1994)	1.9
Germany (1994)	1.7
Greece (1994)	3.4
Iceland (1994)	0.6
Ireland (1994)	1.4
Japan (1994)	1.8
Netherlands (1994)	1.2
Norway (1994)	1.0
Switzerland (1994)	1.3
UK (1994)	0.9
USA (1994)	1.1
Kuwait (1994)	4.2

Source: International Road Safety Comparisons, 2000. Australian Transport Safety Bureau (ATSB) http://www.atsb.gov.au/road/stats/pdf/benchmark_00.pdf

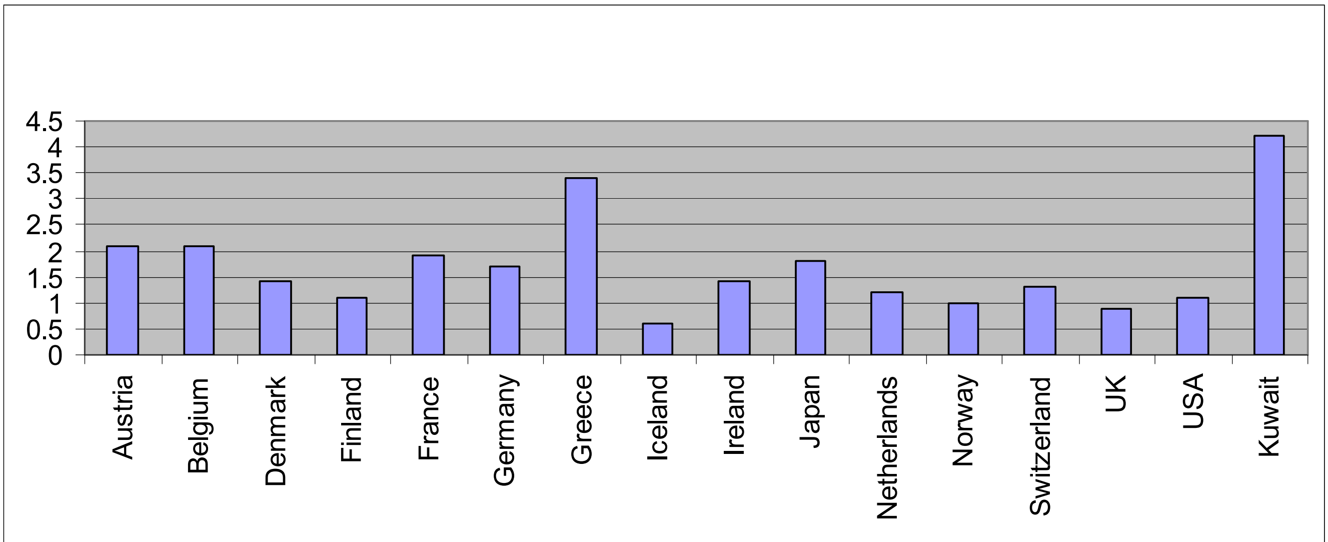

Figure 3.9 Fatalities/100 million vehicle kilometres travelled

3.1.11 Driver licensing, testing and training in Kuwait (based on Kuwaiti Traffic Law 2002)

As was emphasised in the literature review (section 2.2.2), drivers' attitudes and behaviour can be influenced by education and training, ultimately contributing to reduction in the frequency of accidents (Stock *et al*., 1983). Poor driver behaviour, on the other hand, is a major factor in or cause of accidents. According to Sabey (1980), 95% of accidents are caused by human error alone or in combination with other factors. It may be that improved behaviour can be achieved by a good level of testing, training, education (especially of young people) and enforcement. The importance of training gives the discussion of the current status of testing and training in Kuwait and other Gulf countries considerable importance at the present moment.

In Kuwait, the driver licensing system is administered by the GTD. The minimum age for driving is 18 years. To apply for a Kuwaiti driving licence, applicants must go to the Licence Section in the main Traffic Department in Shuwaikh or offices in other areas and obtain a learner's licence. For that purpose, expatriates must (a) be legally resident in Kuwait, (b) have been resident for at least two years, and (c) be earning a salary of not less than KD 400 a month. Some professional occupations (such as medical doctor) are exempt from the above three conditions. The full list (twenty-one professionals) can be found in Appendix F.

Once approval has been granted, the applicant must go to the Licence Section in the Traffic Department in the governorate in which he or she lives. A stamp of KD10 must be affixed to the application form. Then the learner must go to the Traffic Department in Qurtoba for eye and blood tests. The results of the tests, which can be collected after two days, must be submitted to the Licence Section for registration. The eye test is to ensure that there are no problems with vision. If the applicant needs to wear glasses or contact lenses, this will be indicated on the licence, when the applicant receives it. An applicant requiring glasses (or lenses) cannot take a driving test without wearing them. The eye test (or visual acuity test) demands 20/20 vision (6/6 in Kuwait) or adequate support from glasses (or lenses) to cover the deficiency. The blood test is only to identify the driver's blood group, such as negative or positive A, B, AB, O. This also appears on the licence, so that in cases of emergency (i.e. the victim needing blood), time will be saved at the hospital.

Unlike in the U.K., drivers in Kuwait must carry their licence with them the whole time; otherwise to have blood group details on the licence would be a waste of time. Blood group details are not indicated on U.K. licences. As regards vision tests in the U.K., they only involve identifying another vehicle's registration plate at a distance of 20.5 metres at the time of the test (with or without glasses or contact lenses) and there is no mandatory blood test. The U.K. driving licence application form lists 21 medical conditions (such as brain injury, diabetes, epilepsy, sleep apnoea, Parkinson’s disease, and so on), failure to disclose which is subject to a £1,000 fine (DVLA, 2008). There is no requirement like this in Kuwait.

Then the learner must go to the driving test centre at the governorates Traffic Department to fix a date for a driving test, for which a KD10 booking fee is levied. KD10 must also be paid on the day of the test. Learners are only allowed to sit the driving test three times; it includes a written examination (tests taking place from 8am to1pm).

There are four types of driving licence:

1- A private vehicle driving licence is the most common type in Kuwait, for ordinary road vehicles such as saloon cars, estate cars and jeeps carrying no more than 10 passengers and not exceeding 2000 kg. The minimum age to obtain this licence is 18.

2- A public vehicle driving licence is for any type of commercial vehicle (heavy vehicle) including trucks and buses. The holder must already have a private driving licence, and the minimum age is 21.

3- A construction vehicle licence is required to drive vehicles such as bulldozers and tractors. The holder must already have a public driving licence (minimum age 21).

4- A motorcycle license can be obtained at 17 years.

Apart from the condition for a public driving licence, the applicant must already hold a private driving licence.

Drivers from certain countries that match the requirements and standards of Kuwait may obtain a Kuwaiti driving licence based on their home country driving licence (such as GCC, USA, and the United Kingdom). Other nationalities, even if they have a driving licence from their home country, are obliged to apply for a learner's licence and pass a driving test (if it does not match the requirements and standards of Kuwait, such as India and the African continent).

Kuwaiti driving licences are issued for periods of up to ten years, depending on the driver's age. Once the licence expires, it can be renewed in less than a day at the Traffic Department that originally issued it. An application form must be typed and submitted. Whether an eye test is required by a driver who does not wear glasses depends on the driver's age. Drivers up to the age of 40 are exempt from the eye test and are given a ten year renewal of their driving licences for a fee of KD10. Once the age of the private driver licence holder reaches 60, he or she must undergo an eye test at the (Ministry of Public Health (MPH) clinic in Quortuba every five years and every year for public driving licence holders.

3.1.11.1 Testing

As regards testing, it is true that a written test has been added (2003), but it cannot be said that improvement to driving skill levels has been made. It covers basic Traffic Signs, Traffic Laws, and Car Mechanics (about 25 questions).The content of the written test was originally given orally.

The test is too easy. Details of the pass rate are given below. The practical test is also too easy, as described below. It is not a rigorous test over a good length of time. Too many drivers (about fifty) are tested on the same day, so that each has only a few minutes to show his or her ability. The test takes place on a circuit on which there is no public traffic. There are no more than three cars on the circuit at the same time. (Details of what is involved are given below.)

There are numerous boxes on the official driving-test form sheet (see Appendix F), but, unlike in the UK, many items cannot be tested, for example, awareness and respect of pedestrians, as no casual pedestrians are allowed at the test track. The test takes place on a track, to which unauthorised access is not allowed, unlike testing in the UK, which takes place on the road in real conditions. There is no control of tailgating or respecting priorities at junctions, as there is no other traffic. The tester is able to control for turning on and off the engine, seatbelt usage, mirrors and indicators, awareness of traffic signs, keeping in lane, reaction time and speed limits, but these are easy points to pass in such a controlled environment. There is a hill on which to perform hill starts, but it is hardly ever used (see also details of interviews and observation, Section 3.1.13, comments on Table 3.14). There is a narrow, twisting section within the circuit, but it is not always used. There are three other test centres in Kuwait, but they have the same design. The testers seem mainly to be concerned about whether the driver can perform reverse parking. Although the test is too easy, the test centre likes to give the appearance that it is being rigorous. It will therefore fail 56% of drivers and make them take a re-test the following week (GTD, 2005).

In such circumstances, it is easy to imagine that drivers are allowed on the roads, who would not be given a full licence in the U.K. It is also not difficult to conclude that the poor level of training and testing might contribute to the greater number of accidents (per 1000 kilometres driven). These factors, taken as a whole with the other factors of education, enforcement and engineering, indicate a problematic situation for Kuwait. Because of the great cultural similarities, the same could be said of the other Gulf countries, and this is supported by accident information, for example in Figure 3.8, in which only the Emirates and Oman have higher fatality rates.

3.1.11.2 Training

The context of learning to drive and taking a test is very different in Kuwait, compared with, for example, the UK. To begin with, many drivers only learn to drive with friends and family members (48.3% from the survey analysis) and only a small number take a formal optional driving education course (only 17.8% from the survey analysis). Training or instruction is available from the Kuwait Motoring Company (KMC), and in what are known as "driver training offices". Both types of bodies are private but are administered by the GTD.

The KMC was established in 1987, and currently has a staff of 55. The main objective of the company is to provide training to applicants who wish to obtain light, heavy goods and construction vehicle licences. The applicants are given practical and theoretical training in driving, traffic rules & regulations, vehicle maintenance and first aid. KMC has three branches in Shuwaikh, Ahmadi and Farwaniya, and they are approved by the traffic authority (GTD). KMC provides driving training in privately owned vehicles. The trainees are first evaluated to determine which of the five programs below they require (Table 3.9) :

Table 3.9 Driving programmes at Kuwait Motoring Company (KMC)

Driving	**Training Class**
1st Program	6 hrs Theoretical Class & 2-4 hrs Practical
2nd Program	6 Theoretical Class & 8 hrs Practical
3rd Program	6 Theoretical Class & 12 hrs Practical
4th Program	6 Theoretical Class & 16 hrs Practical
5th Program	6 Theoretical Class & 20 hrs Practical

KMC provides training classes for its participants in the following subjects:

1) Traffic Laws

2) Driving Behaviour

3) Traffic Signs & Road marking

4) Car Mechanics

5) First Aid.

The courses are taught in several languages, Arabic, English and other languages but no simulator is yet available. Using a driving simulator, new drivers can gain experience of hazardous driving situations that are rarely encountered in the real world. Such situations are unpredictable and usually encountered after years of on-the-road driving (Anon, 2008 b). The weakness of novice drivers can be immediately identified and they can be trained to take appropriate evasive actions in a variety of hazardous situations that allow them to avoid accidents. This will help to develop sound driver behaviour/skills by repeatedly reinforcing appropriate driving behaviours. This may also include practical real-life situations such as changing lanes, turning, limited visibility conditions, traffic signs and signals, recognizing pedestrian crossing situations, motorway driving, rural roads, mountain driving, etc.

Another reason to use a simulator is that driver training is achieved without subjecting human life to danger as can possibly occur on the real road. Training in a driving simulator is far more economical than in a real vehicle. The effectiveness of training in a simulator can be assessed by determining how much training time on the real vehicle is saved by simulator training (transfer of training). Evaluation studies have shown that simulator-based driver training may be effective, depending on the specific driving task and the quality of the driving simulator use (Kapein *et al.*,1996).

The private companies (offices) who have permission from the GTD to employ qualified instructors and provide a curriculum for practical training also provide special cars for the purpose of driver training. These companies are essentially established to train drivers on the roads, and do not have training centres. (No set number of hours is required).

It is difficult to judge the quality of driving instructors and currently, as there is no professional body to which instructors either can or need to belong, and therefore there is no system to ensure that they maintain a reasonable minimum standard. Three conditions are required to become a driving instructor: 1) a public vehicle driving licence (minimum age 21 years); 2) no criminal record; 3) passing the required GTD test for instructors. These instructors have fewer checks on them than those at KMC.

The non KMC instruction to trainees is neither in-depth nor rigorous. They merely take learners to a deserted strip and teach basic manoeuvres (with concentration on how to pass the test, not how to learn to drive). The instruction at KMC is at only a slightly higher level. They have classrooms, and the practical courses are within the premises and sometimes on the road. However, the training is still inadequate, as there is no training after dark and no specific hazard perception training.

Hazard perception training aims at improving the ability of new drivers to a higher awareness level so as to produce a significant reduction in accidents. The driver training program in Kuwait does not cover specific hazard perception training and new drivers do not have a specific hazard perception test. While some researchers (Sagberg and Bjornskau, 2006) found that a hazard perception test did not result in important safety improvements, others (Fisher *et al.*, 2006) found that a hazard perception training program resulted in substantial improvements in the scanning behaviour of young drivers. Despite this, it is recommended that a hazard training program focus on recognising potential risks and consequently a hazard perception test should be introduced in Kuwait to compensate for the lack of driving experience of young, novice drivers. The training program should concentrate on the fundamental behaviours that are believed to be associated with good hazard perception skills, such as driving at appropriate speed, respecting pedestrian crossings and keeping a safe driving distance.

3.1.12 Comparison of training and accident probability among different nationalities

Twisk and Stacey (2007) gave an overview of young driver regulations in 12 of the 27 European countries as reported by the Organisation for Economic Co-Operation and Development (OECD) and the European Conference of Ministries of Transport (ECMT) (2006). Driver training and licensing systems differ from country to country. These differences include variation in minimum age of drivers, licensing/driving limitations, the use of probationary periods, and test procedures.

Some countries apply the laws relating to drivers obtaining a licence more strictly and some less so. This might or might not affect driver behaviour, hence accident risk. As will be discussed in a later section, a change in driving training and licensing had positive effects in one country (Sweden) but the same change in Norway had no effect at all.

In Europe, a full description of all the different systems of driving licences in use is unavailable, according to Twisk and Stacey (2007), but recently, the Organisation for Economic Co-Operation and Development (OECD) and the European Conference of Ministers of Transport (ECMT) report (2006) provided an overview of the comparative training and licensing system in a majority of European countries. This overview is presented in Table 3.10 below:

Table 3.10 Comparison of training and licensing among different countries.

Country	Min. age to start Learning	Min. age for probationary licence	Min. age for full Licence	Accompanied driving	Restrictions on learner driver	Restrictions on accompanying lay person	Probationary period and conditions	Mandatory training units		Accident rate (Fatal)	
								Theory (hours)	Practice (hours)	per million pop	Per Million veh.
Denmark	17 and 6 months	18	18	No Practical driving. School lessons only	Driving in traffic during driving. School lessons only	No lay instructor admitted	3 years	22 hours	18 hours	69	193
Czech Rep.	N/I	N/I	18	N/I	N/I	No lay instructor Admitted	N/I	36	34	135	359
France	16	No probationary licence. Full licence issued on passing the practical test.	18	Yes	"A" plates Max. 110/100 km/h on Motorways.	28 years old Full licence for 3 years	-	N/I	N/I	93	189
Germany	17 and 5 months	18	20	No Practical driving. School lessons Only.	Driving in traffic during driving. School lessons Only.	No lay instructor admitted	2 years minimum, can be prolonged to 4 years	28	Pre-licence training only	71	129

Table 3.10 (continued)

Great Britain	17	No probationary licence. Full licence issued on passing the practical Test.	17	Yes	"L" plates. No driving on motorways	21 years old. Full licence for 3 years	2 years	0	0	56	122
Greece	18	N/I	N/I	Yes	N/I	N/I	N/I	20	10	153	422
Iceland	16	17	19	Optional	N/I	24 years old	2 years	18	12	79	124
Luxembourg	17 and 6 months	-	18	Not permitted	N/I	N/I	N/I	16	12	110	165
Netherlands	18	N/I	18	No Practical driving school lessons only.	Driving in traffic during driving school lessons only.	Dual brake pedals	5 years	0	0	50	116
Norway	16	N/I	18	Optional	"L" plates. Learner must have completed mandatory course in Basic Traffic Knowledge	25 years-old Full licence for 5 years	2 years	21	15	56	130
Poland	16	18	N/I	Yes	N/I	Age, non-penalty record, participation in Training	2 years	N/I	N/I	148	476

T able 3.10 (continued)

Sweden	16	N/I	18	Optional	Learner's permit	24 years-old. Full license for 5 years	2 years	N/I	N/I	54	118
Kuwait	17 and 6 months	No probationary licence. Full licence issued on passing the theoretical practical test.	18	Yes. Driving instructor or driving school approved by GTD	Not allowed to drive on motorways	Driving instructor Only	-----	0	0	149	382
Bahrain	N/I	No probationary licence. Full licence issued on passing the practical test.	18	Yes. Driving instructor or driving school approved by GTD	-----	Driving instructor	-----	N/I	22	85	203
Saudi Arabia	17	No probationary licence. Full licence issued on passing the practical test.	18	Yes	-----	-----	-----	N/I	9	189	438

Twisk and Stacey (2007) Table + Kuwait Bahrain and Saudi Arabia road accident statistics + road accident (European commission 2004)

As can be seen from the table above, there are differences between the countries in terms of the age of starting to learn to drive and obtaining a full driving licence. Some begin to learn at the age of 16, such as in Norway, Poland, Sweden, Iceland and France, and some begin at the age of 17 and a half, such as in Denmark, Germany and Luxembourg. In the Netherlands and Greece, the minimum age for starting is 18, but in the U.K., 17 is the earliest age. In a few countries, such as France, there can be a two-year gap between starting to learn to drive and obtaining the full licence. In Denmark, the licence can be obtained at the age of 18 after starting to learn at 17 years and six months. British drivers can start learning at 17 and obtain their licence the same year. Germans can start learning at 17 years and five months, can obtain a probationary licence at 18 and a full licence at 20.

In Kuwait and Saudi Arabia, the minimum age to start learning is 17 and a half and 17 years, respectively. A full licence can be obtained in both those countries as well as in Bahrain at the age of 18. There are no probationary periods in these countries.

In four of the countries reviewed by Twisk and Stacey (2007), young drivers are allowed to be accompanied (before obtaining their full licence) by another licence holder, though there is some variation across these countries as to the age of the person accompanying and years that person has held a licence. Those countries are France, Great Britain, Greece, and Poland. However, in the Czech Republic Denmark, Germany and Netherlands, lessons with a driving school are compulsory. Information on some countries is incomplete. There are varying numbers of years of probationary periods before obtaining a licence. The Netherlands is the only country where a stated requirement is to have dual brake pedals.

In three countries, Great Britain, Netherlands and Kuwait, there are no fixed hours at mandatory training units (theory and practical). The theory units in other countries range from 16 hours to 36 hours, while the practical units range from 9 hours minimum to 34 hours. The Czech Republic has the highest training requirement, and some of it includes first aid and vehicle maintenance. Information was not available for the other countries.

3.1.12.1 Accident probability

It is difficult to compare the driving training and testing systems between countries and their impacts on accident probability, because accident probability does not depend on driver training and testing alone, as is explained below. Consideration of the overall road safety level in a country is based on the combined three Es, Engineering, Enforcement and Education, as stated in section 2.2, since road accidents are caused by many factors. It can be seen from Table 3.10, for example, that although the Czech Republic has the highest number of theoretical and practical training hours, the accident rate per million population and per million vehicles ranked eleventh out of the fifteen countries listed in the table.

However, intuitively, driver training must be important, and some indications can be obtained from research on the impacts of training and licensing systems on accident probability. For example, in 1993, Sweden reduced the minimum age for accompanied persons from 17.5 to 16 years, while the age for the full licence remained at 18. This resulted in an increase in the mean hours of accompanied learning from 47.6 hours to 117.6. As a result, in the two following years, the crash risk of those who had begun practising at 16 was reduced by 40% (Gregersen, 1997; Gregersen *et al*., 2000). On the other hand, a similar initiative undertaken in Norway in 1994 did not reduce crash risk (Sagberg, 2000). Issues such as peer pressure are likely to have played a part as well as basic attitudinal differences, and the nature and character of the driving experience. Kuiken and Twisk (2001) argued that driver training should include not only basic vehicle control skills but also issues like driver self-assessment skills, in order to reduce accident risk. Sagberg (2002) concluded that between 5,000 and 7,000 kilometres are adequate for a significant reduction in crashes after licensing, but that further research was required to prove this estimation. So, time spent on practising, driver self-assessment skills and the amount of kilometres driven is considerable issues in the training of drivers before obtaining a licence.

3.1.13 Cross-country comparisons of driver education systems

Jonsson *et al*. (2003) did a comparative study of driver education systems in some European countries, namely Sweden, Finland, Denmark Norway, Iceland, Germany and U.K. They found that there were three different categories of driver education system (curriculum of driving education and driving-licence test).

The first category consists of a system with little compulsory education, such as in Sweden, or no compulsory education, such as in the U.K., where private lessons are allowed. In this system the main focus is on the theoretical and practical tests, to ensure that drivers reach the minimum standard of driving as specified in the curriculum.

The second category of driving education system contains some compulsory education, with private lessons also allowed. The aim of compulsory education is to ensure that the objectives of driver education are fulfilled, since it is difficult to evaluate all aspects of driving through testing only. Examples of these systems are Finland, Iceland and Norway.

The third category is one in which the entire formal driving education is compulsory and private lessons are not allowed. In this system, drivers are given the experience of driving independently through compulsory education and testing. This compulsory education provides learners with sufficient instruction to ensure that they have the necessary attitudes, knowledge and ability to pass the theoretical and practical tests. This type of education is used in Denmark and Germany. Examples of each of the three categories are given in more detail, below, i.e. the cases of the UK, Finland and Germany.

<u>The UK</u>

Although no mandatory professional training is required before applying for a driving licence in the U.K, 98% of learners have some professional instruction prior to sitting for the test (Jonsson *et al*., 2003).

Applicants in the U.K. must achieve basic competence to pass the driving test, covering the full syllabus. The applicant must have knowledge of the Highway Code and motoring laws, as well as a through understanding of their responsibilities as drivers. This can be evaluated in the theory and practical tests.

The theoretical test:

The theoretical test is divided into two parts: the first part consists of multiple choice questions, where the test is computerized and the learner selects the answer by touching the screen. The 35 multiple choice items have to be answered within 40 minutes and the minimum score to pass this test is 30 (86%). The theory test covers a wide range of topics related to road safety. It is split into 14 topics with almost 1,000 questions in the theory test book. (See Appendix G for the 14 topics).

The second part of the theoretical test is a computerized hazard perception test. This test consists of 14 video clips, each lasting about one minute, which characterise real road scenes and developing hazards of various types. The highest score for each clip is five points. The response rate (measured by the click of the mouse) can lead to higher scores. The pass mark is 44 out of 75 (59%). (One of the clips contains two hazards.)

The practical test:

Before applying for a practical test, the applicant must pass the theoretical test. The applicant is encouraged to have some practical training lessons with an approved driving instructor before taking the test. The practical test lasts for approximately 40 minutes, starting with an eyesight test. After passing the eyesight test, the examiner will ask the applicant to perform two vehicle safety checks, then the applicant is required to drive around one of the driving test routes, on which a range of different driving situations are involved, such as three reversing manoeuvres (see Appendix G for the list of the practical test items). In order to pass the driving test, the applicant must not have committed any serious fault and no more than 15 less serious ones (minor errors).

After passing the test, a two-year probationary period starts. Those accumulating six or more penalty points during that period will have their licence revoked and the applicant has to re-take a test.

Finland

The Finnish curriculum

Handling the vehicle is the first priority, so that subsequently the learner can focus on other aspects. Lessons can be with an official driving school or with a private instructor, but dual controls are compulsory.

The first stage of learning to drive involves attaining the necessary ability, knowledge and attitudes, particularly towards other road users. It is divided into four parts: the driver in traffic, driving in traffic situations, independent driving and driving under difficult conditions. Each part comprises both theoretical and practical education.

(1) The driver in traffic

The learner is introduced to the vehicle, to driver education in general, and to the traffic system and general traffic environment. More is taught about traffic safety and how to reduce environmental pollution, before moving on to basic vehicle handling. There is a formal handling test. After the theory lessons, practical exercises are performed in a quiet area with no or hardly any traffic. The learner is taught about preparation for driving, starting, stopping and how to adjust speed and the direction of the vehicle. The student's handling ability is evaluated at the end of the handling education. This part introduces the learner to safe and environmentally friendly ways of driving.

(2) Driving in traffic situations

Under the supervision of the instructor, students should be able to control their driving and the vehicle in common situations that may occur within built-up areas. There are six theory lessons on road user interaction, driving in built-up areas, exiting from traffic and negotiating crossroads. The student practises how to enter and exit from traffic as well as manoeuvres like changing lanes. Before students move on to the next part, they must satisfy a number of criteria: the student has to be able to handle the car within a built-up area, negotiate traffic lights, interact with other road users, and make judgements about traffic situations.

(3)Independent driving

The learner is introduced to roads with higher speed limits, but with attention to risk and fuel consumption. By now, the learner is getting ready for the practical driving test. In addition, there are eight theory lessons, including subjects such as the planning of a driving route and the avoidance of risks, speed dependent on situation, driving on roads, overtaking, the human being as a driver, and what to do at the scene of a traffic accident. There are at least six opportunities to practise driving on roads.

(4) Driving under difficult conditions

The learner is introduced to driving on slippery surfaces as well as driving after dark, but the focus is at first on demonstration rather than training. For the practical education, there are two sessions containing both demonstration and training on a driving course.

There is a 30-minute course on driving after dark. During the practical exercises in driving after dark, the student should understand the dangers caused by poor visibility, be observant, adjust speed and put on the lights. There are two practical driving sessions before taking the driving test, in a secluded place. If the instructor considers the student ready after this part, he or she is allowed to undergo the driving test.

The middle stage

The middle stage starts after a preliminary practical driving test. During this stage, learners are supposed to drive independently and to self-evaluate themselves as drivers. If an accident or a risky situation occurs, the student is supposed to analyse the cause and consider what to do in order to avoid it in the future.

The second stage

In the second stage, the student's independent driving practice in different traffic environments should be the starting point (AKE, 1998). Special focus is given to preventive and environmental ways of driving. The theoretical part contains four lessons about risks in traffic and self-assessment. Two practical assessments are also made in traffic and six on a driving course. A licence can then be issued.

The theoretical test

There is a computerised theoretical test on completion of the first stage (AKE, 2002). There are ten written multiple-choice items and 50 picture interpretation items (see Appendix G). The time limit for each question is 30 seconds and ten seconds for picture interpretations. The pass mark for the questions and picture interpretations is 70% and 84%, respectively).

The practical test

At the start of the practical test, the applicant has to assume a correct driving posture, adjust the temperature and the mirrors and attach the seat belt. Examination is made of vehicle handling, control of the traffic situation, consideration for pedestrians, cyclists, moped riders, etc., methodical but flexible action, risk awareness and economy of driving (Appendix G).

Germany

The German curriculum

Applicants for a driving licence are examined in a practical test and a theoretical test approved by the authorities. Private driving lessons are not allowed. After the tests, a probationary licence, valid for two years, is issued. Offences in that period entail attendance at a number of complementary educational seminars, which involve a 30-minute driving test.

General driving education

Learners are expected to achieve the following:

1- Ability to control the vehicle generally and under difficult traffic conditions;

2- Knowledge and understanding of traffic regulations and their application;

3- Ability to perceive and control danger;

4- Awareness of the effects of driving errors and self-assessment;

5- Readiness and ability to adopt considerate traffic behaviour and control of emotions;

6- Responsibility for life, health, the environment and property.

The general course amounts to at least 12 double lessons of 90 minutes each.

Theoretical education

Theoretical education follows a curriculum set up by the individual driving school. The student is taught about what constitutes good health, including physical ability, sight and general fitness, or physical defects and illnesses, the dangers of alcohol and drug usage, medication, and so on. Psychological and social conditions and attitudes are also considered, especially aggression, fear, stress, and so on. The self-image of the driver, driving ideals and different driver roles are also discussed, as are the law, regulations for different vehicle classes, insurance and vehicle registration, and how to perform safety checks.

Further discussed are different traffic systems, routes and their use, as well as hazard perception when driving on different routes.

The student is taught about rights of way, behaviour and traffic regulations. Within this area, special traffic locations, such as crossroads are discussed. The student is also informed of the necessity to give way where appropriate and about different road signs and signals. The student is taught how to cross a railway and a pedestrian crossing in a safe way. The student is taught about other road users, public transport, heavy goods vehicles, cyclists, children and the elderly. The student is taught about speed, stopping distances and the environment. Learners are taught about manoeuvring and traffic observation. They are taught how to start, stop, turn and reverse the vehicle. Students are taught about the consequences of violating traffic regulations.

Practical training follows the theoretical course, and extends over 12 lessons of 45 minutes each, five of which are on public roads, four on motorways and three after dark. The instructor makes an evaluation before proceeding to the formal tests.

<u>The theoretical test</u>

The theoretical test can be taken at age 17 years and 9 months (BVF, 2002b). Applicants should show that they have the ability to handle the vehicle correctly, with awareness of hazards and the right attitude and behaviour. The test contains 30 multiple-choice items with a total score of 110. The test-taker fills in the answers using a pencil. 101 points (92 %) is the pass mark.

<u>The practical test</u>

Applicants should show that they have the necessary abilities and technical knowledge to drive in an environmentally, energy-saving way (BVF, 2002c). The test is taken both within and outside a built-up area and if possible on a motorway. Roads with light traffic are to be used only to test speed adjustment. The instructor is also in the vehicle. (Both theoretical and practical items in Appendix G).

There are two compulsory driving tasks: reverse parking into an eight-metre gap and moving into a parking space from a position between two parallel vehicles. A further task is selected by the examiner from the following: reverse turning, hill start and emergency braking. Each task may be repeated once. If not successful by the second attempt, the applicant has failed the task. The examiner records any mistakes made by the applicant. The applicant receives a report on the test.

The U.S.A

Each individual state in the United States, including Washington, D.C., has a separate department, called the Department of Motor Vehicles (DMV), responsible for issuing driving licences. The licences in each of the fifty states are different (some with photos, some produced like credit cards). A licence is valid in any state. The minimum age to obtain a licence varies from 14 years and 3 months in South Dakota to 17 in New Jersey.

In most states, newly licensed teenage drivers graduate from "Provisional Driver", to "Junior Operator" or "Probationary Driver", according to local "Graduated Driver Laws" (GDLs). The licences carry restrictions, such as on the carriage and number of passengers, and a curfew for young drivers (usually around midnight, but as early as 9pm in New York). Graduated license holders must always adhere to the restrictions of their home state regardless of where they are driving. Drivers who are 18 or older when they first apply for a licence are not subject to the graduated licensing laws (Anon, n.d. b) www.en.wikipedia.org/wiki/Driver's_license_in_theUnited States, accessed 11/09/2008).

Generally the driver licensing law considers three levels: learner, intermediate, and full. There are three main constraints on drivers at learner level:

Learner level constraints on drivers:

1- They should be supervised by a parent, guardian, or other licensed adult
aged 21 or older.

2- A seat belt must be worn at all times by all occupants of the vehicle.

3- The novice driver should remain free of convictions for at least 6 consecutive months prior to graduating to the intermediate level.

Intermediate level constraints on drivers:

1- Intermediate drivers should be supervised, generally between the hours of 10 p.m. and 5 a.m., a restriction which is in parallel with the curfew for younger drivers.
2- Seat belts should be worn by all vehicle occupants
3- The driving record should be free of convictions for at least 6 consecutive months before graduating to Full License level

Full licence level constraints on drivers:

1- All drivers must adhere to all current traffic laws (and this applies at all levels) (Foss and Evenson, 1999).

Driving education:

Drivers under 18 are usually required to attend a comprehensive Drivers Education program, either at their high school or at a professional driving school, and take a certain number of behind-the-wheel lessons with a certified driving instructor before applying for a licence. Some states like New York also require new adult drivers to attend some form of driver's education before applying for a licence.

Driver education programs are available state-wide to students, adults and-out-of school youths. Public and private school programmers are approved by the Department of Education. Practical training schools follow the same course content and are licensed by the DMV.

The programs in all states are similar, but with some minor differences. Here is the example from Virginia (DMV, 2006). There are 36 classroom periods, with components on alcohol and drug abuse awareness, aggressive driving, distracted driving, motorcycle awareness and organ and tissue donation awareness. It must include 14 in-car instruction sessions – 7 periods of observation and 7 periods of driving.

The driver receives a certificate on completion, a copy of which is sent to the school instructor and to the DMV, who will issue the permanent driving licence.

Testing

Theory test:

The theory test (example also taken from Virginia) consists of two parts. The first is about knowledge of traffic signs, motor vehicle laws, and safe driving techniques. Exam questions can be studied from the driver's manual in each state. All ten traffic sign questions in the first part must be answered correctly before taking the 25 multiple choice questions of the second (general knowledge) part. The pass mark for the second part is 20 out of 25 (80%). Both parts are computerised.

Practical test:

The examiner for the driving test, which normally lasts 10-15 minutes, is a DMV representative. A major criterion is driving carefully and safely (see Appendix G). The examiner will assess the new driver's ability to drive safely over a predetermined route. The route will contain a variety of traffic situations. At all times during the driving test, new drivers must operate their vehicles in a safe and responsible manner, obeying all traffic laws. The examiner observes and attributes a score for specific manoeuvres, as well as general driving behaviour. The pass mark is normally 70 out of a 100.

Japan

All the instructions regarding the driving test in Japan are from the (Anon, 2007). (Japan Driver's License website www.japandriverslicense.com.

The Japanese test involves a tool that simulates on-screen the actual course on which the practical road skills test will be taken. It provides clear instructions on what to do during the test, along with key points for passing as well as possible reasons for failure. The new driver will be able to run through the actual test course online before the driving test in order to memorize all sections of the course.

Although the test course simulation is considered as adequate preparation for the driving test, some applicants like to take the option of driving on the test course before the exam. One hour is allowed for that, which enables the applicant to make around 5 or 6 circuits of the course, and gives confidence to the person taking the test.

The theoretical test

The written test is not particularly difficult and consists of 10 True or False questions. The pass mark is 7 out of 10. The theory test is available in English, but instructions about the test may be only in Japanese (depending on the city where the test is taken). The main point is to know the Japanese words for True and False.

Again depending on the test centre, the theory test will either be paper based (Yokohama & Nagoya) and written in a classroom environment, or touch screen computer based (Tokyo). It is suggested that new drivers read a copy of the Japan Automobile Federation's, English Rules of the Road book. However, this is not felt to be necessary for most people, as the team that designed the site did not study for the test and passed at the first attempt.

The practical test

The practical test is held inside the testing centre. The examiner instructs the new driver to go through the circuit. When the examiner says that the test is over, the driver should return to the start point directly without finishing the course. The examiner will stop the car (using a separate brake) and make sure you have understood his or her instruction. If a new driver makes a "major" mistake (for example, driving on the wrong side of the road or driving down the middle of a double width lane), a failure will be notified immediately. The examiner will check for the following items:

1- Adjusting the seat belt and fastening the seat belt.
2- Looking in the mirrors, checking over the shoulder for blind spots and using the indicator before turning right or left and changing lane.
3- Stopping with the front bumper behind the line at a traffic light or stop sign (stopping beyond the line or too soon is considered a failure).
4- Not hitting the curb when turning into a narrow street or on an S-bend. This is also considered a failure.

3.1.13.1 Comparison of accident rates

It appears that each of these five countries (the UK, Finland, Germany, the USA and Japan) has a somewhat different system in terms of driving education and testing. However, Kuwait is extremely different from these countries in so far as hardly any of the items applied in the testing systems of those countries are actually applied in Kuwait (see section 3.1.11.1). Furthermore, data on accidents per vehicle-kilometre are unavailable in Kuwait, so it is difficult to make comparisons on testing systems between Kuwait and these countries from this point of view.

The theoretical test in Finland contains more items than the tests in the other countries. It consists of 10 multiple-choice items and 50 picture interpretations, while the UK and USA tests have 35 items, Germany 30 and Japan only 10 items, but the UK theoretical test has an additional hazard perception test.

The overall test lasts 40 minutes and 30 minutes in the UK and in Finland, respectively. In addition to the overall time limit on the test, Finland also has a time limit for each item. The time limit for the multiple-choice items is 30 seconds, but for the picture interpretations it is only 10 seconds. There is no official time limit in Germany, the USA or Japan.

As regards the practical test, Germany and the UK place greater emphasis on the number of manoeuvres tested. In the UK, the test contains certain elements on fixed test routes. Germany, Finland and USA have a similar system covering different traffic situations and manoeuvres, while in Japan the test is held inside a test centre.

Driving education is not compulsory in the UK or Japan, and the practical test is considered as the most important way to assess whether the learner has reached the required level of competence. However, the theoretical and practical tests in the UK are more comprehensive than in Japan. In UK, the theoretical test has two parts. The first part covers several items (14 in total, see Appendix G), and requires the learner to study around 1,000 questions. The second part is the hazard perception test. The practical test lasts about 40 minutes on a test route where a range of different driving situations can be encountered (23 Items, see Appendix G). In contrast, the Japanese theoretical test is very easy, as described earlier, and the practical test at a test centre covers only a limited number of items (see Appendix G). This could be one reason why the accident rate in the

UK is lower (7.5 fatalities per 100,000 vehicle-kilometres) than that in Japan (11.2 fatalities per 100,000 vehicle-kilometre).

Some countries, like the USA, have little compulsory education, while others, like Finland, Germany have absolutely compulsory education. In the USA, drivers under 18 are usually required to attend a driver's education program and are subject to the Graduated Driver Laws (GDLs), while in Finland and Germany, drivers must have driving education lessons to ensure that they have the knowledge and attitude required before taking the test. Just as the theory test in the USA covered less items than are Finnish or German ones (see appendix G), the practical test is also shorter in the USA (10-15 minutes) than in Finland or Germany (at least 30 minutes), where there are more chances for the examiner to detect driver mistakes.

Although Finland and Germany both have compulsory driver education, Finland has a better accident rate (about the same as the UK, 7.6 fatalities per 100,000 vehicle-kilometres (see Table 3.11) than Germany (9.7 fatalities per 100,000 vehicle kilometres). This could be due to the fact that in Germany there is no general speed limit on motorways, where 12% of traffic fatalities occur (ETSC, 2006). Although the German driving education and testing systems are more comprehensive than in the USA, the accident rate in the US is considerably less (9.4 fatalities per 100,000 vehicle-kilometres). This could be because of the effect of the Graduated Driver Laws (GDLs) in the USA, which involve restriction criteria on young drivers. Japan appears to have the highest accident rate, and has no compulsory education and an apparently easier driving test.

Table 3.11 Fatalities per billion vehicle-kilometres in the five countries

Country	Fatalities per billion vehicle-kilometres
United Kingdom	7.5
Japan	11.2
Germany	9.7
USA	9.4
Finland	7.6

Source : Anon, 2004 http://www.driveandstayalive.com/info%20section/statistics/stats-multicountry-percapita-2004.htm

3.1.14 Comparative assessment of driving tests across other Arabian Gulf countries.

The research for this thesis has been able to collect data from various sources, leading to various types of statistical analysis. What is much more difficult to achieve is a comparative assessment of driving training and testing in Kuwait and other Gulf countries. This is mainly because of the lack of information in these countries. As was suggested in the previous section, there are many serious inadequacies in the Kuwaiti system of training and testing, and it cannot be expected that matters are very different in other Gulf countries, due to the similarities that exist between them. (One significant point of difference is that there are no female licence holders in Saudi Arabia.) Assessments have been carried out by the Transport Research Laboratory (TRL) in, for example, Riyadh (the capital of Saudi Arabia) (TRL, 2003) and Bahrain (TRL, 2006), but the results remain unpublished. The results have been used and the approach adopted, as no other published material is available to the author.

The assessments in Saudi Arabia and Bahrain are not subject to public scrutiny. Training and testing organisations are small state-controlled units who display little interest in issues of accountability. As well as being unpublished, information given to the author was to be treated with discretion. Current assessment forms (identical information for the two centres) were provided for Riyadh and Bahrain.

The author had to make his own assessment for Kuwait. The assessment format is shown in tables 3.12, 3.13 and 3.14, along with the weighting and scoring system used for Riyadh and Bahrain. The format is applied to Kuwait and assessment was made by the author himself. This is the approach that was used by TRL in Saudi Arabia and Bahrain, and is based on a personal assessment, albeit by an expert in the field. The same approach has been applied to Kuwait. The assessments are based mainly on value judgements and this should be borne in mind when results for the three countries are compared. The main contribution of the work on this comparative assessment is to highlight the relatively poor state of driving training and testing affairs in these countries. Some comments have been added to sections of the assessment form to highlight how subjective these assessments are.

To assess driving training and testing in Kuwait, performance indicators for each driving training and test category were developed. The three categories are: (1) Driving training (Table 3.12), (2) Driving information (Table 3.13) and (3) Driving testing (Table 3.14). In this way, the situation concerning driver training and testing in Kuwait can be put into perspective. Each category scores a maximum of 100. The categories have between two and four sections, and each section has up to four sub-sections. The sub-sections are weighted relative to their importance in the overall driving training and testing context. The score achieved is based on an assessment of the quality and quantity of any activity currently being carried out in Kuwait. Only scores over 80 out of a hundred are seen as indicative of satisfactory performance (Table 3.17).

The scores for each sub-section are given as a percentage. For example, the category 'driving training' scores a maximum of 100 points. The three sections are weighted 20-50-30. Details of how the scores were attributed in Tables 3.12 to 3.14 below are given in Appendix E.

Table 3.12 Assessment of driving training methods in Kuwait (category 1)

	Maximum score	Actual score given	Percentage awarded
(i) Trainee and new drivers clearly identifiable and Restricted	**20**	**8**	**40%**
(a) Provisional licence only awarded after a knowledge test	4	0	0
(b) Distinctive plates for learners and new drivers	8	4	50
(c) Speed restrictions for learners and new drivers	8	4	50
(ii) Driving schools provide good training for instructors	**50**	**12.75**	**25.5**
(a) Driving instructors trained, tested, approved and monitored	25	6.5	25
(b) Instructor tests assess teaching ability	10	2.5	25
(c) Instructor's manual setting out syllabus and methods	15	3.75	25
(iii)Tuition given in real traffic conditions	**30**	**5.25**	**17.5**
(a) Early tuition on quiet roads	6	3	50
(b) Later tuition includes rural, night driving, overtaking, parking and emergency actions	12	0	0
(c) Advanced course available with bonus schemes	10	0	0
(d) Observed good driver behaviour	9	2.25	25

Comments on the above table

Whilst it is true that distinctive plates are available for learners and new drivers, it might be that driving school learners or companies use them too. On the other hand, drivers who do not have official training may not use them at all.

Private discussions with driving instructors in three different companies revealed that they had been hired with little or no training or testing. Also, although, instructors had to have been approved by the GTD, they were not subsequently monitored, and would only come to the attention of the GTD if unacceptable behaviour by the instructor such as drinking and driving were to be reported. The focus of the teaching appeared to be on enabling the pupils to pass the driving test, rather than providing comprehensive instruction, and the available manual, syllabus and approach material was not used.

Table 3.13 Assessment on driving information methods in Kuwait (category 2)

	Maximum score	Actual score given	Percentage awarded
(i) Information available on driving rules procedures and law	**80**	**20**	**25**
(a) Highway code	48	12	25
(b) Driving Manual	24	6	25
(c) Leaflets on key topics	8	2	25
(ii) Information available on driving test and licence Procedures	**20**	**0**	**0**
(a) Leaflets available	20	0	0

Comment on the above table

The Highway Code is a small booklet containing a page advising "Be aware, ready, visible and patient while you are driving, to increase your chance of staying alive, followed by 15 pages of commonly understood road signs and road markings such as Stop and Road works ahead. Candidates have a simple written test on this document.

Table 3.14 Driving testing methods in Kuwait (category 3)

	Maximum score	Actual score given	Percentage awarded
(i) Driving test examines all key areas related to road Safety	**40**	**10**	**25**
(a) Physical/medical fitness assessed	8	4	50
(b) Knowledge of highway code assessed	8	2	25
(c) Control skills assessed on/off road	8	4	50
(d) Procedural advanced skill assessed on road	16	0	0
(ii) Driving test is conducted in uniform and objective Way	**30**	**10.5**	**35**
(a) Examiners tested, trained and monitored	12	6	50
(b) Examiners use form to record faults	9	4.5	50
(c) On-road routes standardized to include key manoeuvres and hazards	9	0	0
(iii) More rigorous tests for professional drivers	**20**	**6.5**	**32.5**
(a) On-road tests longer than for car drivers	4	1	25
(b) On-road tests use appropriate class of vehicle	10	2.5	25
(c) Knowledge test includes extra items appropriate to Profession	6	3	50
(iv) Feedback given to failed drivers	**10**	**5**	**50**
(a) Written statement of reasons for failure	10	5	50

Comments on the above table

The testing of knowledge on the highway code lacks rigour, as indicated in the comments on Table 3.13. Physical fitness tests comprised only blood and eye tests. The level of monitoring of examiners is minimal. The examiners only need to have a public driving licence. They are a division of the police who wear a military style of uniform.

There might be reasons given for failure, but testing is anyway incomplete and inadequate. The official driving test has 13 categories on which a driver should be examined (see Appendix F). However, the examiner only checks for a couple of those items, which makes for an incomplete test (Section 3.1.11.1). Also, the time allotted for the test is only about five minutes. This is an insufficient amount of time to determine whether or not a driver is suitably competent. It seems that, of the 13 items for testing, the examiners tend to focus on only one particular skill, that of reverse parking.

The author had the opportunity to visit a testing centre, for the purpose of assessing procedures. Interviews were conducted with personnel inside the centre. The low quality and rigour of the testing procedures is quite commonly known. However, to avoid subjectivity, the author conducted observation and interviews at the test centre as well as among drivers in Kuwait (three instructors in a private company and two other personnel).

The observation at the test centre took place on November 7th in 2007, and lasted a full hour. Each test takes only about 5 minutes, with a five-minute interval between each cycle of testing. As there are three test cars on different parts of the track at the same time, the author was able to observe the procedures in about 18 tests. (The observation was described in section 3.1.11.1)

The aim of the interviews was to confirm the author's opinion and the observation. Three instructors in different private companies were interviewed, as well as two of the personnel at the test centre. In addition, five drivers who passed the test on the day of observation, as well as ten new licence holders encountered in daily life were interviewed.

The interviews with the instructors and test centre personnel lasted about 15 minutes each, and were semi- structured, to cover the points in Tables 3.12 to 3.14. The interviews with fifteen drivers referred to above were much shorter, unstructured and informal. The purpose was to establish whether the testing system is rigorous enough. There was consensus amongst all interviewees (including instructors and test centre personnel who are responsible for applicant drivers) that the test is too easy. This was also confirmed in the questionnaire (see Table 8.9). Out of 1,528 respondents, 493 added further comments at the end of the questionnaire. 13.68% of the comments (n=148) indicated that obtaining a licence is easy (this figure included obtaining a licence through irregular channels), but the main implication is that the test is too easy.

Table 3.15 Summary for Driver Training and Testing scores in Kuwait

	Maximum score	Score	Percentage awarded
Driving Training and Testing	**100**	**27.2**	**27.2**
Driver training	40	10.4	26
Driver testing	40	12.8	32
Driver information	20	4	25

Summary for Driver Training and Testing scores in Kuwait can be seen in Table 3.15. Permission was granted only to publish summary results for Riyadh and Bahrain. The summary results for the three countries are presented in the Table 3.16 below.

Table 3.16 Summary for Driver Training and Testing scores in three Gulf countries

	Kuwait	Riyadh	Bahrain
Training	26%	51%	40%
Testing	32%	67.5%	50%
Information	25%	43.5%	25%
Percentage awarded	27.2%	56.1%	41%

The scores from 0 to 100 are banded and labelled with descriptors (see Table 3.17 below).

Table 3.17 Performance indicator for driving training and testing

Score	Current activity achievement
0	No activity or completely ineffective
1-10	Some activity but amount or quality insufficient for any safety impact
21-40	Minor activity evident but major problems exist which considerably restrict impact
41-60	More activity but there are still some major drawbacks which reduce impact
61-80	Some effective activity is evident but there is still some significant improvement to be made
81-100	Activity is clearly effective and up to the standards found in the best countries

According to the table, Kuwait falls into a category where some testing activity is evident, but there are indications of major (serious) problems. Riyadh and Bahrain are in a higher band, suggesting that their approach to training and testing is somewhat better. To take the case of Riyadh, it too has only one motoring school (the Dallah School). It probably gained points in the TRL assessment for having, for example, a simulator and driver perception equipment. The school has a higher profile and amenities. This does not mean, however, that drivers who pass tests with this school emerge as better drivers than those in Kuwait. The fatality rates (per 1000 vehicles) in Riyadh are higher than Kuwait and considerably better in Bahrain (see Table 3.18).

Table 3.18 Fatality rates for the three Gulf countries.

Country	Fatalities	Number of vehicles	Fatality rate (per 1000 vehicle)
Bahrain	70	294,869	0.24
Kuwait	407	1,043,879	0.39
Saudi Arabia (Riyadh)	453	900,000	0.5

* Average fatality and number of vehicles from 2003 to 2005

To conclude, the status of driving training and testing in the Gulf and their assessment is of an alarmingly low standard. Considerable efforts need to be made in order to force change towards improving road safety.

3.1.15 Traffic law enforcement in Kuwait

As has been stated before (in Chapter 2), traffic law enforcement is a rapid way to influence driver behaviour and reduce accidents, if applied strictly (ETSC, 2005). However, in practice, laws must be seen to be appropriate for the current road safety situation. If laws are seen to be inappropriate, widespread disobedience may lead to them being repealed.

New traffic regulations were recently passed by the National Assembly in Kuwait (June 2001) introducing stiffer penalties for offences with high risk associated, such as crossing red lights, speeding or driving under the influence of alcohol or narcotics, and for repeat offences. GTD is responsible for traffic law enforcement. The Ministry of the Interior encourages the payment of fines to the GTD to avoid the cost of court hearings.

Operating a vehicle under the influence of alcohol or drugs is punishable by up to one year in prison and/or a KD 500 fine. The court can also withdraw a driving licence in the case of repeated offences.

Reckless driving, driving without a valid driving licence or driving a vehicle not listed on the driving licence is punishable by a KD 100 fine and/or one month in jail. Out of court settlement is possible after the payment of a KD 30 fine.

Passing a red light is punishable by up to three months in jail and/or a KD 300 fine. Speeding, road racing and driving on the wrong side of the road are punishable by a fine of up to KD 100. For an out-of-court settlement, the violator will have to pay a KD 50 fine.

Failure to fasten the seat belt, failure to produce a driver's licence or the vehicle's log book upon request by traffic police is punishable by a fine of up to KD 15. An out-of-court settlement is possible after payment of a fine of KD 10.

There are two types of monetary penalties, settlement and fines imposed by the court. Settlement refers to fines that may be paid without going to court. Out-of-court settlements must be made within 60 days of committing the offence or from the date of notification. If this time limit is exceeded then the offender must pay the minimum court fine in settlement, unless he decides to go to court (article 41: Kuwait Traffic Law).

Out-of-court settlement is not acceptable in certain circumstances, and the matter must go to court, where the penalties are more onerous. If passing a red light or exceeding the speed limit results in death or serious injury, out-of-court settlement is not allowed and the driver is liable to a court fine of at least KD1,000 and a jail term of one to two years. If these offences are carried out under the influence of alcohol or drugs, the jail-term is two to three years.

A points system has also been introduced. It is a record of offences over a period of one year. Accumulated points may lead to suspension of the driving licence for up to one year or revocation of the licence completely, requiring drivers to pass a driving test again. The current points system for traffic offences became effective from October 1, 2001.

Four points are recorded for passing a red light, exceeding the speed limit, driving the vehicle in the opposite direction to the traffic flow or reckless driving. Three points are recorded for driving a vehicle other than the type allowed on the driver's licence, driving a vehicle with an expired or suspended registration, using a vehicle for racing without a permit, using a vehicle to commit immoral acts, driving a vehicle with no licence or with a tampered licence plate, or using false information to obtain a licence or car registration documents.

Two points are recorded for using a private vehicle to ferry passengers for money, deliberately obstructing traffic, driving a vehicle with malfunctioning brakes or handing over the vehicle to someone without a valid driving licence. One point is recorded for driving a vehicle with unclear or illegible licence plates, driving a vehicle with a missing plate, or making any changes to the shape and colour of the plates, driving with an expired car registration, failure to produce the driving licence or log book, operating a vehicle producing excessive noise or smoke or with insecure cargo or faulty tyres

A driver who accumulates 14 points faces having his licence suspended for three months for the first time. For the next 12 points, the driving licence is suspended for six months and for nine months to a year for the next 10 and 8 points respectively.

For the next six points, the fifth time, the driving licence is revoked and the driver must apply for a new driving licence and take the driving test again.

3.1.15.1 Applying the traffic laws in practice

As can be seen from the previous section, traffic law enforcement is comprehensive, but is the law applied seriously? In fact, the law is not so strict, and the following weaknesses may still be observed. Drivers may not feel much of a disincentive to commit violations if they can settle out of court. Furthermore, the doubling of fines for repeated dangerous offences recommended in article 40 (punishment) is often neglected. The points system has not until now been applied seriously, although it is approved by law. That is because some traffic department officials may show too much leniency.

A further weakness in enforcement is that there is no extra charge for late payment of fines. Fines that can be paid out-of-court need only be settled before the date of the annual vehicle inspection. In addition, brand new vehicles do not require inspection for 3 years from the date of purchase. The deadline for payment is within 60 days of notification, but this is not strictly applied.

Car insurance is cheap, 19 KD (annually for third party), and there is no rise in premium after an accident. There is, to date, no law prohibiting the use of a mobile phone while driving. A retest can be applied for by drivers, who have committed serious or dangerous offences, but cases of reapplication are rare, and drivers continue to drive anyway. This was observed by the author in Kuwait but it was also confirmed by interviewees (instructors in three different companies).

3.1.16 Comparison of penalty point systems across different countries.

Different countries have different traffic offence controls. Some countries impose low fines, while offending in other countries can be very costly. Some countries impose only a fixed fine. Some but not all countries may have a system of points on the licence. Finland is an example of a country where a day fine system is in place, whereby the level of the fine is dependent on income, as discussed in section (5.6.1.3). A points system is in place in the UK, Ireland, Japan, Singapore, and Kuwait.

The penalty point system is one in which the licensing authority issues points to drivers following a road traffic offence. Major offences may lead to more points being issued. A certain number of points over a given period of time can lead to suspension or revocation of the driving licence.

The penalty points system is able to significantly reduce accidents, especially when they are combined with other tools, such as warning letters and licence suspension (Elvik and Vaa, 2004).

Tables 3.19 to 3.23 show typical traffic offences, with associated fines and points, such as careless driving, speeding, failure to stop at traffic lights, alcohol and mobile phone use in the UK (Anon, 2008 a) (www.motorlawyers.co.uk/ offences/ penalty_ points _system.htm, accessed 21/09/2008), Ireland (Tracey, 2007) (www.tracey solicitors .ie/ penalty-points.html (accessed 21/09/2008), Japan (Anon,2008 c) (www .pref. ibaraki .jp/ bu kyoku/ seikan/kokuko/ e-ibaraki, accessed 21/09/2008), Singapore (Anon,2005) (www .xpatxp erience.com/vehicles/Singapore_traffic_rules.shtml, accessed 21/09/2008) and Kuwait (Kuwaiti Ministry of the Interior, 2002).

In the UK the accumulation of 6 points within the first two years of holding a full licence leads to revocation of the licence, whilst reaching 12 points inside three years normally results in a ban. It can be seen from Table 3.19 that 3-9 points will be added and a fine of £200-800 imposed for careless driving, while 3-6 points are added with a £60 fine for speeding. In some circumstances, the fine can go up to £2,500 in court for serious motorway offences. Traffic light offences incur 3 points and a £60 fine, but in court this can go up as high as £1,000, subject to a means test. Drink driving incurs 3-11 points, a mandatory 12-month disqualification for the first offence, a 3-year ban for a second offence within 10 years and a fine of up to £5,000 and/or 6 months imprisonment. Using a mobile phone while driving incurs 3 points with a £60 fixed penalty and up to £25,000 for bus, coach or heavy vehicle drivers. In the UK, points can be waived in some cases if a car driver is prepared to pay for and attend a driver awareness programme (a three-hour seminar costing £74).

Table 3.19 Points and fines in the UK

UK	Points	
Careless Driving	3-9	£200–£800 but subject to a theoretical maximum of £2,500.(ban discretionary)
Speed	3-6	*Attending a speed awareness course (at the discretion of the Police) * Accepting a Fixed Penalty of 3 points and £60 fine; * For more serious offences, or disputed cases, attending Court. Current maximum fines are up to £2,500 for motorway offences and up to £1,000 for offences on any other road. 40% over the speed limit risks of an immediate disqualification.
Traffic light offences	3	Fixed Penalty or Court. Currently, the fine on a Fixed Penalty is £60, at Court it is means tested but limited to £1,000.
Driving while unfit through drink or drugs or with excess alcohol	3-11	Mandatory 12 month disqualification for the first offence 3 years for second offence within 10 years Fine of up to £5,000and/or 6 months imprisonment
Use of hand–held mobile phone	3	£60 Fixed Penalty Notice, but in Court, the fine can be as much as £1,000 or £2,500 bus, coach or heavy goods vehicle drivers.
Dangerous driving	3–11	Ban for 2 years further driving test

Anon, 2008 a http:/www.motorlawyers.co.uk/offences/penalty_points_system.htm, accessed 21/09/2008)

In Ireland, a driver who accumulates 12 points within a three-year period will automatically lose his or her driving licence for 6 months, those points being removed at the end of the 6-month period. The points and fine system is detailed in Table 3.20. Careless driving incurs 5 penalty points and a mandatory court appearance. Drivers may also be fined up to a maximum of £1,190, or given a prison sentence up to a maximum of 3 months. Speeding offences incur 2-4 points with a fixed fine of £64, if paid promptly or £95 if paid after 28 days, and up to £635 in court. Failure to respect traffic lights incurs 2-5 points, with a fixed fine of £64 to £95 (as with speeding) and very recently (September, 2008), using mobile phone became a driving offence, incurring 2 penalty points and a fixed fine of £64 or £95.

Table 3.20 Points and fines in Ireland

Ireland				
Offence	Penalty pints on payment	Penalty points on conviction	Fixed Charge	
			Amount paid in 28 days	Amount paid in next 28 days
Driving carelessly		5	Court fine: This is defined as '*driving a vehicle in a public place without due care and attention*'. It involves a mandatory court appearance. Drivers may also be fined up to a maximum of 1,500 euros, or given a prison sentence to a maximum of 3 months or both.	
Speeding	2	4	€ 80	€ 120 A driver may challenge the speeding violation in Court. However, if found guilty, four penalty points will be given a fine of up to €800 for a first offence.
Failure to obey traffic light	2	5	€ 80	€ 120
Driving a vehicle when unfit		3	Court fine	
Using a mobile phone	2		€60	€90 The fixed charge will increase to €90 and if not paid within 56 days and up to €2,000 for non-payment.

Anon, 2006 www.transport.ie/upload/general/7262-0.pdf (accessed 21/09/2008).

The regulations in Japan are very different to those in European countries and the fines and penalties can be very high, as shown in Table 3.21. Drivers who accumulate 15 points in the first 3 years will have their licences revoked. 6-14 points incur suspensions lasting from 30 to 180 days. Reaching 15 points leads to a 1-4 year ban and a re-test. These suspensions and bans depend on the seriousness of the offences. The penalty points and fines are detailed in Table 3.21 below:

Table 3.21 Points and fines in Japan

Japan					
Type of violation		Demerit points			Penalty
			BAC 0.03	BAC 0.05	
Dangerous driving		25			2 years Jail 500,000
Speeding	50km or more over	12	13	19	Court
	40km–50km	6	9	16	Court
	(Expressway) 35km–40km	6 (3)	9 (8)	16 (15)	-35,000
	(Expressway) 30km–35km	6 (3)	9 (8)	16 (15)	-25,000
	25km–30km	3	8	15	18,000
	20km–25km	2	7	14	15,000
	15km–20km	1	7	14	12,000
	15km or under	1	7	14	9,000
Ignoring traffic signals	Red light	2	7	14	9,000
Driving under the influence of drugs			6	13	2 years Jail 300,000
Use of mobile phone while driving		1	7	14	6,000

Anon 2008 c, www.pref.ibaraki.jp/bukyoku/seikan/kokuko/e-ibaraki (accessed 21/09/08).

Dangerous driving incurs 25 penalty points, an immediate ban, two years in jail or a £ 2,560 fine. Speeding varies from 1-12 points, depending on how many kilometres per hour the driver was going above the speed limit. If it is more than 40, court attendance is compulsory; otherwise a fine of £46-80 is imposed, according to five levels of over-speeding. Ignoring traffic lights incurs 2 penalty points and a fixed fine of £46.

Driving under the influence of alcohol incurs 6-13 penalty points, depending on blood alcohol concentration (BAC), 6 penalty points if the BAC is 0.15mg and 13 penalty points if it is 0.30 as well as 2 years in jail or a £1,537 penalty fine.

In Singapore, drivers lose their licences when they accumulate 12 points in their first year or 24 points in 2 years. In that case, a driving education course and a re-test become compulsory.

The penalty points and fines are detailed in Table 3.22. Reckless/dangerous driving offences incur 12 penalty points and a fine of up to £1,143 or jail for up to 12 months, or both. For subsequent offences, the fines and jail terms are doubled and a ban is incurred. Speeding incurs 12 penalty points and a fine of up to £381 or jail for up to 3 months. Disqualification and doubling of fines and jail terms are also incurred for subsequent offences. Failing to comply with traffic lights incurs 12 penalty points and a fine of £76. For using a mobile phone while driving, drivers incur 12 penalty points and fines of up to £381 or jail for up to 6 months. Doubling up and disqualification are the same as for the previous offences. For driving under the influence of alcohol, points are not involved, but instead there is an automatic and immediate ban and a fine of between £381 and £1,903, or up to 6 months in jail.

Table 3.22 Points and fines in Singapore

Singapore	Points	
Reckless/dangerous driving	12	Fines of up to S$3000 or jail up to 12 months, or both. Subsequently, the fine is up to S$5000 or jail up to 2 years, or both. Disqualification from driving.
Speed	12	* Fine up to S$1000 or jail up to 3 months; and on subsequent conviction, fine up to S$2000 or jail up to 6 months. Disqualification from driving.
Failing to comply with traffic light signals	12	$200
Diving under the influence of alcohol	-----	Fine between S$1000 and S$5000, or jail up to 6 months. Subsequently, fine between S$3000 and S$10000, and jail up to 12 months. Disqualification from driving. (Fine and/or jail and loss of licence)
Using a mobile phone with no hands-free device	12	Fine up to S$1000 or jail up to 6 months, or both. Subsequently, fine up to S$2000 or jail up to 12 months, or both. Disqualification from driving.

Anon,2005www.xpatxperience.com/vehicles/singapore_traffic_rules.shtml, accessed 21/09/2008

In Kuwait, a driver who accumulates 14 points faces a three month suspension for the first offence. After the next 12 points, the licence is suspended for six months and for nine months and one year for the next 10 and 8 points, respectively (for further detail see Table 3.23 and refer back to Section 3.1.15). Details concerning use of alcohol or drugs (one year in prison and/or a £1,000 fine) were also given in the same section, as well as reckless driving, driving without a valid driving licence or driving a vehicle not listed on the driving licence (£200 fine and/or one month in jail), passing a red light (three months in jail and/or a £ 600 fine) and speeding (up to £200). Using a mobile phone has not yet been made a punishable offence.

Table 3.23 Points and fines in Kuwait

Kuwait		Traffic Department		Traffic Court	
Violation type		Reconciliation	points	Imprisonment not more than	Fine not more than
Careless driver		KD 30	4	3 months	KD 100
Speeding	More than 40 km	KD 50	4	3 months	KD 100
	Not exceeding 40 km	KD 40	4	3 months	KD 100
	Not exceeding 30 km	KD 30	4	3 months	KD 100
	Not exceeding 20 km	KD 20	4	3 months	KD 100
Using a mobile phone while drive	Not applied				
Driving a vehicle under the influence of alcohol, drug or narcotics				One year	500KD

Kuwaiti Ministry of the Interior (2002)

It appears that different penalty points and systems of fines are used across different countries. Furthermore, the terminologies used in publications about the regulations and penalties are subject to variation. For example, in Germany, reference is made to violation of various traffic offences, without reference to specific traffic light violations. Unlike most of the countries referred to above, the UK makes a specific differentiation between dangerous and careless driving. Careless driving means being simply below the standard of normal, prudent motoring, and there is no need to establish any actual or risk of injury/damage. For dangerous driving, the standard has to be "far below" the norm and it has to be obvious that there is a risk of personal injury or serious damage. For dangerous driving, the penalty can be two years in prison, but when it leads to a fatality, it can be as high as 14 years. In a Magistrates' Court, the maximum prison term is 6 months but with the option of referring the case to the Crown Court for sentencing, if is felt that 6 months is inadequate.

As regards dangerous and/or careless driving, it seems that Japan, the UK and Singapore have stricter regimes than Ireland or Kuwait in terms of penalties. In the former countries, drivers risk losing their licences immediately. Dangerous driving in Japan incurs 25 points, while the maximum permitted is 14, but in the UK and Singapore, a ban depends on the seriousness of the offence. A substantial fine and/or the possibility of a jail sentence are used in enforcement in each of those countries, whereas in Ireland, only five points are incurred and a court fine, and in Kuwait there is a £60 fine and a maximum of three months in jail and/or a £200 fine (sentenced in the court).

The two tables below present comparative data on strictness of regime for five countries in terms of their points system and severity of fines. The amount of the fine is only meaningful if average annual income is also known. Table 3.24 shows the points deducted in the five countries for five kinds of offences, while Table 3.25 shows the amount of fine and its percentage in ratio to average *per capita* income *per annum*. The data is presented for two European countries (the UK and Ireland), two Far East countries (Singapore and Japan) and Kuwait. The figure representing the most strict regime for each offence is highlighted in bold in each table.

Table 3.24 The number of points on the licence that leads to a ban and the number of points awarded for offences.

Offence and points deducted / Country	Japan	UK	Singapore	Ireland	Kuwait
Number of points leading to a ban	**15**	6 in the first year, otherwise 12	12	12	14
Careless / Dangerous driving	**25** points fixed	3-11	12	5	4
Alcohol / Drugs	6-13 points	3-11	**Disqualification**	3	**Disqualification**
Speeding	1-12 points	3-6	**12**	2-4	4
Traffic light violations	2 points	3	**12**	2-5	4
Mobile phone	1 point	3	**12**	2	0 (not applied yet)

Table 3.24 suggests that Japan has quite a radical and even logical system, whereby drivers who are dangerous on the roads are simply taken out, earning ten more points than are needed for a ban for other offences. Singapore is also quite radical. Every offence on the list leads to an automatic ban, but a very dim view is taken of alcohol and drugs. Offenders in this category are disqualified for a time specified by the courts. Kuwait is as severe as Singapore on alcohol, but this probably has as much to do with local Islamic culture as traffic safety enforcement.

Otherwise, in most countries, a ban can come into force after about four offences, but this is variable, as can be seen in Table 3.24. It can be concluded from the table that Singapore has the severest regime overall, but Japan has by far the strictest penalty in terms of points for dangerous driving, and Kuwait is on a par with other countries in other aspects, apart from alcohol and drugs, which is for religious reasons more than traffic enforcement considerations.

Table 3.25 below presents a similar trend as in the data above. That is to say that Singapore has the highest severity of punishment by fines in relation to *per capita* income except for in the category of dangerous driving, where once again Japan is the most strict, taking away one eighth of the income of an average earner. There are some differences between this table and the last one. In the UK and Singapore, drugs and alcohol are seen as major dangers, and receive higher punishment even than dangerous driving in Japan, taking out more than one fifth of an average earner's income. The other difference is that alcohol and drugs are not punished in Kuwait as harshly in terms of fines as in terms of the driving ban. This is perhaps because money is not such a deterrent in Kuwait, or perhaps because the disqualification is a sufficient deterrent in itself.

Table 3.25 Fines in the five countries in relation to average *per capita* income

Fines in pounds and ratio of fine to average per capita income (%) / Country	Japan	UK	Singapore	Ireland	Kuwait
Average per capita income in pounds sterling (2007)	20,440	23,191	17,618	26,121	17,168
Careless / Dangerous driving	2,560 **(12.5%)**	200(0.9%)-800 (3.5%)	1,143 (6.48%)-1,903 (10.8%)	n/a court decides	60 (0.4%)
Alcohol / Drugs	1,537 7.5%	Up to 5,000 (21%)	381 (2.2%)-3,810 **(21.6%)**	n/a court decides	1,000 (5.8%)
Speeding	46 (0.2%)-180 (0.88%)	60 (0.3%)	Up to 381 **(2.16%)**	64 (0.3%)-95 (0.4%)	40 (0.2%)-100 (0.6%)
Traffic light violations	46 (0.2%)	60 (0.3%)	76 **(0.4%)**	64 (0.3%)-95 (0.4%)	100 (0.6%)
Mobile phone	30 (0.1%)	60 (0.3%)	Up to 381 **(2.16%)**	48 (0.2%)	0 (0%)

World Bank, 2008: http://siteresources.worldbank.org/DATASTATISTICS/Resources/GNIPC.pdf Gross national income per capita 2007, Atlas method

Although Singapore and Japan are more strict with their rules concerning these five offences, the UK still has the lowest fatality rate (7.5 fatalities per billion vehicle-kilometres), while Singapore and Japan have 9.6 and 11.2 fatalities, respectively. The fatality rate in Ireland is 10.9, almost the same as Japan, in spite of the latter being more strict. The fatality rate per billion vehicle-kilometres in Kuwait is unavailable, but it has the highest rate compared to the other five countries based on fatalities per population or vehicles registered.

3.1.17 Vehicle licensing

The requirement for the inspection of vehicles is set out under traffic law No. 67 of 1976. Vehicle inspection is regulated by the General Traffic Directorate (GTD). There are five sites for vehicle inspection in Kuwait, located in Shuwaikh, Jabriya, Farwaniyah, Ahmadi and Jahra. Car test centres have four lanes: two for private vehicles, one especially for import vehicles and one for commercial vehicles. The law specifies the frequency of inspection. A new car is first registered for three years. Thereafter, registration must be renewed annually.

The test is not onerous, since many vehicles are new and roadworthy. In most cases, the inspector first checks for damage to bodywork or paint problems, then checks the lights, indicators, horn, windscreen wipers, tyres, over-shaded window glass and exhaust emissions by depression of the accelerator pedal (there is no instrument available for a proper emissions test).

Third party vehicle insurance is compulsory and costs KD19 a year. Comprehensive insurance is also available. To re-register a car after the third year, the insurance must first be renewed and then the car taken for testing. The receipt issued by the insurance company and 'log book' must be taken with the car to a testing station at a Traffic Department in the governorate in which the car owner lives. KD5 must be paid for a revenue stamp, which the cashier sticks on to the insurance receipt. Then a check must be made to see whether there are any outstanding fines on the car (such as for speeding). If any fines are due, a paper is issued and stamped by the cashier. The stamped insurance receipt and old 'log book' can then be exchanged for a new 'log book'.

Several items required to be checked by law tend to be dealt with perfunctorily. Some items already referred to are checked, but not always thoroughly, such as windscreen wipers or washers (there is not much rain in Kuwait). Spare tyres and car jacks are not checked. Car pits are available, but not used to check for leakages or damage. All in all, the checks only take a few minutes and are not thorough. For example, brakes and handbrakes are not physically tested.

In the UK (Anon, 2008 d) www.motester.co.uk/cog.html *(accessed 29/09/2008),* the standards are quite rigorous, with more than 150 items compulsorily checked. Although the tests are under MOT administration, they are conducted in privately owned garages. The mechanics who carry out the tests should have at least three years experience, and need themselves to pass a test. Particular attention is given to safety and emissions, with modern equipment used in the garages, which can detect small percentages of gases. Furthermore, the test reports have been computerised, and are linked to the MOT computer system. This means that the MOT can monitor when tests start and finish, as well as the pass / failure rate. That means that there is close monitoring, and test garages can be inspected either randomly or on suspicion of any strange results. The mechanics have to enter the system using a smart card and MOT pass code. The average vehicle test time is 45 minutes to one hour. Like Kuwait, new vehicles do not need an MOT test for three years. After that, the vehicles are tested annually.

Among the tests conducted are categories like the vehicle structure, the engine, the steering, the tyres and wheels, the brakes, the windscreen, the mirrors, the suspension, the exhaust system, the horn, the lights, the bonnet catch, the doors, the seats, the seatbelts and the registration plate. Vehicle testing has now become standardised across the EU, with only minor variations to allow for some degree of flexibility.

Clearly, Kuwait has an inferior system compared to Europe. There are plenty of checks that are recommended to be done, but they are not done rigorously, and the test lasts only about five minutes. This is in contrast to Europe, where the vehicle has to be thoroughly checked, even if it appears to be in excellent condition. In Kuwait, if the vehicle looks in good condition, they can wave it through more quickly. Even some aspects of the checks are not entirely to do with vehicle safety. Advertising is not allowed to be carried or any other written form or picture on the bodywork, except for well-known, authorised companies, like McDonalds. Permission is required from the Ministry, and is not commonly given.

The test in Kuwait involves only pressing the accelerator, checking the indicators and a brief visual inspection. The emission content is not checked. There are normally queues of cars waiting to be tested at the state-run centres. There is little monitoring of inspectors.

3.1.18 Vehicle Insurance

TRL carried out a study of motor insurance in nine countries, four in the developing world and five in the developed world (Aeron-Thomas, 2002). The aim was to study the role of insurance in road safety issues, and was based on the fact that 85% of deaths on the roads occurred in low-income countries, where road safety capability is quite new. Insurance systems compensate for losses, so it is in insurance companies' interests that the number of crashes and casualties is reduced. The study involved five higher income countries (HICs) and four lower income countries (LICs). British Columbia, Victoria and Karnataka were taken to represent Canada, Australia and India, respectively. Table 3.26 is adapted from the TRL document to show the countries in rank order of PPP, which stands for Parity Purchasing Price. Fatality rate is deaths per 10,000 vehicles. A ranking is given in the same column, which more or less follows the trend of the countries' relative wealth. The insurance system is State (S), Private (P) or Mixed (M).

Table 3.26 TRL study of nine countries' insurance status

	PPP	Fatality Rate / Rank	System	Compliance (estimated)	Fine for non-compliance
B.C., Canada	25,440	1.4 / 4th	S	98-99%	-
Victoria, Australia	23,850	1.2 / = 1st	S	Collected with licensing fee	250 US$
UK	22,220	1.2 / =1st	P	90%	143-7143$
Sweden	22,150	1.3 / 3rd	P	99%	Up to 10% extra premium
New Zealand	17,630	2.5 / 5th	S	90%	42 US$ per day
South Africa	8,710	14.6 / 8th	S	100%, levy on fuel	-
Costa Rica	7,880	6.0 / 7th	S	84%	-
Karnataka, India	2,230	5.3 / 6th	M	85-90%	10 $
Ghana	1,850	54.9 / 9th	M	70%	69 $

Private insurance is common in most countries, but the state is the main or sole provider in the majority of the cases in the TRL study. India has only just allowed privatization of insurance, with just two private companies and four public sector ones. Victoria only recently considered – but rejected – the opening up of insurance. Private insurance schemes did not get off the ground in New Zealand either. However, Sweden and the UK rely on private insurers, while Ghana and India have mixed systems.

Ghana and the UK have relatively strict penalties for non-compliance, and the deduction of 6-8 penalty points. A survey of UK magistrates courts indicated that the majority of fines were not more than £200. Fines in India could be as low as £7, depending on the size of the vehicle.

The main message from the table above is that HICs have better compliance and mainly better fatality rates. Third party car insurance is notably very cheap in Kuwait, costing only £40 (19 KD), while comprehensive insurance is quite expensive, at around

£1,000 per year on average. It is calculated as 5% of the value of the new car, on which Kuwaiti drivers may spend on average £20,000. That is why most drivers just go for third party. Those few who take comprehensive vehicle insurance usually do so when they are offered a deal for one year on a brand new car, with two further years included at third party. The premium is fixed, irrespective of the make of car, its age, the age of the driver, the region where the driver lives, or any other factor.

Premiums in the UK, on the other hand, depend on the age of the driver, the size and type of vehicle, the driver's occupation (e.g., student or musician), address, parking place, annual mileage, and type of licence (UK driver license or international). In September, 2008, the author obtained quotations from a car insurance company for three individuals, aged 30, 23 and 17, all living at the same address, to cover a two-litre engine car, third party, and on international driving licences. The quotations were £950, £2,500 and £8,000, respectively. This also took advantage of the no-claims bonus. The premiums would be higher if the driver had been at fault in an accident or had committed dangerous offences. Sometimes it is difficult to obtain insurance in such cases.

The no-claims bonus can help to reduce premiums, and drivers who have a certificate to prove that they have not been involved in an accident for which they were at fault can have cheaper insurance. Companies would like to discourage young drivers from driving cars with big engine capacity, and raise the premiums accordingly. Cohen and Dehejia (2003) conclude that compulsory insurance reduces fatalities and hence the cost of accidents.

3.1.19 Traffic violations in Kuwait

The total number of traffic violations in general increased sharply between 1999 and 2005, from 276,791 (an average of 0.37 violation tickets per vehicle), to 3,045,265 in 2005 (2.7 tickets per vehicle) (Table 3.27), mainly due to enhanced police enforcement systems, especially automated ones like speed cameras, which were introduced in November, 2000. Thus, in 2001 speed violations accounted for 48% of total violations, compared to 8% in 2000 (see Table 3.28). If parking violations are excluded from the count (as they are not a significant cause of accidents) and administrative violations are also excluded, speeding violations, including racing on the highway, can be said to account for 63% of offences, a reflection of driver attitudes towards speeding.

Speed violations subsequently reduced to 23.6% and 19.5% of the total in 2002 and 2003 respectively; this was because a large proportion of drivers were reducing speed at or before speed camera locations (Aljassar, 2004).

Passing red traffic lights is another issue that should be focused on. It accounted for an average of 7.3% of the total violations over the years 2001, 2002 and 2003, and became much worse (nearly double) in 2004 and 2005. Penalties increased sharply after the introduction of red light cameras in November, 2000. It also showed how reckless drivers could be at these common fatal accident locations.

Table 3.27 Violations per vehicle

Year	Number of violations	Number of registered vehicles	Ratio
1999	276791	754500	0.37
2000	321135	767807	0.42
2001	1459277	875620	1.67
2002	1740527	947382	1.84
2003	2384397	954978	2.5
2004	3043451	1042617	2.9
2005	3045265	1134042	2.7

Table 3.28 shows that the most common traffic violations in this period were parking, speed limit offences, not wearing a seat belt, car safety violations, crossing red traffic lights, driving on the wrong side of the road, and disregard for road markings. The increased number of violations suggested either a worsening situation, or an improvement in police deployment. However, the number of accidents and fatalities has also steadily risen, so a serious deterioration should be considered. Illegal parking (35% of the total violations in 2003) reduces road capacity and sight distance, which might cause accidents. The high percentage may indicate a lack of parking facilities.

Administrative violations, such as driving with an expired driving licence or vehicle registration, driving without registration plates, driving without insurance, using false plates, driving trucks at prohibited periods, damaged licence or plate, and driving without holding a driving licence, shows drivers' disrespect for traffic regulations.

The violation types in Table 3.28 show the range of bad habits among drivers in Kuwait and the frequency of detection by the police. The actual number of offences committed would be even greater if those that were not detected could be counted. The data analysis of road accidents and road traffic violations in Kuwait indicates a continuing decline in road traffic safety over recent years.

Table 3.28 Recent trends in road traffic violations (1999-2005)

Type of Violation	Years						
	1999	2000	2001	2002	2003	2004	2005
Exceeding speed limit	37,412	25,507	702,723	410,825	463,651	687,144	685,495
Driving without a licence	3,316	8,768	15,276	14,742	28,112	33,966	50,405
Reckless Driving or Racing on the highway	1,066	1,862	3,757	4,985	6,333	7,770	8,320
Passing red traffic lights	9,776	12,571	142,883	117,862	125,640	250,717	273,173
Driving while drunk	5	14	54	22	4,221	11	18
Driving on the wrong side of the road	7,333	16,794	22,696	32,716	34728	61,782	86,583
Driving without licence plates	1,169	2,240	233	6,835	11,480	15,460	17,422
Driving without insurance	6,227	9,860	9,550	17,940	31,136	33,026	42,845
Using false plates	991	801	561	692	18,311	861	1,472
Car safety violations	43,627	74,118	119,602	137,491	164,480	210,093	292,783
Unauthorised use of vehicle	5,129	11,178	15,874	17,759	19,617	30,340	37,972
Disregard for road markings	3,146	6,599	10,557	8,866	19,336	27,640	26,037
Sudden entry or stop	943	713	21	46	81	61	
Ignoring priority of way	322	376	240	456	6,766	282	312
Notwearing a seat belt	14,611	11,814	53,570	138,375	182,982	132,724	117,988
Driving trucks at prohibited periods	4,115	1,352	314	9,425	9,001	22624	23435
Using a car for illegal purposes	6,282	8,271	6,267	5,476	8,409	8431	8434
Overloading of vehicle	1,509	2,695	2,076	3,868	10,153	20392	49018
Traffic code violations	901	8,307	16,585	22,280	23,382	24,291	50,587
Notwearing glasses	140	358	139	133	194	178	315
Wearing veil or shroud	105	95	753	219	606	407	2,351
Parking on pavements	4,112	3,402	14,331	4,434	3,730	827	2,594
Damaged licence or plate	2,820	3,292	3,919	8,261	9,302	7,293	8,879
Violation of buggies & motorcycle	147	277	384	885	1,599	1,421	2,260
Driving with expired driving licence or vehicle registration	4,891	10,756	23,282	197,230	277,160	270,012	297,065
Driving without holding a driving licence	9,442	28,189	44,716	42,363	53,714	55,545	77,882
Parking in a no parking zone	101,230	62,393	244,451	523,597	834,903	1,051,762	713,945
Other violations	6,024	8,533	4,463	12,744	35,370	88391	167,675
Total	276,791	321,135	1,459,277	1,740,527	2,384,397	3,043,451	3,045,265

Source: Annual Statistics, General Traffic Directorate, the Ministry of the Interior, State of Kuwait

3.1.120 pedestrian facilities and driver behaviour in Kuwait

Whilst some areas of Kuwait have good zebra, signal controlled facilities and pedestrian footbridges, many areas do not. According to Koushki and Ali (1993), the geometric standards of the road network in Kuwait city centre have provided wide roads for vehicles, but limited pedestrian facilities. Not much has changed since then. However, the authors stated that Kuwait city centre still ranked favourably in the Middle East. Details of the system deficiencies were also presented by Koushki and Ali (1993), as follows:

- Policies tend to favour car use generally, making it difficult with longer walking distances for pedestrians
- Discontinuities in walkways cause pedestrians to make long detours
- Vehicles are frequently found on pedestrian spaces and walkways
- Crossing -roads and intersections involves conflicts with hostile vehicular traffic
- Lack of shade prevails at pedestrian walkways
- Areas of vacant land increase walking distances between land uses, and discourage pedestrians.

The problem with zebra crossings in Kuwait is that drivers do not respect them, and this may have an adverse effect on pedestrians using them correctly. As was seen in Table 3.29, 67% of pedestrians chose not to cross at a near zebra crossing. Furthermore, drivers are reluctant to stop for pedestrians. This leads to poor usage of these facilities, even when traffic flow levels are high.

Poor road user behaviour may be due to a low level of road user knowledge of traffic rules and regulations or may be the result of inadequate enforcement of traffic laws, or a combination of such factors. Pedestrians not crossing the road at the correct place and drivers not stopping at pedestrian crossings are not among the violations listed in Table 3.28.

The paragraph below describes some pedestrians issue worldwide, for the purpose of subsequent comparison with situation in Kuwait

Before applying new pedestrian facilities in a country, it should be taken into consideration that a system which has a good impact on reducing accidents in one country may not be appropriate in other countries due to cultural differences and attitudes, and the level of road user knowledge of traffic rules and regulations. For example, TRL carried out studies of road user behaviour at pedestrian crossings and junctions in selected urban areas in a number of developing countries, namely Cyprus, Kenya, Indonesia, Thailand, Turkey, Pakistan, Sri Lanka and Jamaica, comparing them with the UK as an example of a developed county. The results of the study showed that fewer drivers were prepared to stop for pedestrians at zebra crossings in the selected cities in developing countries and in Surabaya (Indonesia), almost no drivers stopped at zebra crossing, compared with the UK (London and Reading) where pedestrians were at lower risk when crossing a zebra crossing (see Table 3.29) (TRL, Jacobs at al., 1981). Excluding Surabaya, an average of under 15% of drivers were prepared to stop, while in the British cities, nearly three quarter of drivers were prepared to stop, though this figure dropped to 40% in London in 1978.

A recent study was carried out by the author to determine the readiness of drivers, given a free choice, to stop for pedestrians at zebra crossings (two uncontrolled zebra crossings in Kuwait city). The numbers of vehicles approaching the crossing that stopped or did not stop each time a pedestrian stepped into the road were recorded. Stepping into the road is here defined as having one foot at least on the zebra crossing. A car within 30 metres of the crossing should be prepared to stop. Four studies were made by Jacobs *et al*. (1981); the studies were made in London (1963, 1967), Nicosia and Nairobi (Figure 3.10, Driver Stopping Behaviour at Zebra Crossings). The shortest stopping distance by drivers when pedestrians wanted to cross was about 15 metres (the recommended stopping distance is 23 meters (thinking distance and breaking distance) at 30 mile/hour (Highway Code, 2004)). The longest stopping distances were between 35 to 50 metres. The most common stopping distance was around 30 meters. Drivers more than 40 meters away from the crossing may probably feel that the crossing will be clear by the time they reach it. Vehicles that stopped behind another vehicle that had stopped were excluded (only free choice vehicles were included). Few drivers chose to stop (1.5%) when a pedestrian stepped into the road. It was also noted that 67% of pedestrians chose not to cross at zebra crossings, though they usually crossed near it (within 50 metres). This implied that pedestrian facilities are not fully utilized because of drivers' lack of compliance (Figure 3.10, Driver Stopping Behaviour at Zebra Crossings).

Table 3.29 Stopping behaviour of drivers at pedestrian zebra crossing.

City	**Number of sites studied**	**Percentage of drivers choosing to stop for pedestrians on the crossing (average for sites studied)**
Bangkok	**4**	**16**
Colombo	**4**	**11**
Kingston	**5**	**10**
Nairobi	**6**	**17**
Nicosia	**2**	**17**
Surabaya	**4**	**0.2**
London 1967	**2**	**73**
Reading 1967	**1**	**74**
London 1978	**5**	**40**
Reading 1978	**4**	**72**
Kuwait City* (recently)	**2**	**1.5**

* Two sites were selected in Kuwait City close to shopping centres, where there were good pedestrian crossings (zebra crossings). The first site was Fahad Al-Salem Street (speed limit 45km/h). Out of 434 vehicles that should have stopped, only 4 vehicles chose to stop for pedestrians. The study was made on 12/11/ 2007 during the off-peak period (10:30 to 11:30). The second site was Al-Shohada street (speed limit 45km/h). Out of 273 vehicles that should have stopped only 5 vehicles chose to stop for pedestrians. The study was made on 13/11/ 2007 during the off-peak period (11:00 to 12:00).

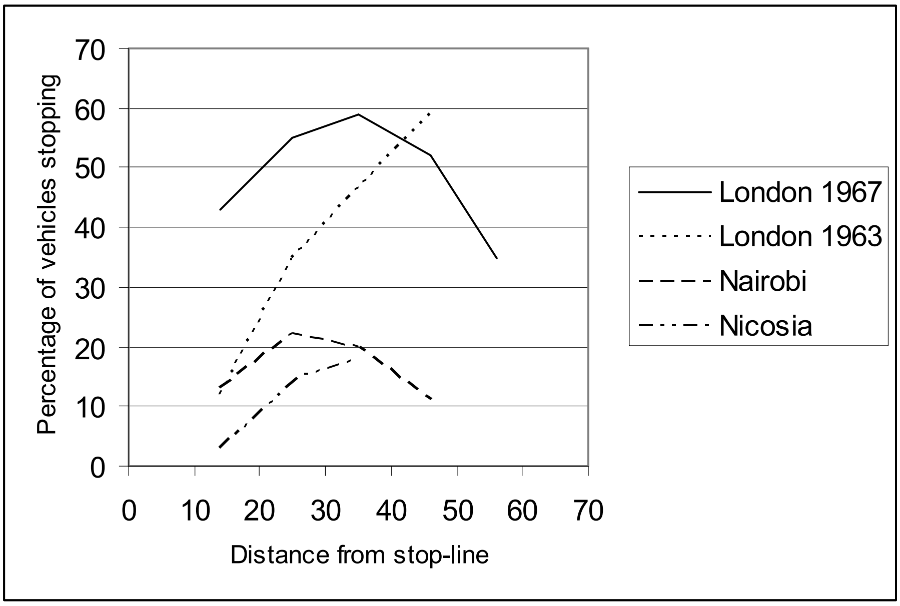

Figure 3.10 Driver behaviour at zebra crossings
Source: Jacobs *et al.*, 1981, TRL Supplementary Report 646.

3.2 Detailed accident data analysis for the year 2002

3.2.1 Data collection

In 2002 there were 37,650 road accidents in Kuwait, causing 2,249 injuries and 315 fatalities (reported by the GTD, 2002). Around 61% of the accidents occurred in the capital governorate (Kuwait City) and the Hawalli governorate, 31% and 30% respectively, see Figure 3.11. 61% of accidents occurred in Kuwait City and Hawalli, but these governorates comprise only 38% of the population. That means a *per capita* accident rate which is 2.5 times greater. This is not surprising as Kuwait city and Hawalli governorates have greater vehicle activity, and have located in them most of the Ministries, work places, shopping centres, universities, and so on. There are also more people journeying to these governorates and more pedestrian activity.

The data were collected for one year (1/1/2002 to 31/12/2002). 1,283 casualty reports by the police (traffic accidents resulting in injury or death) were collected from the General Investigation Administration in the Ministry of the Interior for each governorate, during a visit to Kuwait (1/4/2004 to 1/6/2004). All the information from each accident report was entered on a spreadsheet in Microsoft Access. Other summary accident statistics were collected from the General Traffic Directorate (GTD) in Kuwait City. The data was sorted and organised for each category of information and analysed with a view to assessing potential opportunities for action in Kuwait.

In order to collect the data, two letters were required, the first from the Director of the Transportation Research Group at the University of Southampton, addressed to the Ministry of the Interior, and the second from the Public Authority of Applied Education and Training (PAAET) (the author's employer) to the Minister of the Interior confirming the need for this data for the research.

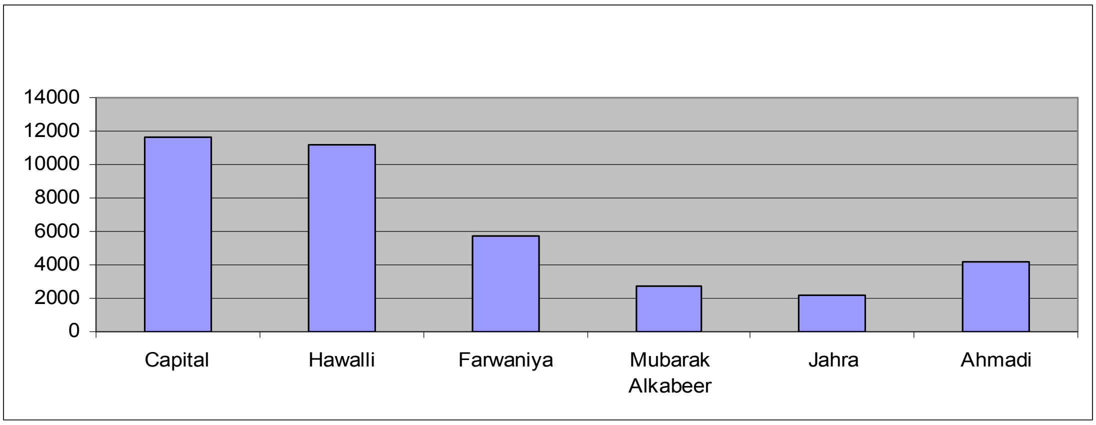

Figure 3.11 Number of accidents per governorate

3.2.2 Data entry

All the information on each accident report was entered on a spreadsheet in Microsoft Access. The data was sorted and organised for each category of information as follows:

1- Administrative data

Serial number

Police station name

Governorate name

Case number

Accident time, day of week, and date

2-Environmental data

Weather conditions

Road surface condition

3-Location

Area name

Street name

4- Road characteristics

Link or junction type

Speed limit

5- Accident data

Accident type

Collision type

Accident cause

6- Driver details

Age

Gender

Nationality

7- Casualty details

Road user type (driver, passenger, pedestrian)

Age

Gender

Nationality

The position of casualty at the time of accident

Casualty type (slight, serious, fatal)

8- Vehicle details

Number of vehicles involved

Vehicle types

3.2.3 Data Analysis

The one-year (2002) data was investigated and analysed according to the objectives of the study. The analysis in this study concerns frequency (or percentages) for each category in each element of the police reports, and trends and patterns.

3.2.4 Results

3.2.4.1 Location

Due to the lack of exact accident location data, detailed analysis cannot be made, for example, at black spots on roads in Kuwait. Although street names and names of area locations can be obtained from police accident reports, in the case of long streets, this is too imprecise. Data were also recorded inaccurately or incompletely.

3.2.4.2 Link & junction types

Most casualties occurred on links (Figure 3.12) rather than at junctions, 78% and 12% respectively. A link is here defined as a long stretch of road that connects two junctions. On a road of some length, the exact location along that stretch of road should be given. If, in addition, that stretch of road has more than one side road coming on to it, the particular side road should be identified in the accident report. The remaining 10% of casualties occurred in other locations, such as parking areas and the desert. The highest percentage of casualties occurred on links (78%), an indication of how reckless drivers can be in Kuwait.

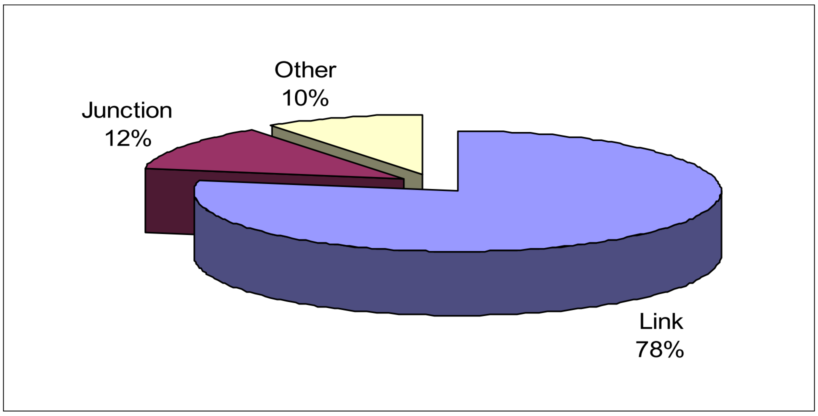

Figure 3.12 Casualties on link and junction

The highest proportion of accidents (39%) occurred on dual carriageways with a separating median, followed by roads divided into three sections (29%); (see Figure 3.13). These types of roads are common in Kuwait.

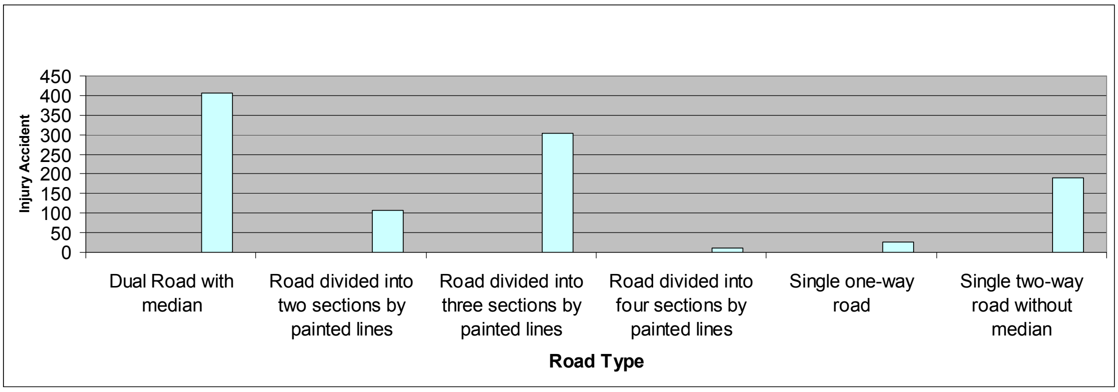

Figure 3.13 Casualties based on road type

Concerning junction type, nearly 57% of junction accidents are at signalised intersections. This figure gives an indication of driver behaviour or attitude towards red traffic lights; (see Figure 3.14).

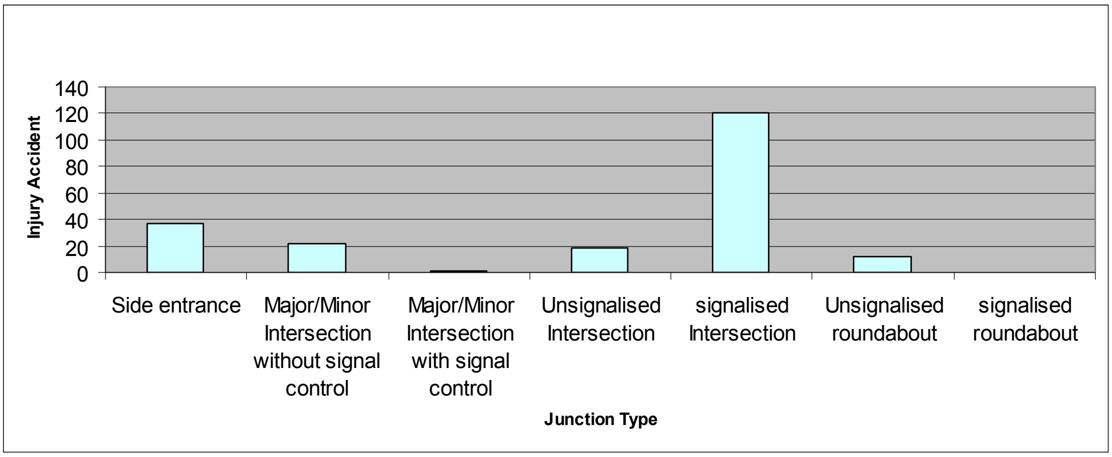

Figure 3.14 Casualties based on junction type

3.2.4.3 Vehicles involved

Accidents were categorised according to the number and type of vehicles involved, as shown in Figures 3.15 and 3.16. Nearly 45% of the accidents involved two vehicles. Accidents involving one vehicle accounted for 43%. Overturning, and hitting a stationary object were common, but over 60% of all injury accidents involved one vehicle causing a pedestrian casualty. The remaining accidents involved three or more vehicles.

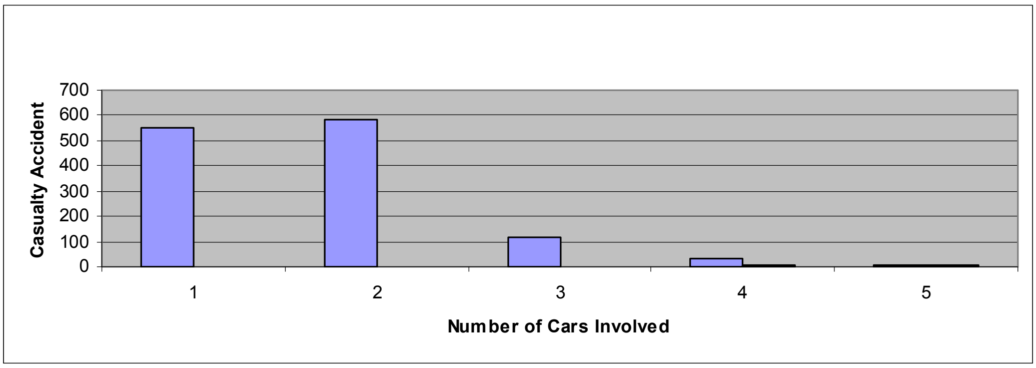

Figure 3.15 Casualties based on number of vehicle involved

Out of the 2,212 vehicles involved in accidents, 2,089 were identified in police reports, and, of them, 77% were passenger cars. This indicates both the high prevalence of passenger cars in Kuwait (83.5%) and the tendency for speeding. The second highest vehicle type involved was pickups (around 9.3% of total vehicles). Trucks and buses came third and fourth (4.5% and 3.2% respectively) (see Figure 3.16), although buses account for only 1.4% of total vehicles (see table 3.2). The low percentage of motorcycles is notable (3%). However, 2.6% of the casualties resulted from young drivers racing or driving carelessly. The bicycle is not a commonly used mode of transport. A few adults and young children use them locally, but there are no cycle paths on Kuwaiti roads.

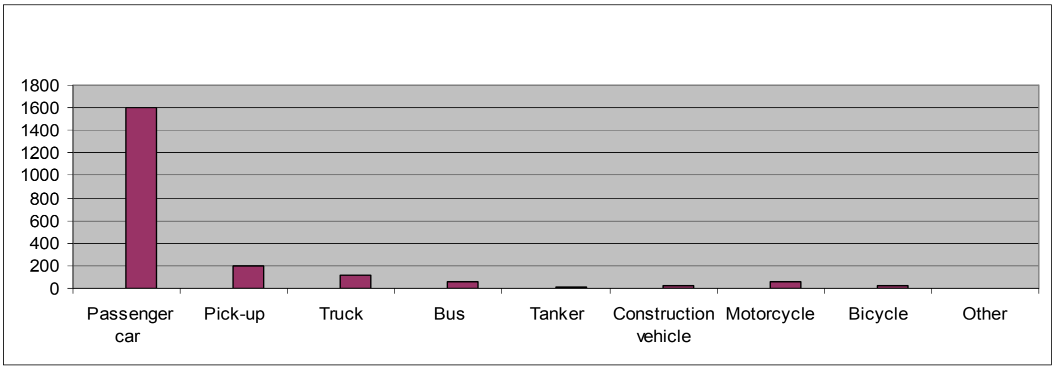

Figure 3.16 Casualties based on vehicle type involved

3.2.4.4 Casualty profiles

As regards severity of injury, it may be seen from Figure 3.17 that most casualties are slight (64%). However, there remains cause for concern, as nearly one quarter of injuries are serious, and nearly one eighth involve death, almost one every day.

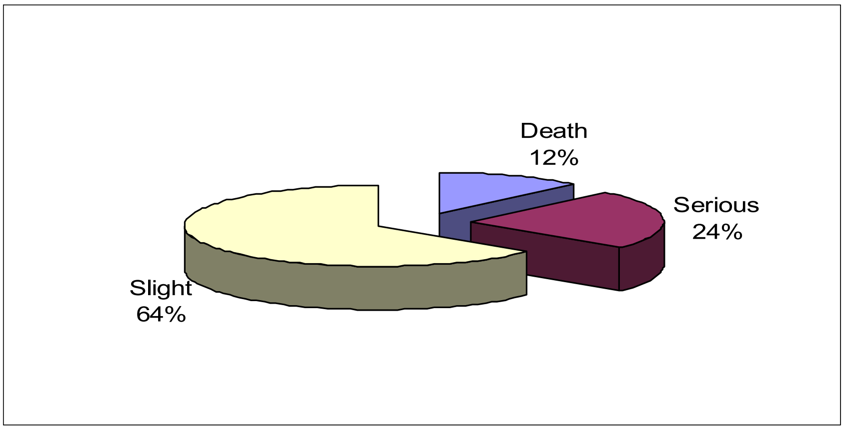

Figure 3.17 Casualties based on severity

As regards gender, the lower percentage of female casualties (19%) indicates that males use the roads more, and perhaps less carefully. Females use seat belts more than males (Koushki *et al*., 1996) reducing their severity of injury

Concerning age group, most casualties were young to middle aged. Around 74% of casualties were between 18 and 47 years old, perhaps because this age group use the roads more frequently (see Figure 3.18).

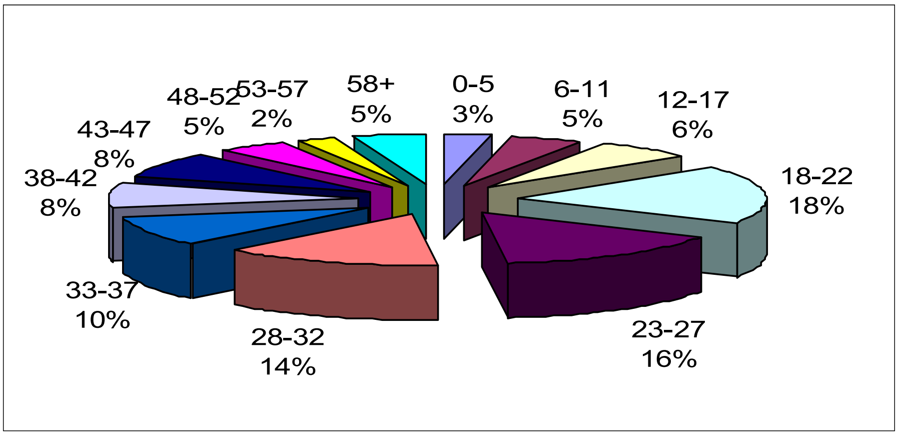

Figure 3.18 Casualties based on age

Figure 3.19 shows the distribution of casualties according to nationality. Although Kuwaitis account for only 37% of the population of the country, Kuwaitis accounted for 47% of all casualties. Asians (from the Indian subcontinent and the Far East) accounted for 27% and other Arab states 21%. The proportion of nationalities outside these three categories is small.

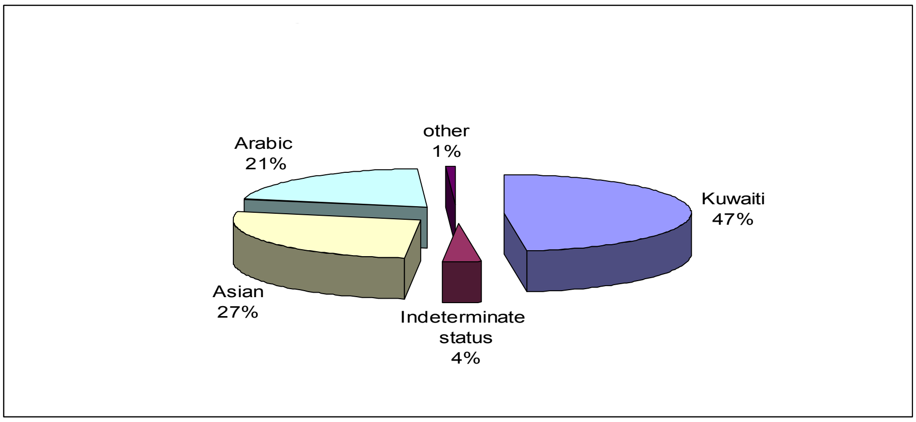

Figure 3.19 Casualties based on nationality

3.2.4.5 Casualties according to road user type

It may be seen from Figure 3.20 that car drivers represent the highest proportion of casualties (about 48%). Passenger casualties come next with 33%. (It should be remembered that minimal use of public transport is made in Kuwait, less than 3% of daily journeys (Koshki *et al*., 2003)). Pedestrians represent 19% of casualties. This is probably due to the lack of pedestrian facilities, hot weather during the summer, and poor driver behaviour, which discourage pedestrians from taking to the street. However, they account for many fatalities (34% of total fatalities) probably due to their vulnerable position in the road.

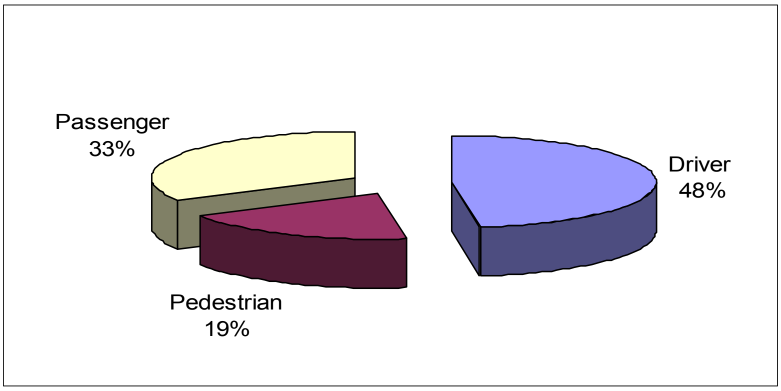

Figure 3.20 Casualties based on road user type

3.2.4.6 Driving licence holder

There were 657,798 driving licences issued in Kuwait in 2002, 78% of which were for males and 22% for females. Based on nationality, the highest proportion was for Kuwaitis with 39%, other Asians and Arab nations representing 30% and 27% respectively (Figure 3.21). Figure 3.22 shows age groups and nationality. It can be seen that Kuwaiti drivers aged 18 to 32 have the highest proportion. Other Asians are the highest in the age group 33- 52, while other Arabs feature highly elsewhere. It could also be that females do not report accidents, as for cultural reasons they do not like to attend male-dominated police stations.

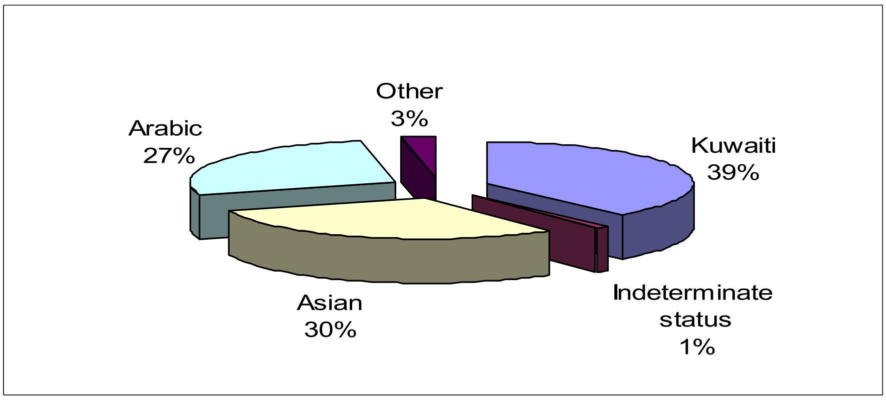

Figure 3.21 Driving licences based on nationality
Note: driving licence data for 2004

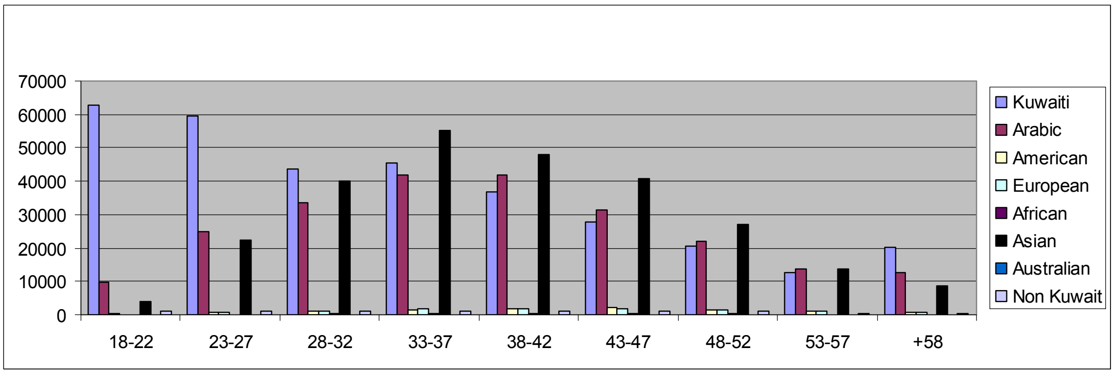

Figure 3.22 Driving licences per age group and nationality
Note: driving licence data for 2004

3.2.4.7 Drivers involved in accidents

As is the case all over the world, the proportion of female drivers involved in road accidents is lower than for males. Females represent 22% of the driver population, and almost half of them (11%) are involved in accidents. The proportion of males involved in accidents is much higher, perhaps because males drive more than females, and/or that females tend to drive more carefully and slowly.

It was found that most casualty accidents involved young drivers. Drivers aged 18 to 37 contributed 68%. The age group with the highest casualty rate was 18 to 22, with 23%, although that age group represents only 9.2 % of all licence holders. It was also found that accidents involving casualty decrease as age increases (see Figure 3.23). The higher proportion of injuries among young drivers may reflect the fact that they favour high speed, and have less driving experience. Moreover, there were 17 under-age drivers involved in accidents.

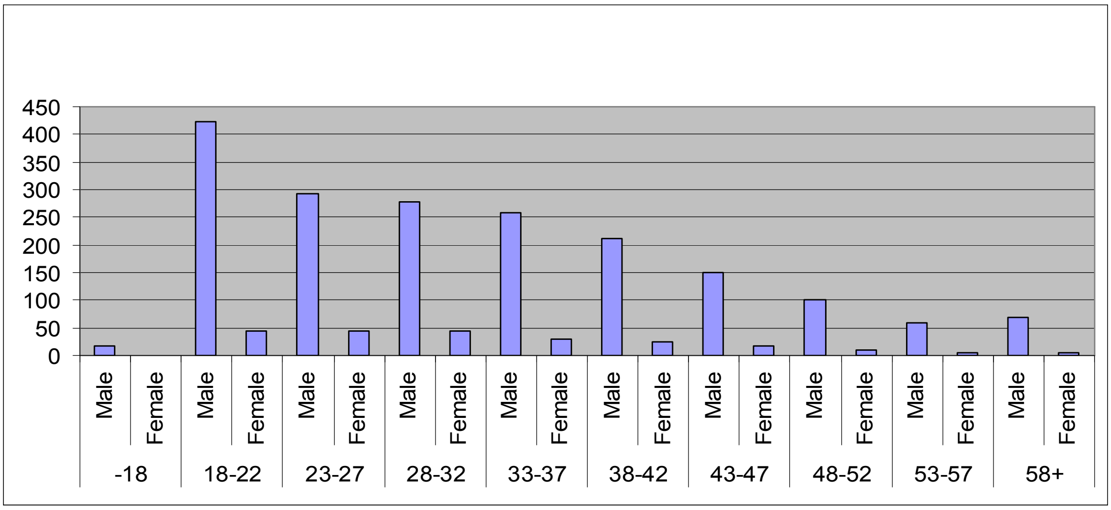

Figure 3.23 Drivers involved in accident by age and sex

In terms of nationality, Kuwaiti drivers constituted 48% of those involved in accidents where a casualty occurred. Kuwaiti nationals account for only 39% of the total number of licence holders, but most of them drive a saloon car, which is the category most involved in road traffic accidents. Another reason is that there are more young Kuwaiti drivers. The second-most involved nationality group in accidents were Asians. The proportion of Asian drivers in accidents was high (25%). Arabian drivers came next; they constituted about 22% of all drivers (see Figures 3.24 and 3.25). Again this is because of the high proportion of Asian and Arabian drivers in Kuwait.

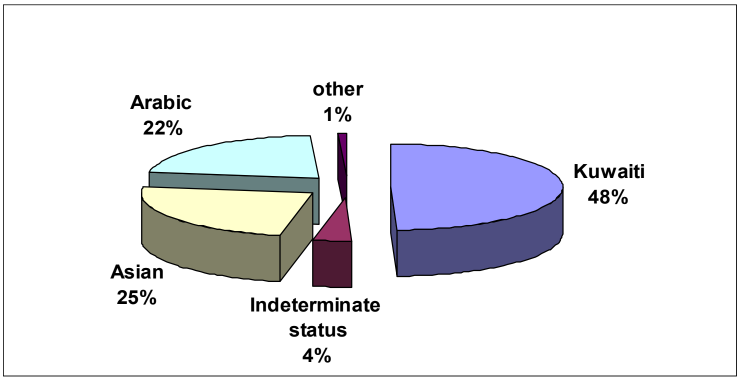

Figure 3.24 Drivers involved in accidents based on nationality

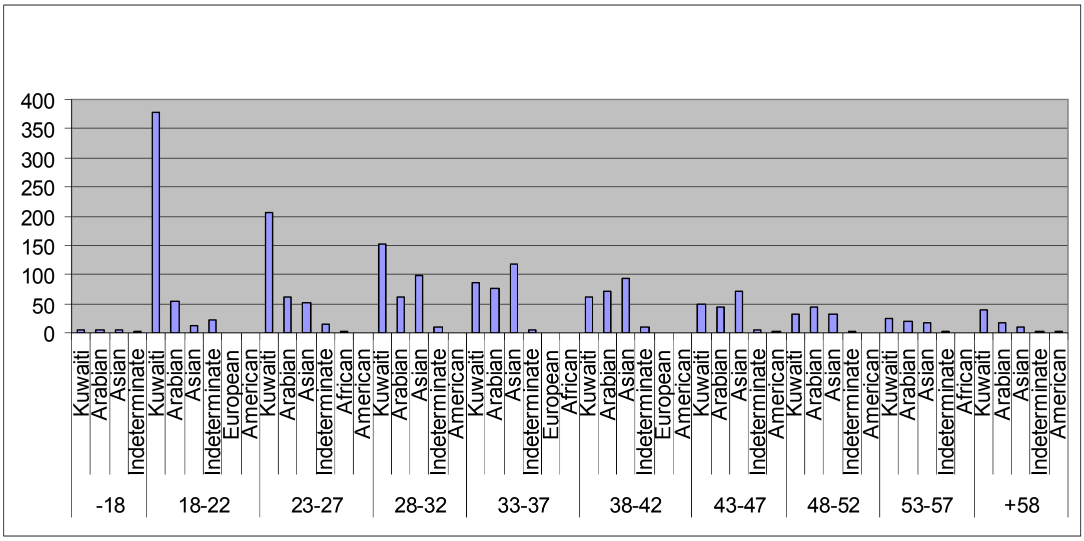

Figure 3.25 Accidents based on driver age and nationality

3.2.4.8 Passengers

This section deals with casualties to passengers as opposed to drivers. 25% of passenger casualties were female. Females are less likely to be on the roads than males. Moreover, they tend to sit on the back seat, and so are less vulnerable.

As with drivers, passengers in the18 to 22 age group had the highest percentage of casualties with 17%, followed by the 23-27 age group (16%), the 12-17 age group (15%), and the 28-32 age group (13%), (see Figure 3.26). The percentage was 11.4% for under 12's; this high percentage among child passengers is perhaps due to non-use of child restraints. Many parents put their children on their laps, as the use of child seats is not very common in Kuwait. One of the reasons for this is that drivers are not strictly fined for this violation.

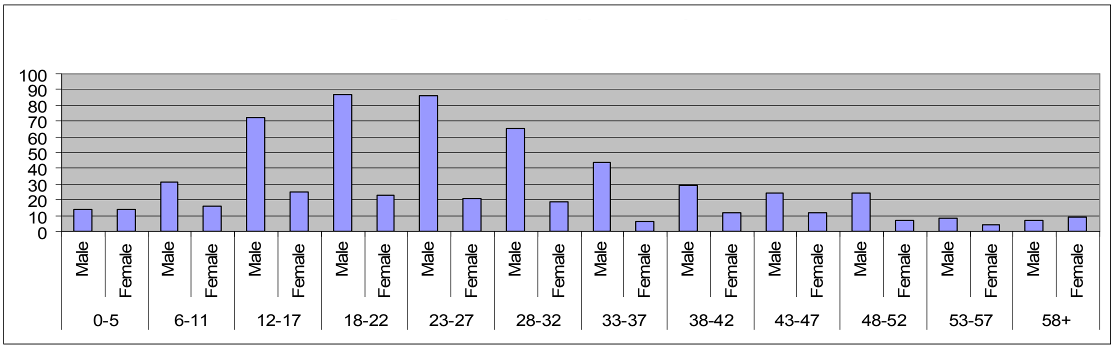

Figure 3.26 Passengers involved by age and sex

3.2.4.9 Pedestrians

It was shown in section 3.2.4.5 that 19% of casualties were pedestrian. Only 18% of the pedestrian casualties were female. This lower proportion can be attributed to low female pedestrian use of the road, and it is uncommon for females in Kuwait to walk long distances.

The proportions by nationality were Asian (41%), other Arab (28%) and Kuwaitis (25%). The first two categories probably represent low-income workers unable to afford a car (see Figure 3.27), while Kuwaitis generally do not like walking in the streets.

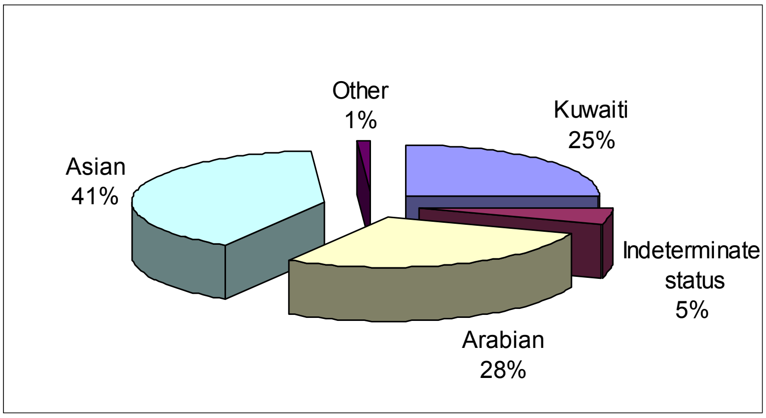

Figure 3.27 Pedestrian accidents based on nationality

In terms of pedestrian age, the analysis shows that 21% of casualties were children under the age of 12, 58% of whom were Kuwaiti. This could be due to the limited education programme for children at school, and, again, reckless driver behaviour. The pedestrian age group of 23 to 47 contributed 51%. Asian pedestrian casualties appear to be in the highest proportion (almost 54%) in this group age. It should also be noted that 11% of pedestrian casualties were more than 58 years old (see Figure 3.28).

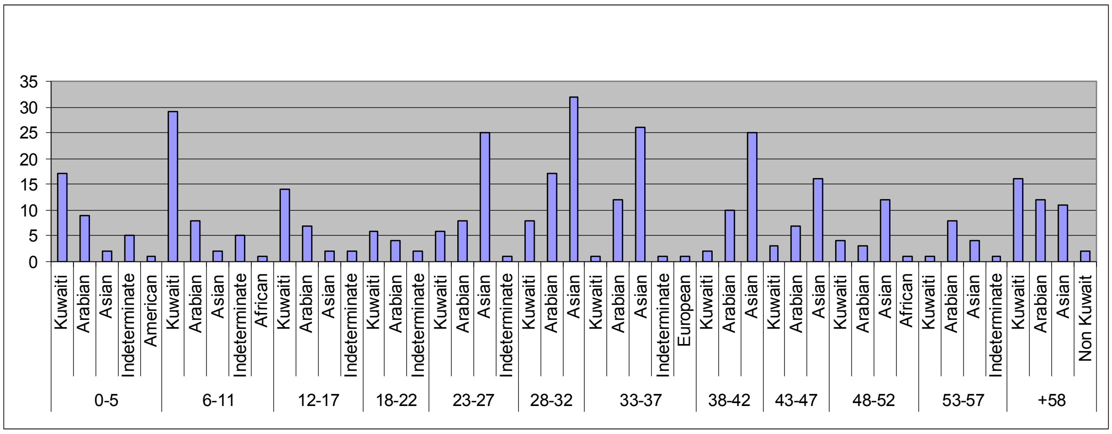

Figure 3.28 Accidents based on pedestrian nationality

3.2.4.10 Pedestrian circumstances

The analysis shows that almost 78% of pedestrian accidents occurred when crossing the road. This may be due to a lack of adequate pedestrian crossings and/or reckless/poor driving behaviour. Pedestrians walking in the road side came in second place at 10%, then pedestrians on the pavement at 6%. Roadside accident occurs due to obstructions on the pavement, such as cars parked or house-building material, as well as poor driver behaviour (see Figure 3.29). Police reports also indicate poor pedestrian behaviour, as eight percent of injury accidents involved pedestrians on motorways, where they are banned. An issue might be lack of adequate crossing facilities such as footbridges.

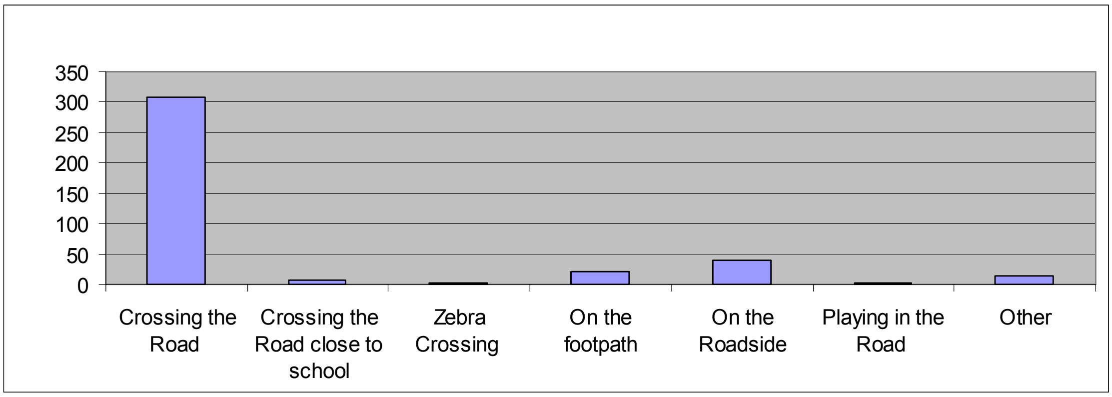

Figure 3.29 Accidents based on pedestrian movement

Out of all single vehicle accidents which caused injury or death, 60% result in pedestrian casualties (19% of all casualties and 34% of all fatalities) (accident report data results). This implies a complete lack of hazard perception training on the part of drivers, poor pedestrian behaviour and a lack of pedestrian facilities. This was also supported by a study carried out by Koushki and Ali in 2003, who found that reckless driving, was responsible for nearly 50% of pedestrian accidents, but more than 21% of pedestrian accidents occurred because of inappropriate pedestrian crossings. 12.4% of pedestrians were hit in outdoor car park and 16% of pedestrian accidents were caused by speeding drivers. These statistics are derived from police data. The law in Kuwait (for example traffic law/ article 196) puts much more responsibility on drivers to be attentive to pedestrians in urban areas. This was clarified in an interview with a member of a law enforcement unit.

It can be seen from Figure 3.30 that the highest proportion of drivers involved in pedestrian accidents according to age group is the young driver's age group (18-22) (accident report data results).

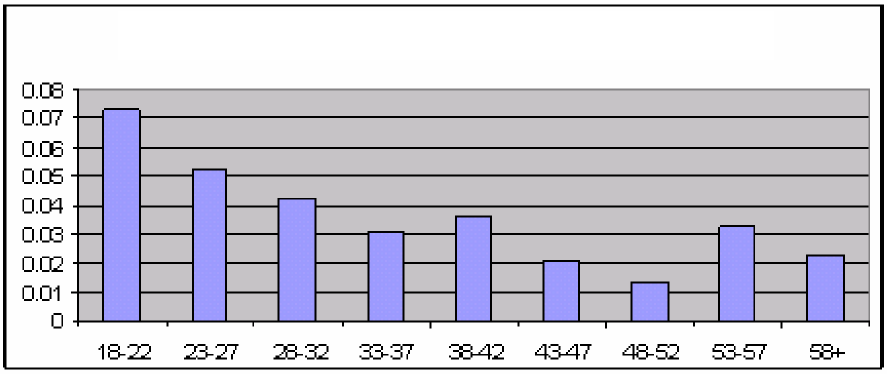

Figure 3.30 Percentage of drivers involved in pedestrian accidents in according to age

3.2.4.11 Accident types

Table 3.30 and Figure 3.31 represent the distribution of accident types. Most of the casualty proportions were small, except for the following four types: vehicle-to-vehicle collisions, pedestrian accidents, overturning, and hitting roadside obstacles (lamp stands, trees, barriers, and roadside walls). Nearly 80% of accidents are vehicle-to-vehicle and pedestrian accidents; vehicle-to-vehicle collisions were about 51%. Pedestrian accidents constituted about 27%, usually because drivers were careless or pedestrians were not aware of road safety. Overturning and hitting roadside obstacles accounted for 9% and 8% respectively.

Table 3.30 Accident type

Accident type	Frequency
Falls	10
Roadside obstacles	77
Roadside obstacles, overturning	29
Hitting an animal	5
Overturning	115
Pedestrian accident	344
Vehicle-to-Bicycle	9
Vehicle-to-Motorcycle	13
Vehicle-to-Vehicle	527
Vehicle to Vehicle, Roadside obstacles	64
Vehicle-to-Vehicle, Roadside obstacles, Overturning	10
Vehicle-to-Vehicle, overturning	50
Vehicle-to-Vehicle, pedestrian accident	28

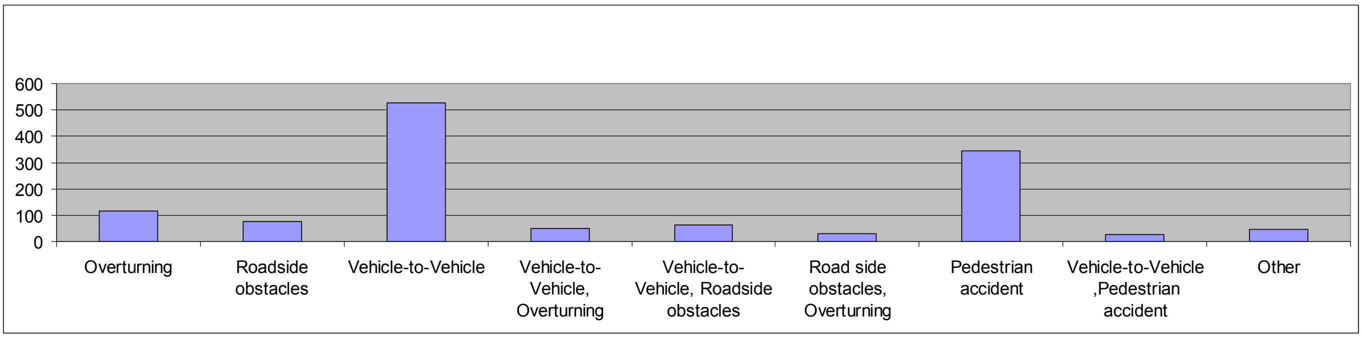

Figure 3.31 Accident types

3.2.4.12 Collision types

As shown in Figure 3.32, the most frequent collision type was nose-to-tail (39%). The next highest collision type involved cars travelling in the same direction, but with an impact angle referred to in the figure as 'other angle' (25%), impact from a right angle (18%), cars travelling in the same direction bouncing off each other, known as sideswipe (common direction) (10%). There were fewer head-on collisions or opposing direction accidents since single two-way roads are not common in Kuwait.

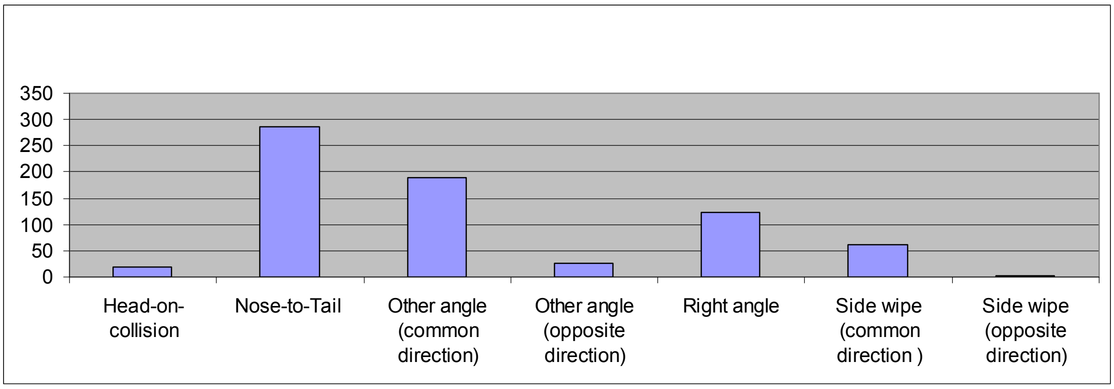

Figure 3.32 Collision types

3.2.4.13 Accident causes

The accident causes shown in Figure 3.33 are based on police interpretation. Most accidents are ascribed to driver error. More than 50% were identified as having occurred because of lack of attention (distraction, carelessness, etc). It can be noted that alcohol is not a contributory cause, because it is prohibited in Kuwait. This is an alarming situation and, if true, driver attitudes towards driving need to be changed. The second cause was changing lanes or swerving (12%). Other obvious causes of casualties were passing red lights (8%), hit & run 7%, not leaving enough distance (5.5%), ignoring right of way (5%) and speeding (4%).

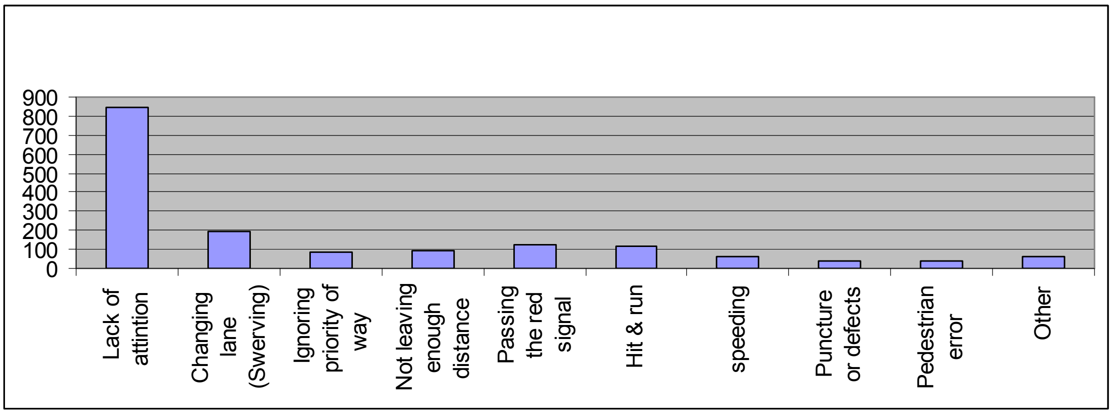

Figure 3.33 Accident causes

Chapter 4

4 Potential opportunities for action in Kuwait

4.1 Introduction

Having reviewed the international literature on accidents in Section 2.1 and literature on remedial measures in Section 2.2, as well as accident data from Kuwait in Chapter 3, the purpose of this section is to establish some preliminary ideas on potential opportunities for remedial action in Kuwait. According to the reviews of the international road accident literature, road user behaviour is the main cause of accidents in developed, developing and emerging countries (Section 2.1.5). There are substantial differences in developing and emerging countries in terms of behaviour, knowledge, attitudes and culture, as well as road conditions, vehicle type and maintenance, and traffic characteristics. Behaviour in some developing and emerging countries may be due to a lack of knowledge about road safety rules and regulations, or general attitudes towards road safety matters. Less discipline may be observed compared with developed countries, such as the UK (Downing *et al*., 1991). Reviews of road accident data in Kuwait also show that driver errors are the main cause of accidents (Section 3.2.4.13), and therefore this should be the main issue targeted in attempts to reduce road accidents in Kuwait. The three Es (Engineering, Education, and Enforcement) should be the main focus to eliminate driver errors, by changing behaviour and attitudes, as programmes in developed and developing countries have obtained good success in changing drivers' attitudes and behaviour, hence reducing the number of accidents and their severity (Section 2.2).

Recommendations will be based on the above reviews as well as from the police accident reports, as follows:

4.2 Specific recommendations

- In order to determine appropriate solutions and countermeasures, it would be necessary to improve the quality of police accident reports, so that precise details can be collected related to specific accident locations and other factors. A black spot study could be conducted at the most frequent accident locations in Kuwait, as such studies have been successful in reducing location-based accident factors and driver errors in other countries (Section 2.2.5). Databases should also be accessible to researchers, to encourage the analysis of accidents and the development of a better understanding of road safety characteristics and trends.

- Reckless drivers in Kuwait should be encouraged to control their speed (63% of total violations, section 3.1.11), so traffic calming schemes over a wide area might be introduced in order to reduce speeding, the number of accidents and their severity, as has been successfully achieved on Ghanaian roads and in developed countries (Section 2.2.5).

- Although vehicle safety issues were not found to be a serious problem, they nevertheless constituted a frequent traffic offence in Kuwait, with an average of 12.5% of total violations in recent years (Section 3.1.11). Drivers should check and maintain their vehicles regularly, as, for example, changes in temperature and humidity affect vehicle performance, especially the capacity to function at high temperatures. Checking the condition of tyres and air pressure is an issue that should be taken into consideration in hot weather. Annual vehicle inspections, combined with frequent random checks of vehicles on the road, should be carried out more often by the authorities.

- More strict traffic law enforcement is needed, especially in relation to driver behaviour on the roads, for example regarding speeding offences, reckless driving, hit and run, and red light violations (Section, 3.2.4.13).

- Increased police presence to monitor speeding and other traffic offences, along with heavier penalties, might be recommended at frequent accident locations (links or junctions) or where the most reckless driving is observed. Such action in Egypt reduced the total number of accidents by over 50% (Section 2.2.4). Penalties should be applied without hesitation, no matter what the driver's social position; all drivers should be treated equally by the law.

- Indirect enforcement, such as hidden (or mobile) cameras, can also be used more often in Kuwait, since they have a significant impact in reducing crashes and casualties in both speed camera areas and on the roads in general (Keall *et al*., 2002). The location of cameras may be changed regularly, so that drivers do not become familiar with where they are.

- It is necessary to update the present legislation as regards the penalty points system. New regulations may be supported by governmental campaigns and publicity to raise public awareness of the problem, and have an impact on traffic offenders.

- Drivers and passengers must be both encouraged and obliged to use seat belts, because different studies have shown a significant reduction in the severity of injuries when they are used (section 2.2.3).

- Poor driver and pedestrian behaviour and a lack of pedestrian facilities on Kuwaiti roads contribute to a high fatality rate among pedestrians (Koushki and Ali, 2003) (34% of all fatalities in road incidents, according to the present study) (Section 3.2.4.5). This area needs careful study in order to improve driver and pedestrian behaviour.

- It is very apparent that there are deficiencies in the current standards of driving. Common errors are changing lanes (swerving), ignoring rights of way, not leaving enough distance from the vehicle in front, and passing red lights. Driver testing and training systems need to be improved. The theoretical test should concentrate on eliminating errors and bad habits most commonly found in drivers. For practical driving, driving schools must also concentrate on eliminating bad habits and dangerous manoeuvres, using well-qualified instructors, since new applicants show their best behaviour only in order to pass the practical test. In the practical test the driver should also be tested by a qualified examiner to ensure that new drivers have reached the minimum driving standard.

- Programmes of driver education with an appropriate curriculum to deal with improving bad driver behaviour and attitudes should be applied in secondary schools as a compulsory course, which might have a good impact on reducing accident risk and the number of accidents, as was found in Denmark and in the USA (Section 2.2.2). Effective campaign and publicity programmes are also needed in different languages (about 120 nationalities are represented in Kuwait) to encourage safe driver behaviour and improve attitudes towards traffic regulations.

- All measures must be seen as a package introduced according to an agreed timetable. Adequate funds must be made available, with close cooperation with all organisations concerned (e.g. the police, legal and medical departments, engineers, and so forth).

Chapter 5

5 Questionnaire data analysis

5.1 Introduction

Based on the previous chapters, several problems concerning road safety in Kuwait need to be investigated deeply in order to better diagnose the nature of this problem and to recommend appropriate remedial measures. One of the most common problems that appeared from the police report data analysis (covering only accidents in which casualties occurred) was driver error, which was considered by them to be the main contributory factor to accidents (91.5%), agreeing with the Arabic Interior Ministers' Council in 1998 of 90% for all accidents. Therefore, this factor should be focused on. To obtain an in-depth understanding of the problem, a questionnaire survey (self reported) was undertaken for a large, random sample of drivers in Kuwait (N=1528), which focused on driver behaviour and attitudes towards traffic regulations and the potential acceptability of remedial measures. The questionnaire is described in detail below.

5.2 Description of the questionnaire survey data contents

The questionnaire consists of various variables which are grouped into six sections (parts) as follows:

The first section is 'Part A: General Information' and it consists of variables related to general demographic information. These include age, sex, nationality, residential area, occupation; workplace, education level, marital status and annual income.

The second section is 'Part B: Car Use' and it consists of variables related to car use in terms of distance travelled annually (kilometres), driving experience and vehicle type.

The third section is 'Part C: Driver Education' and it consists of variables related to driver education and training.

The fourth section is 'Part D: Accidents with Motoring Offences' and requests information variables related to accident type, accident cause, type of violation , driving history, various accidents during the past 10 years, and the various violations committed in the last 5 years.

The fifth section is 'Part E: Driver Behaviour' and it consists of variables related to driving behaviour and attitude towards traffic regulations. There are 27 questions. These 27 questions were classified according to various aspects, such as lack of attention, speeding, overtaking, ignoring priorities, passing red traffic lights, not leaving enough distance from the vehicle in front, and carelessness while driving, which are the main causes of accidents from previous police accident reports. The responses to the questions were taken on a five-point Likert Scale as follows:

1 → 'Always'

2 → 'Usually'

3 → 'Sometimes'

4 → 'Rarely'

5 → 'Never'

Thus 1 represents the worst behaviour (attitude) towards driving and 5 represents the best behaviour (attitude) toward driving.

The sixth section, is 'Part F: Remedial Measures: your opinions,' consists of variables related to remedial measures such as road design, enforcement of traffic laws, updating traffic laws, traffic education, and driver training. There are 17 questions. The responses to the questions were taken on a five-point Likert Scale as follows:

1 → 'Extremely Agree'

2 → 'Agree'

3 → 'Not Sure'

4 → 'Disagree'

5 → 'Extremely Disagree'

The last page of the questionnaire consisted of free space for 'Suggestions and Comments' (see Appendix: D).

5.2.1 Aggressive driver behaviour score modification

Reason *et al*. (1990) developed a questionnaire to measure concepts and types of driver behaviour (sections entitled 'Errors' and 'Violations'). Stradling and Meadow (2000) modified this further to produce the Manchester Driver Behaviour Questionnaire, on which the questionnaire for this thesis is based. The questionnaire regarding driver behaviour in Kuwait is somewhat modified to suit expected driver behaviour in Kuwait.

According to Lajunen *et al.* (2004), The Manchester Driver Behaviour Questionnaire has been used across the world, for example in Australia by Blockley & Hartley (1995), Sweden (Aberg & Rimmo, 1998), New Zealand (Sulmann & Meadows, 2000), China (Xie *et al*., 2000) Finland and the Netherlands (Lajunen *et al*., 1999) and Turkey (Sümer *et al*., 2002).

The Manchester Driver Behaviour Questionnaire (DBQ) aimed to measure how often drivers experience each of the following three categories of lapses, errors and violations.

As regards lapses, the questionnaire asked how often drivers tried to pull away from traffic lights in third gear, how often they operated the wrong switch, took the wrong lane approaching roundabout or junction, misread signs on exiting roundabouts, how often they felt disorientated, reached a wrong destination, forgot where they had left their car in the car park or hit something when reversing.

Such lapses are usually considered not to be life-threatening. They were more commonly reported by females than by male drivers. Age was also found to be statistically associated with lapses, with older drivers tending to report more.

As regards errors, the Manchester questionnaire asked how often respondents failed to see a `Stop' or `Give Way' sign and narrowly avoided colliding with traffic having the right of way, how often they failed to observe cyclists, pedestrians crossing side roads, failed to check the rear-view mirror before pulling out or changing lanes, and failed to pay attention to the vehicle in front when it was about to turn off the main road. Other errors identified were braking too quickly on a slippery road, or steering the wrong way in a skid, underestimating the speed of an oncoming vehicle when overtaking, and attempting to overtake someone signalling an offside turn. “Errors constitute the failure of planned actions and include failures in observation and misjudgements” (Reason *et al*., 1990).

The Manchester Driver Behaviour Questionnaire asked questions on violations, such as how often drivers disregarded the speed limits late at night or very early in the morning, crossed a junction knowing that the traffic lights were changing, drove close to the car in front in an aggressive manner, overtook on the inside, raced with other drivers, showed hostility to a particular class of road user, or expressed anger verbally.

Violations are typical of aggressive behaviour driving. They are deliberate deviations from practices believed important to maintain safety in a potentially hazardous system (Reason *et al*., 1990).

Based on the Manchester studies, the driver violation score was found to be a much better predictor of level of accident involvement than the error or lapse score. However, according to Reason *et al*. (1990), both errors and violations potentially lead to accidents, whereas lapses are unlikely to have a major impact on driving safety.

Many road safety professionals cite speeding and alcohol as the most important immediate precursors of crashes. The Manchester analysis divided aberrant driving behaviour into three kinds: speeding, drink-driving and other general classes of violations, speeding being the most frequent violation.

Lawton *et al*. (1997) categorised violations according to motivational interpersonal aggression ('aggressive violation') and deliberate deviation ('ordinary violations'). On the other hand, Lajunen and Parker (2001) and Lajunen *et al*. (1998) stated that violation items are sometimes difficult to differentiate, because of local conditions, snow on the road (Scandinavia) or larger number of cyclists (Holland). Also, culture plays a part. Sounding the horn clearly reflects aggression in Scandinavia, while in Southern Europe, the horn is used much more liberally. Culturally sensitive items need careful consideration for international comparisons. Therefore, the distinction between "ordinary" violation and aggressive violation may depend on the context and the intention behind the act.

The literature referred above noted variations in the categories of lapses, errors and violations that reflect true cultural differences. Traffic cultures may vary at regional level. The Manchester Driver Behaviour Questionnaire Item “brake too quickly on slippery road” has very different meanings in countries with a long snowy winter and in countries where snow tyres are never required. Similarly, cycling is very much more common as a daily form of transport in the Netherlands than in the hilly part of Turkey, and so attention to cyclists is much more relevant in the former country.

Aggressive driving behaviour has various kinds of definitions. The most comprehensive definition is as follows: “The operation of a motor vehicle in a manner that endangers or is likely to endanger people or property” (NHTSA, 1998). The factors listed by James and Nahl (2000) as representative of aggressive driving are: Running stop signals, Blocking intersections, Failing to yield right-of-way, Weaving in/out of traffic, Speeding above the limit, Tailgating, Failure to use indicators when required, Changing speed erratically, Blocking other vehicles, Communicating threats or insults with voice, Gestures, or sounding the horn unnecessarily, Intentionally breaking suddenly, and Chasing other vehicles. Other authors add other factors, such as careless driving, failure to stop for pedestrians, cell phone usage and so on.

In the current survey, questions were selected to be related to errors and violations. Violations are more closely related to accident involvement. The driver behaviour score is used as an index of aggressive behaviour (average score of 21 questions related to violation and accident causation in Kuwait), taking into consideration firstly accident causes as identified in police accident reports (Lack of attention, Changing lane, Swerving, Ignoring Priority, Not leaving enough distance, Passing a red signal, speeding, Accidents involving pedestrians, and other); secondly according to offences common in Kuwait; and thirdly in relation to the traffic environment and culture in Kuwait. For example, a striking difference in Muslim culture is that alcohol is not commonly consumed.

The driver behaviour section in the questionnaire survey consists of twenty-seven questions, twenty-one items of which relate to violations (14,15,16,17,19,20,23,24 ,25,26,27,28,29, 30,31,32,33,34,36,38, 40) while the other 6 items are related to errors (Appendix D)

Parking on a double yellow line, failure to use a seatbelt, indicators or to check a blind spot when driving and misjudging the distance required to stop could all be part of aggressive driving behaviour, or could just be considered as careless or negligent driving. Questions on such failure and misjudgement (6 error items) were included in the survey, but have not been included in the assessment of aggressive driving behaviour (only the 21 items of violations).

5.3 The questionnaire survey data collection

A pilot survey of 67 questionnaires was distributed to Kuwaiti drivers in the UK in November 2005 to identify potential problems of design. 15 of the sample were interviewed for further clarification, and some questions were removed after the pilot survey. For example, many respondents are not able to specify what their weekly mileage is, but would be more able to calculate their annual mileage. Another question that may cause discomfort is regarding whether drivers 'enjoy' speeding.

In the main survey, from 3/12/2005 to 15/1/2006, 2,500 questionnaires were distributed to a random sample of drivers at various locations in Kuwait (six governorates) in both Arabic and English form. Every opportunity was taken to distribute the questionnaires, such as at schools, in supermarkets, at meeting places, at the airport, in the mosque and even in the street. It was found useful to talk to senior managers in both the public and private sector, as they could also give access to non-Kuwaiti workers. 50% of the sample were Kuwaiti drivers and 50% were non-Kuwaiti drivers in this survey. A total of 1,614 questionnaires were returned, 86 questionnaires were rejected, either because they were incomplete or because answers were considered to be unrealistic (for example, the same response being given for every question); therefore the total number of respondents was 1,528. The overall response rate was 61%; 72% of the respondents were male and 28% were female (in the total population of Kuwaiti license holders, 78% were men and 22% women in 2004). The mean age of the participants was 32.1, the youngest being eighteen and the oldest seventy.

The response rate from Kuwaiti drivers was higher than from non-Kuwaiti drivers (80% and 42%, respectively). Failure to respond could have been because the questionnaire may have been longer than was seen acceptable by some people. However, the overall response rate of 61% was considered good, since no reward was given for filling in the questionnaire, and perhaps reflects the importance of road safety to the respondents. The high response rate should have reduced bias, but there was some possibility that, for example, those with very high accident rates may not have responded. This is discussed further in Chapter 7.

5.4 Characteristics of respondents

5.4.1 Geographical distribution

The questionnaire was distributed to Kuwaiti drivers in all the six governorates (see section 5.3). The distribution of drivers with a licence in 2005 was 29% from Hawally, 28% from the Capital, 19% from Farwania, 15% from Ahmadi, 7% from Jahra and 2% from Mubarak Alkabeer. The distribution of respondents to the questionnaire was similar. The largest group of respondents were from Hawally Governorate (434, 28.4%), the second largest group of respondents were from the Capital Governorate (344, 22.5%), the third group (321, 21%) from Farwania Governorate, the fourth group (246,16.1%), from the Ahmadi Governorate, the fifth group (105, 6.9%) from Jahra Governorate and the sixth (78) 5.1% from Mubarak Alkabeer.

5.4.2 Education level and socio-economic status

In terms of education level, the respondents were classified into five levels, as follows:

1) Below High school (7%)

2) High school (32%)

3) Diploma (18%)

4) Bachelor Degree (35%)

5) Postgraduate Diploma (8%).

In terms of marital status, 60.7% were married and 39.3% unmarried. The respondents reported their current job and their total monthly income. This information was used to ensure that the sample came from different social segments.

5.4.3 Traffic safety education

Only 32.2% of the respondents had any traffic safety education training whilst at school. This shows that traffic safety education needs to be employed for all children at school, starting from the first year, which could help to produce good drivers and responsible pedestrian behaviour, since from the police reports, 19% of casualties are pedestrian and 21% of them are children under the age of 12 years. “This type of education both helps children avoiding road accidents when they are young and makes them safer when they become adult” (Quimby, 2001).

5.4.4 Driving education

The theoretical driving education in Kuwait is generally poor. The results show that only 17.8% of the sample had taken theoretical driving education courses in school, at work or in self study before they obtained their driving licence. The theory test in Kuwait is far below the level of examination in the UK, where individuals have to study a book of around one thousand questions and the take hazard perception test. The theoretical test in Kuwait consists of only around 25 questions of different kinds that the driver has to study, including some on traffic signs (Section 3.1.11.1).

5.4.5 Training (learning to drive)

53.3 % (809) had learnt driving with driving instructors or at driving school, 26.5% (403) learned by themselves, 18.6% (283) learned either with relatives or friends and the remaining 1.6% (34) learned using a variety or combination of methods. In other words, 53.3% of the respondents were officially trained and 46.7% were trained unofficially. The proportion will vary when taking into account nationality and gender.

It was found that 59% of male drivers were unofficially trained, while 14.7 % of female drivers were unofficially trained. 54.5% of Kuwaiti drivers were unofficially trained and 32% of non-Kuwaiti drivers were unofficially trained.

5.4.6 Illegal driving

The respondents were asked if they had driven illegally on the road before obtaining their driving licence. 36.1% of them had driven illegally before obtaining their driver licence, and 90% of them were less than 18 years old (see Table 5.1).

Table 5.1 Frequency & percentage of people who had driven illegally (under age limit or not having a driving licence).

Age	frequency	percentage
Under 14	21	4.1%
14	35	6.8%
15	55	10.7%
16	145	28.2%
17	205	39.8%
18	30	5.8%
Over 18	24	4.6%

This shows carelessness in 'obeying the driving regulations'. In more detail, it was found that 45% of men had been driving illegally **before obtaining the driving licence** while 11.3% of females had been driving illegally on the road **before obtaining their driving licence**. Also, 43% of Kuwaitis & 22% of non-Kuwaitis had been driving illegally on the road before obtaining their driving licence. The implications of this will be discussed below (section 5.7).

5.4.7 Experience

The respondents were asked about their total number of years of driving and it was revealed that the number varied from 1 to 54 years, with a mean of 11.58 years of driving.

5.4.8 Annual kilometres

Annual kilometres ranged from 'less than 5,000 km' to 'over 40,000 km', with a mean of 20,740 km. (see Table 5.2). Figure 5.1 shows the distribution of the annual average kilometres for men and women separately: 22,645 km for men and 15,778 km for females. This shows that men are driving 43.5% more than the distance that females are driving.

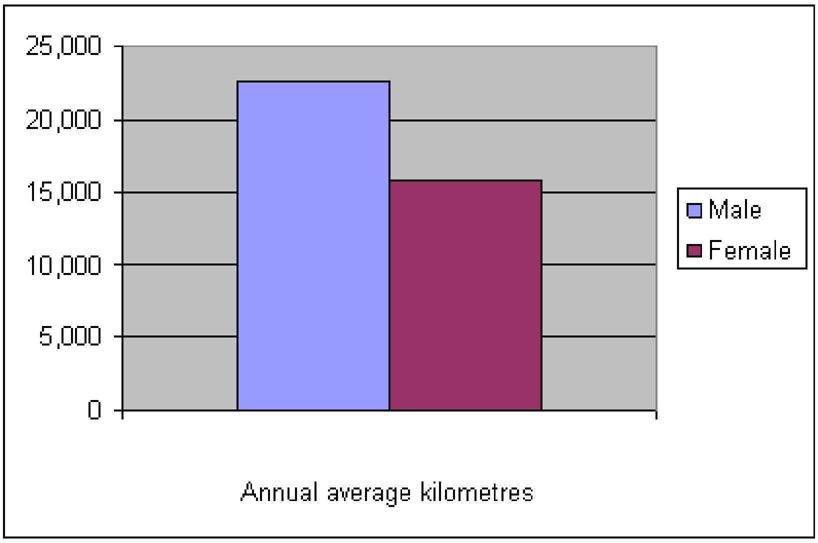

Figure 5.1 Average total kilometres based on gender

Table 5.2 Frequency distribution of annual average kilometres driven.

Annual Average Distance Travelled in km	Frequency
less than 5,000	100
5,000-10,000	212
10,000-15,000	209
15,000-20,000	305
20,000-25,000	174
25,000-30,000	174
30,000-35,000	136
35,000-40,000	97
Over 40,000	121

5.4.9 Accidents

It was found in the survey that, out of 1,528 respondents, 861 (56.4%) had been involved in one or more accidents over the last ten years. 31.3% (478) had been involved in one accident, 15.3% (234) had been involved in two accidents and 9.8% (149) in more than two accidents.

The total number of accidents was 1,489, 84% (1,254) of which involved property damage only and 16% (235) caused injury. The percentage of respondents claiming that the accident was not their fault was higher (58%) than the percentage of those admitting responsibility (42%).

5.4.10 Accident type

Accident type was categorised in the questionnaire according to the most common accident types listed on the police accident reports. The results show vehicle-to-vehicle to be the most frequent accident type, which agreed with the police reports. Pedestrian accidents do not show up as frequently in this sample (because accidents involving injury in this sample were only 16% of the total, whereas police report data include only accidents in which injury occurred, and pedestrians are frequent victims of accidents) (see Table 5.3)

Table 5.3 Accident type (survey)

Accident type	Frequency
Vehicle-to-Vehicle	1,215
Hitting roadside obstacles	158
Overturning	52
Pedestrian accident	22
Other	37
Total	1484

5.4.11 Accident causation

The respondents were asked about the causes of accidents (either their own fault or other drivers' mistakes). The results show that lack of attention was the most frequent, according to police reports. However, there was some variation concerning causes in the survey compared to what was found in the police reports. Speeding represented 12.6% of accident causes in the survey, passing a red light 2.6%, and not leaving enough distance from the vehicle in front 11.4%. On the other hand, speeding represented 3.7% of accident causes in the police reports, passing a red light 7.5%, and not leaving enough distance from the vehicle in front 5.4%. Differences occur because the survey relates to all types of accident, whereas the police reports relate just to accidents involving casualty, and the interpretation of the accident may also be somewhat different between road users and the police (see Tables 5.4 and Figures 5.2).

Table 5.4 Comparison of accident causes between police reports and the survey

Accident Causes	Frequency	
	Police reports	Survey
Lack of attention	845	639
Changing lane (Swerving)	197	148
Ignoring priority of way	84	95
Not leaving enough distance	90	176
Passing red signal	126	40
Speeding	62	194
Puncture or defects	41	48
Pedestrian error	38	31
Other	180	170
Total	1663	1541

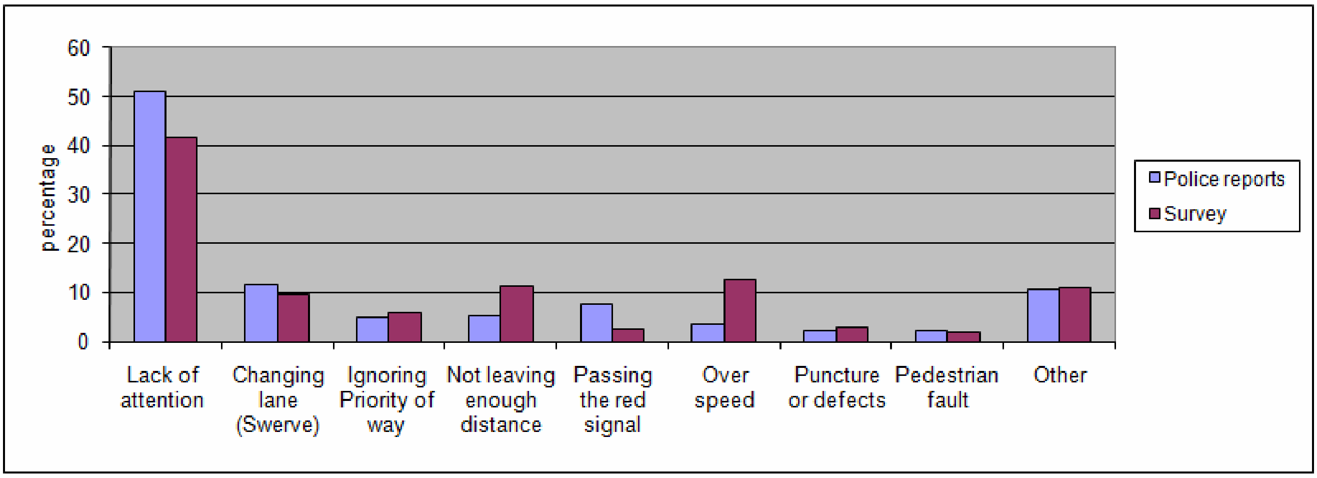

Figure 5.2 The proportion of accident causes in the police reports and the survey

5.4.12 Violations

The most frequent violations from the General Traffic Directorate (GTD) annual statistics are similar to the violation information gathered in the survey data (Tables 5.5 and 3.28). The violations are speeding, passing a red light, parking in a non-parking zone, not wearing a seatbelt, driving on the wrong side of the road, car safety violations, and driving without holding a driving licence. The survey and the GTD annual statistics both have speeding and parking as the most common violations.

Table 5.5 Violation (survey)

Violation	Frequency
speeding	1643
racing on highway	63
passing red signal	555
wrong side	142
no insurance	75
car safety	129
road marking	53
sudden entry or stop	8
ignoring priority of way	11
not wearing the seat belt	422
traffic code violation	40
parking on the pavement	105
damaged licence or plate	39
driving without a licence	47
driving with expired licence or plate	63
driving without holding driver licence	109
parking in non-parking zone	1246
other	199
Total	4949

5.5 Approach to statistical and descriptive analysis

There are many kinds of statistical tests, but each kind of test applies to certain assumptions and conditions, so choosing the appropriate statistical test depends on the nature of the data and the kind of dependent and independent variable (continuous or categorical, for example, that may be relevant).

In this survey, the descriptive analysis involves: 1) the overall driver aggressive behaviour score as a continuous dependent variable, and 2) accident involvement as a categorical dependent variable. The results based on these two dependent variables are described separately in sections **5.6.1** and **5.6.2** in relation with independent variables. SPSS software has been used for all descriptive analysis.

A T-test (two sample T-test) and a one-way analysis of variance (ANOVA) is appropriate for testing hypotheses in the case of the dependent continuous variable with other categorical independent variables, and a chi-square test is appropriate for testing hypotheses in the case the of categorical dependent variable with other categorical independent variables.

The T- test is a general method to compare two different independent population means. It is simply a test of whether or not two independent populations have different mean values. The one-way ANOVA technique is an extension of the two sample T-test. It is applied when the comparison involves three or more levels of single independent variables. In both tests, the null hypothesis is that the means (average values of the dependent variables) are equal, and the distribution is assumed to be normal or approximately normal, if the sample size is sufficiently large. In ANOVA, the F-test reflects whether the group means of the dependent variable differ significantly from each other.

The effect size index, Eta square **(η^2)**, which indicates the relative magnitude of the differences between means, is used to assess the importance of the results. Generally, Eta square **(η^2)** is the proportion of variance of the dependent variable associated with a given independent variable. Usually the η^2 index of 0.01, 0.06, and 0.14 represent small, medium and large effect sizes, respectively (Green *et al*., 2000).

In order to determine which groups (independent variables) are different from which, as in the case of the one-way ANOVA, post-hoc multiple comparisons using Dunnett's C test (a test that does not assume equal variances) are made to determine the differences in each pair's group mean.

The chi-square test (χ^2) test is a classical statistical method that allows the testing of the independence of categorical variables. This test will indicate associations in cross-tabulated data, based on chi-square distribution. It also indicates significance or not in associations between rows and columns in a two-way table.

Odds ratio analysis is a common measure of association for 2 by 2 tables. It is widely used in medical studies of risk factors, such as the relation of a treatment to heart attacks, but risk can be applied to any situation in which the independent (column) variable is a treatment or cause and the dependent (row) variable is an outcome or effect. In this study's case the dependent variable is accident involvement, which must be a binary variable, for example either 'not involved in an accident' or 'involved in more than one accident'. The independent variable must also be binary, such as age, gender, marital status, experience, nationality, education level, driver education, driver training and speed limits.

Cramer's V is a statistical measure of the strength of association (dependency) between two (nominal) categorical variables in a contingency table (it assesses the strength of the relationship between the row & column variable or what we call the effect size).Values range from 0 (no association) to 1 (maximum possible association). Traditionally Cramer's V of 0.1, 0.3, and 0.5 represent small, medium and large effect size respectively.

In any hypothesis testing, it is necessary to specify a value for the probability of type I error (**α**), which is called the significance level of the test. From this probability, we reject the null hypothesis (H_o) if the p-value is less than α, which is typically set at 0.05. Over a number of generations of statistical analysis, it has become customary to choose an alpha of 0.05 and accordingly select the critical region.

Holm's Sequential Bonferroni corrections are the standard approach for controlling type I error. The observed significance level (α) is adjusted when performing pair-wise comparisons in a two-way contingency table.

5.5.1 Reliability Analysis

An internal consistency estimate of reliability was computed for all the 21 violations' variables representing the aggressive driving behaviour scale, after having dropped the six items which represent errors (Section 5.2.1.) The value of Cronbach's Alpha was calculated as 0.897, which shows a very high internal consistency among these 21 variables.

5.5.2 Factor analysis

Before starting the analysis of "Aggressive Driving Behaviour" a factor analysis statistical method was conducted to analyse the dimension of the 21 items of aggressive driving behaviour using principal component methods with varimax rotation. Three criteria are normally used to determine the number of factors to rotate: the *a priori* hypothesis that the measure was unidimensional, the "SCREE TEST", and the interpretability of the factor solution. First factor analysis using the Principal Components extraction method was run to reassess its factor structure. The output showing the initial statistics and the "SCREE PLOT" from the principal components analysis is displayed in Table 5.6, Table 5.7 and Figure 5.3, below.

Table 5.6 Eigenvalues computed by principal component analysis.

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.036	33.503	33.503	3.311	15.768	15.768
2	1.550	7.383	40.886	3.269	15.567	31.334
3	1.192	5.678	46.564	2.287	10.890	42.224
4	1.068	5.084	51.648	1.979	9.424	51.648
5	.941	4.482	56.130			
6	.838	3.991	60.121			
7	.798	3.798	63.919			
8	.738	3.516	67.435			
9	.722	3.436	70.871			
10	.673	3.205	74.076			
11	.646	3.076	77.152			
12	.606	2.884	80.036			
13	.597	2.841	82.877			
14	.558	2.658	85.535			
15	.514	2.446	87.981			
16	.470	2.240	90.221			
17	.462	2.200	92.421			
18	.430	2.047	94.468			
19	.424	2.021	96.489			
20	.390	1.857	98.346			
21	.347	1.654	100.000			

In Table 5.6, the Eigenvalues are listed for components 1 to 21. These are important quantities. The total amount of variance in an analysis is equal to the number of variables (in this case 21). The extracted factors (or components, because the principal components were used as the extraction method) account for the variance among these variables. An Eigenvalue is the amount of variance of each variable accounted for by a factor. An Eigenvalue for a factor should be greater than or equal to zero and cannot exceed the total variance, 21 in this case (21 variables to be factorized). The percentage of variance of the variables accounted for by the factors as shown in the output is equal to the Eigenvalue divided by the total amount of variance times 100. Thus the Eigenvalue associated with the first factor is 7.036 and the percentage of total variance accounted for by the first factor will be equal to = (7.036 / 21) * 100 = 33.503.

Eigenvalues are helpful in deciding how many factors should be used in the analysis. Many criteria have been proposed in the literature for deciding how many factors to extract based on the magnitude of the Eigenvalues. One criterion is to retain all factors that have Eigenvalues greater than one (Green *et al*., 2000). Thus by default, in this case, it will be four components See table 5.7. The four components accounted for 15.77%, 15.57%, 10.89% & 9.42% of the variances in the 21 variables; in total, 51.65 %.

The first component included 9 items. These items are Q24, Q25, and Q26, which related to driver stated behaviour towards traffic signals, Q27 and Q30 related to driver behaviour towards right of way at major/ minor roads and U turns, Q36 and Q38, are related to driver behaviour towards changing lane or direction, Q23 related to following behaviour to the vehicle in front, and finally Q34 related to driver behaviour towards inattention (distraction) while driving.

The second component consisted of 6 items: Q14, Q 15, Q16, Q17, and Q19 were related to driver behaviour towards speeding; Q14 could lead to speeding (indirectly). Q20 is related to behaviour towards lane changing (overtaking), which could involve speeding.

The third component contained 3 items: Q32 is about showing anger to other road users, Q33 is about inattention while driving by using a mobile phone, and Q40 is about aggressive following behaviour.

The fourth component also contains 3 items: Q28 and Q29 are about right of way at stop signs and roundabouts, and Q31 is about stopping for pedestrians at zebra crossings (Table 5.7).

It can be seen that the components were not always classified as expected. For example, the third component contained a mixture of violations which have different natures (not similar set of factors): showing anger to other road users, using the mobile phone while driving, and not leaving enough distance from the vehicle in front.

Table 5.7 Rotated Component Matrix

	Component			
	1	2	3	4
Q27	.671	.184	.008	.172
Q26	.666	.259	.156	.083
Q25	.634	.334	.139	.064
Q38	.611	-.129	.262	.080
Q36	.479	.292	.399	.194
Q23	.477	.389	.283	.116
Q24	.471	.431	.292	.025
Q30	.444	.149	-.007	.339
Q34	.415	.266	.305	.176
Q14	.136	.758	.172	.090
Q15	.204	.715	.038	.187
Q16	.178	.694	.367	.104
Q19	.157	.630	.376	.107
Q17	.375	.445	-.069	.005
Q20	.382	.409	.269	.072
Q32	.106	.044	.737	.027
Q40	.332	.262	.631	.111
Q33	.081	.312	.626	.129
Q28	.140	.086	.149	.792
Q29	.211	.048	-.016	.753
Q31	.027	.132	.129	.663

However, this way of deciding the factors according to the Eigenvalues does not give the correct result in most of the cases (Green *et al*., 2000). Thus another criterion is to examine the plot of the Eigenvalues, also known as the **"SCREE PLOT".** In the Scree plot one should retain all the factors with "EIGENVALUES" in the "SHARP DECENT PART OF THE PLOT" before the Eigenvalues start to level off. This criterion more frequently yields accurate results than the **"Eigenvalues-greater-than-1"** criterion.

Based on the Scree plot, as shown in Figure 5.3, it may be concluded that, in the current study only one factor should be rotated out of the 21 variables. Having only one factor, the process stops there. The only factor or the first factor (in this case) accounted for 33.503% of the variable variance. Thus, based on the factor analysis we have calculated the "Aggressive driving behaviour score" from these 21 variables only. The score is computed by adding all the 21 variables and dividing by 21 to give the mean score for each individual driver.

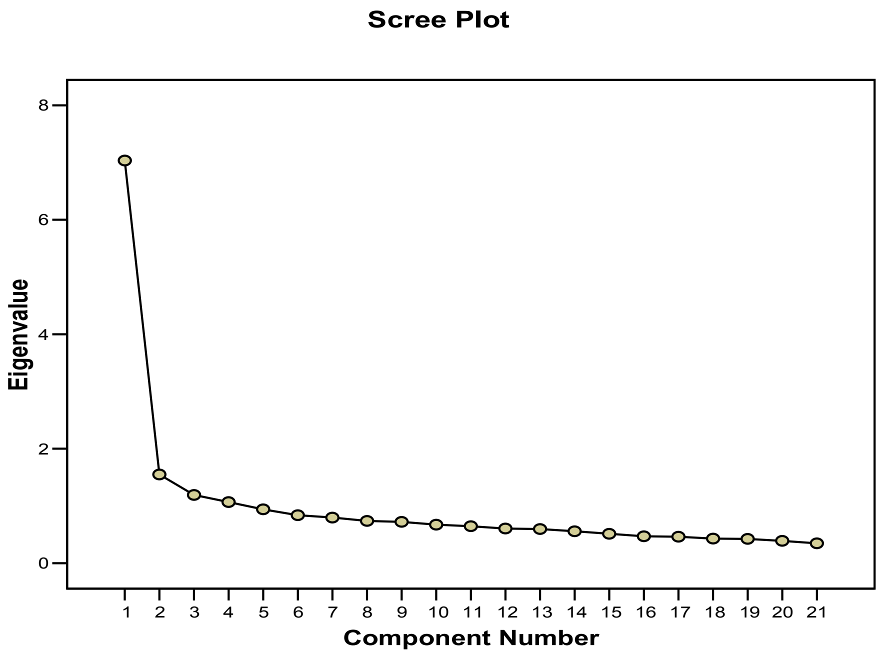

Figure 5.3 Scree Plot for the 21 items of the aggressive driving behaviour score

5.6 Results

5.6.1 Overall aggressive driver behaviour score with other factors

The overall aggressive driver behaviour score has been introduced as a dependent variable and the other factors (Age, Gender, Education Level, Marital Status, Nationality, Driver Experience, Driver Education, and Driver Training) are independent variables. An overall driver behaviour score is calculated as an average of the 21-question Part E of the questionnaire for each individual driver. The T-test is used to compare the significant differences in overall driver behaviour scores between two independent groups (such as Gender, Marital Status, Nationality, Driver Education, and Driver Training). When the analysis involves three or more groups, such as Age, Education Level and Driver Experience, the One Way ANOVA technique will be applied to test the significant differences between them, whilst Dunnett's C test will be used to test the significant differences between each single group and other groups (multiple comparisons). In both the T- test and One Way ANOVA the level of significance is at the 0.05 level ($P < 0.05$).

5.6.1.1 Age (Age versus Driver Behaviour Score)

A One-way analysis of variance was conducted to evaluate the relationship between "age" and "driver behaviour score". The hypothesis assumed that the younger age group drivers have more aggressive driving behaviour on the road than the older age group drivers. The independent variable, the age factor, had four age ranges: 18-29, 30-39, 40-49 & 50-above. The dependent variable was the driver behaviour score. A lower driver behaviour score indicates more aggressive behaviour on the road. The ANOVA was significant, $\underline{\mathbf{F}}$ (3, 1524) = 97.658, $\underline{\boldsymbol{p}} < .0001$. The strength of the relationship between age group and driver behaviour score, as assessed by $\boldsymbol{\eta}^2$, was strong, with the age factor accounting for more than 16% of the variance of the dependent variable.

Follow-up tests were conducted to evaluate pair wise differences among the means. Because the variances among the four groups ranged from 0.22 to 0.37, it was not assumed that the variances were homogeneous, and post hoc comparisons were conducted using Dunnett's C test, a test that does not assume equal variances among the four groups. The results of these tests, as well as the means and the standard deviations for the four age groups, are given in Table 5.8. There were significant differences in the means between the age groups (18-29, 30-39), (18-29, 40-49), (18-29, 50-above), (30-39, 40-49), (30-39, 50-above), but no significant differences in the means between the age groups (40-49, 50-above) were found. The drivers of the age group 18-29 showed the highest aggressive behaviour (mean = 3.45), whereas the drivers of the age group 50-above showed the lowest aggressive behaviour (mean= 4.13) (Figure 5.4). Thus the results of the ONE-WAY ANOVA supported the hypothesis that the younger age group displays more aggressive driving on the road than the older age group. Young drivers, compared with other groups, are more likely to underestimate the probability of specific risks caused by traffic situations (Brown & Gorger, 1988; Deery, 1999) and they overestimate their own driving skills (Moe, 1986).

Table 5.8 Driver behaviour score among different age groups

Age Group	N	Mean	SD	18-29	30-39	40-49
18-29	714	3.45	0.61			
30-39	429	3.76	0.54	*		
40-49	278	4.00	0.48	*	*	
50-above	107	4.13	0.47	*	*	NS

Note: NS= non significant differences between pairs of means, while (*) = significance using Dunnett's C procedure.

The practical implication of these results is that younger drivers are more aggressive on the roads than older drivers; the lower age group compares unfavourably with the other age groups. The 30's age group also compares unfavourably with the 40's and over 50's age group, among whom there was no significant difference.

Thus, it could be recommended that the driving test be made more stringent for younger drivers. More strict penalties should be imposed on drivers who violate the law repeatedly. A points system should be more effective in Kuwait, which may solve many problems regarding this issue. (This is discussed further in section 8.3.5.)

It could be effective to apply different levels of penalties to different categories of offences. For example, in the form of compulsory driver training, suspending the driving licence or retest. Various types of retest could also be considered depending on the severity of the case and requirements.

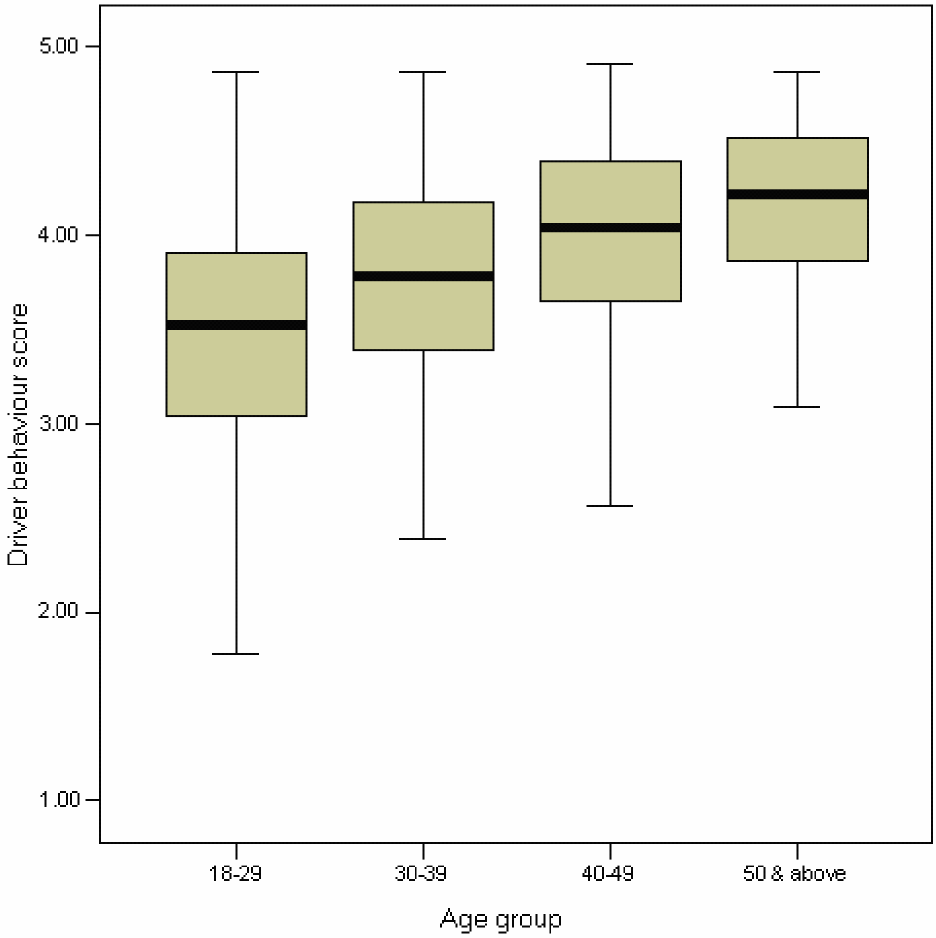

Figure 5.4 Aggressive behaviour box plots and means for different age groups

5.6.1.2 Gender (Gender versus Driver Behaviour Score)

An independent-sample t -test was conducted to evaluate the hypothesis that male drivers have more aggressive driving behaviour on the road than female drivers. The test was significant, t (953.117) = (-2.41), p = 0.016. The results of the independent-sample t -test supported the hypothesis that male drivers (M = 3.66, SD = 0.64, N=1104) on average have more aggressive driving behaviour than female drivers (M = 3.74, SD = 0.512, N=424) (see figure 5.5). This was also found in a survey undertaken by Laapotti *et al*. (2003), which evaluated driver attitudes towards road safety in Finland. The study revealed that female drivers had a more positive attitude towards road safety and rules than male drivers.

In the current study, the eta square index (η^2) indicated that **only** 0.4% (very weak) of the variance in aggressive driving behaviour was accounted for by gender. This means that gender is not a strong factor in aggressive driving behaviour in Kuwait. (More investigations on this issue will be discussed in the next chapter, where multivariate analysis is applied.)

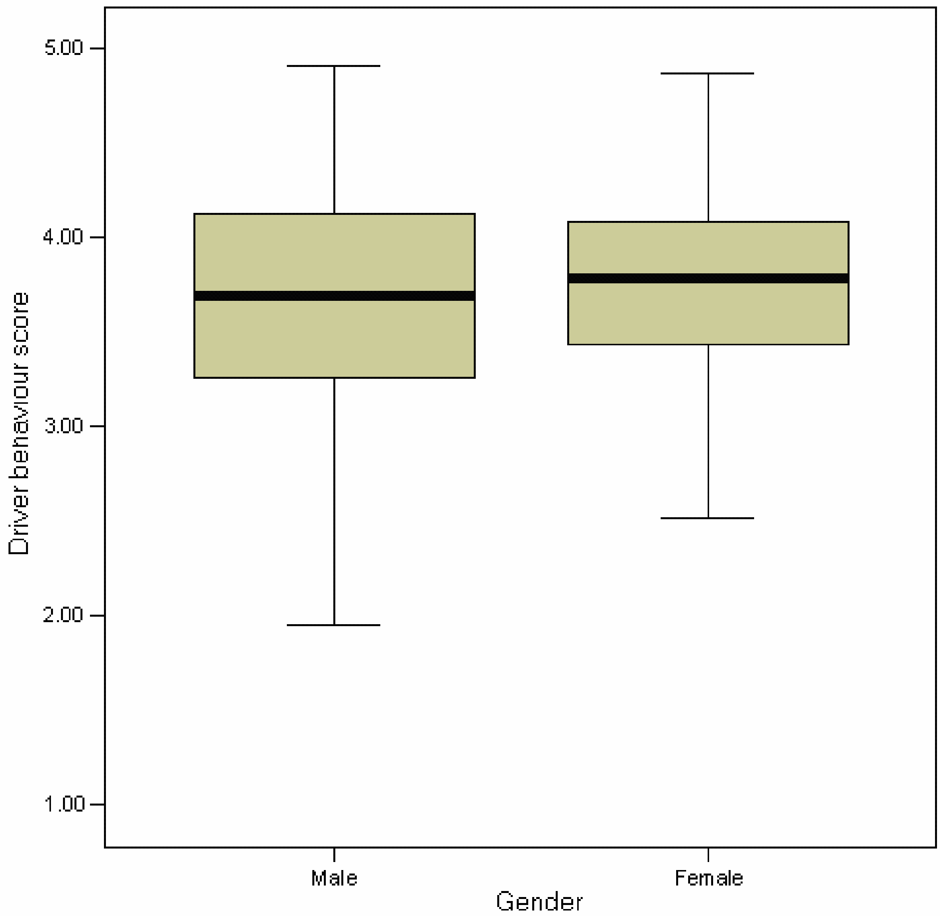

Figure 5.5 Aggressive behaviour means and box plots based on gender

5.6.1.3 Nationality (Nationality versus Driver Behaviour Score)

An independent-sample t -test was conducted to evaluate the hypothesis that Kuwaiti drivers have more aggressive driving behaviour than non Kuwaiti drivers. The test was significant, t (1526) = (-14.55), $p < 0.001$. The results of the independent-sample t -test supported the hypothesis that Kuwaiti drivers (M = 3.53, SD = 0.57, N=1001) on the average are more aggressive drivers than non-Kuwaiti drivers (M = 3.97, SD = 0.57, N=527) (see figure 5.6). The eta square index (**η**^{2}) indicated that 12.2% of the variance in aggressive driving was accounted for by nationality, a strong factor.

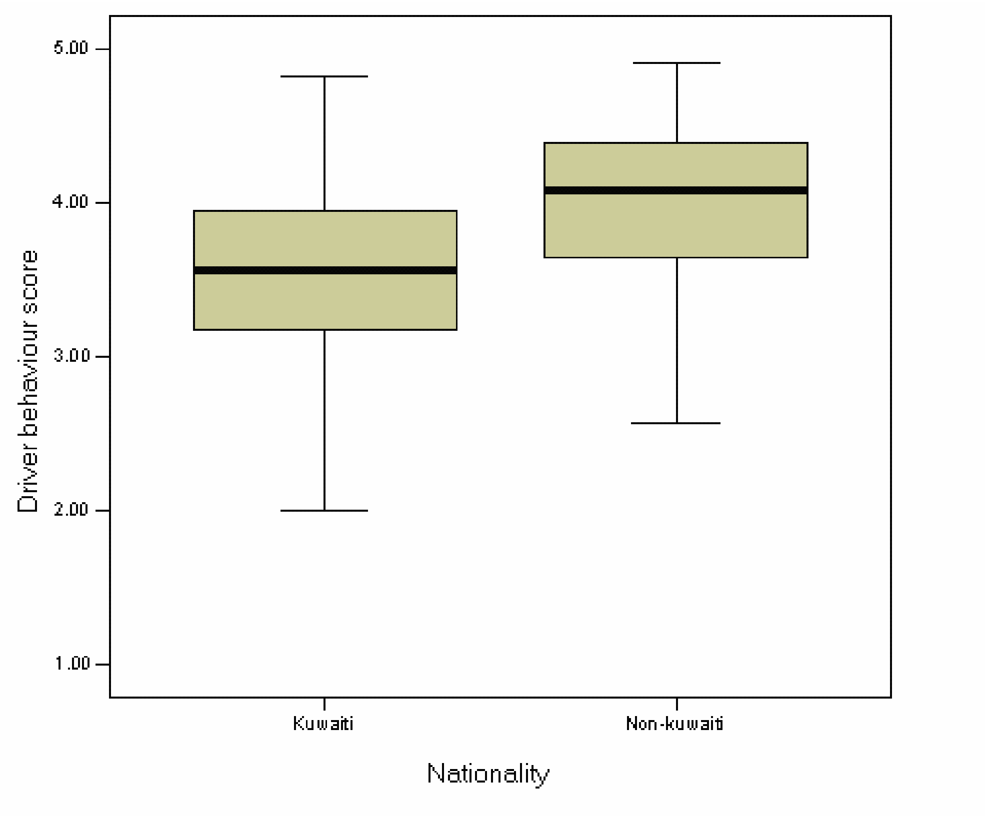

Figure 5.6 Aggressive behaviour means and box plots based on nationality

One reason is that there are more young Kuwaiti drivers than young non-Kuwaiti drivers in the country's population and the sample as well (90% of Kuwaiti drivers are in the age group 18-24 in the sample.) The independent-sample t-test was run again, excluding 500 cases of young drivers in the age range 18-24. As a result, Kuwaiti drivers still had more aggressive driving behaviour than non-Kuwaiti drivers. The test was significant, t (1026) = (-10.41), $p < .001$. (M = 3.68, SD = 0.51, N=555) (M = 4.02, SD = 0.55, N=473). The eta square index (η^2) indicated that 9.6% of the variance in aggressive driving was accounted for by nationality, which is less than strong but above medium (between strong and medium). It can be seen that the effect of removing young drivers from the sample reduced the eta square index (η^2) from 12.2% to 9.6%, but still there was a significant difference between Kuwaitis and non-Kuwaitis in terms of driving aggressively.

This outcome could be because non-Kuwaitis are more concerned about having to pay fines than Kuwaiti drivers, who generally have better financial status, so normally do not care about the fines they may pay.

The practical implication is that fines on Kuwaiti citizens are ineffective. It might be an idea to have penalties linked to financial status. In Finland, fines are generally based on two factors: the severity of the offence and the driver's income (Lappi-Seppala, 2004). In Finland and elsewhere in Scandinavia, fines known as day-fines were imposed from 1999 to ensure equal severity of fines for offenders on different incomes and level of wealth. First of all a day-fine is calculated to be roughly half of the offender's daily income, after taxes. Secondly according to the severity of the offence, the number of days' of day-fines is fixed between 1 and 120. For example the typical number of day-fines for drunken driving would be around 40 day-fines. The monetary value of one day-fine for a person who earns 1500 euros/month would be 20 euros, according to Lappi-Seppala (2004). For someone with a monthly income of 6000 euros, the amount of the one day-fine would be 95 euros. Thus the total fine for the same offence would be for the former offender 800 euros and for the latter 3,800 euros. There was a significant reduction in traffic violations after applying the day-fine system in Finland, according to the table in Lappi-Seppala's article (Table 5.9).

Other countries in Europe (Germany, Austria and France) have been influenced by the model, but the idea did not receive support in England and Wales.

Table 5.9 The use of fines in Finland, 1970-2000

	1970 **N**	1980 **N**	1990 **N**	1995 **N**	2000 **N**
- penalty order (prosecutor)	150 542	249 006	311 889	277 530	196 156
-of these, traffic violations	129 140	189 752	252 239	234 977	137 677
-Petty fine (the police: only traffic violations)			69 291	52 009	103 499

Source: Lappi-Seppala's Table (2004)

It could be suggested that young Kuwaiti drivers of some social status may be tempted to drive recklessly knowing that they have connections and may be able to get away with their misdemeanour. Traffic laws should be enforced, no matter what the social status of the driver.

5.6.1.4 Marital status (Marital status versus Driver Behaviour Score)

An independent-sample t-test was conducted to evaluate the hypothesis that drivers who were single had more aggressive driving behaviour than drivers who were married. The test was significant: $t\ (1134.216) = -13.173$, $p < 0.001$. The results of the independent-sample t-test initially supported the hypothesis that single drivers ($M = 3.43$, $SD = 0.63$, $N=601$) on average had more aggressive driving behaviour than married drivers ($M = 3.84$, $SD = 0.54$, $N= 927$) (see Figure 5.7). The eta square index (η^2) indicated that 11% of the variance in aggressive driving behaviour was related to marital status.

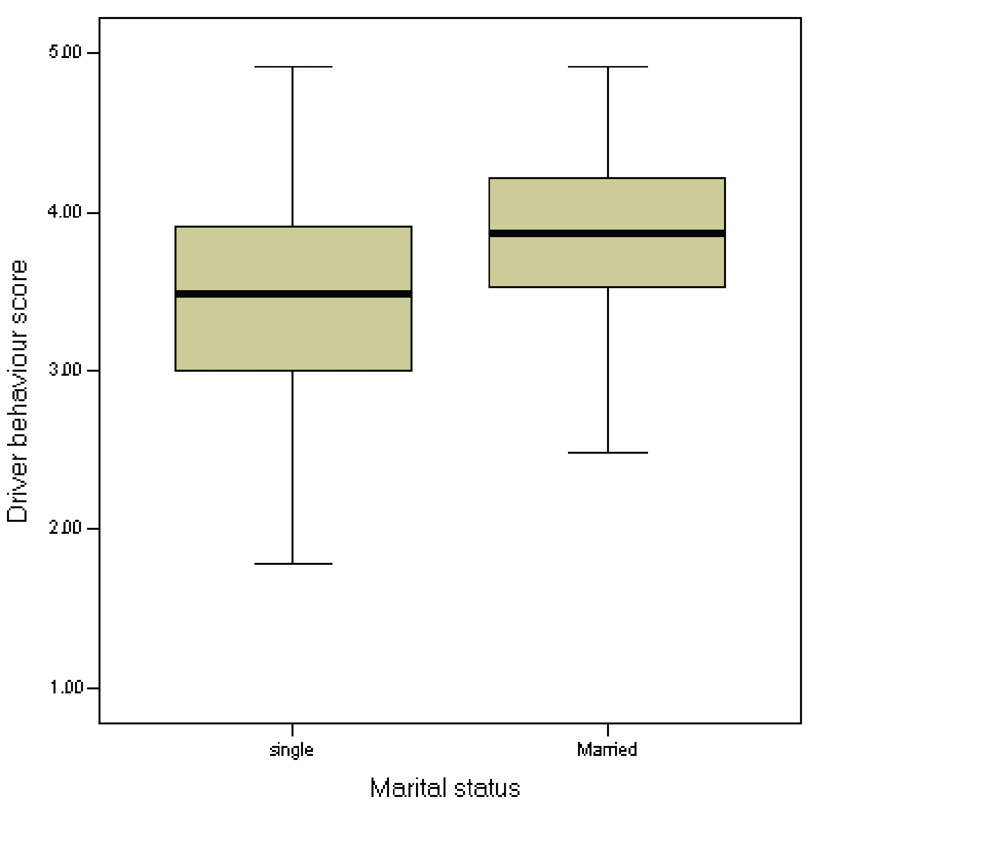

Figure 5.7 Aggressive behaviour means and box plots based on marital status

However, there were more young single drivers than married drivers in the sample (87% of drivers in the age group 18-24 were single). The independent-sample t-test was re-run after dropping 500 cases of young drivers in the age range 18-24. As a result, single drivers still have more aggressive driving behaviour than married drivers. The test was significant t (221.107) = -3.24, p = 0.001. The results of the independent sample t-test supported the hypothesis that single drivers (M = 3.63, SD = 0.63, N=165) on average had more aggressive driving behaviour than married drivers (M = 3.86, SD = 0.53, N= 863). **However, the eta square index (η^2) dropped from 11% to 1.3%, which means that the young age plays a major role in aggressive driving behaviour, rather than marital status.**

Marital status still has a small effect on aggressive driving behaviour. Married drivers perhaps have more concern, due to family responsibilities. There is an implied need for further education and training of young, unmarried drivers, either through the media or driving schools in order to increase their feeling of responsibility and improve their hazard perception.

5.6.1.5 Education level (Education level versus Driver Behaviour Score)

One-way analysis of variance was conducted to evaluate the relationship between "education level" and "driver behaviour score". The hypothesis assumed that the lower the level of education the more aggressive the driving behaviour on the roads would be. The independent variable, the education level factor, included four levels: Up to High school, Diploma, Bachelor Degree, and Postgraduate. The dependent variable was the driver behaviour score. (A lower driver behaviour score indicates more aggressive behaviour.) The ANOVA was significant, F (3, 1524) = 37.48, $p < 0.0001$. The strength of the relationship between education level and driver behaviour score, as assessed by η^2, was less than strong, with the education level factor accounting for 7% of the variance of the dependent variable.

Follow-up tests were conducted to evaluate pair wise differences among the means. Because the variances among the four groups ranged from 0.29 to 0.41, it was not assumed that the variances were homogeneous, and post hoc comparisons were conducted using Dunnett's C test, a test that does not assume equal variances among the four groups. The results of these tests, as well as the means and the standard deviations for the four groups, are reported in Table 5.10a. There were significant differences in the means between the groups (Up to High school, Diploma), (Up to High school, Bachelor), (Up to High school, Postgraduate), (Diploma, Postgraduate), but no significant differences in the means between the groups (Diploma, Bachelor), (Bachelor, Postgraduate) were found. The drivers with Up to High school level showed the highest aggressive behaviour (mean = 3.49), whereas the Postgraduate drivers showed the lowest aggressive behaviour (mean= 3.92) (see figure 5.8).

Initially the results of the ONE-WAY ANOVA supported the hypothesis that lower education level drivers had more aggressive driving behaviour than those who had a higher education level.

Table 5.10a Driver behaviour score among different education levels

Groups	N	M	SD	Up to High school	Diploma	Bachelor
Up to High school	599	3.49	0.640			
Diploma	273	3.76	0.572	*		
Bachelor	531	3.81	0.544	*	NS	
Postgraduate	123	3.92	0.609	*	*	NS

Note: NS = non significant differences between pairs of means, while (*) = significance using Dunnett's C procedure.

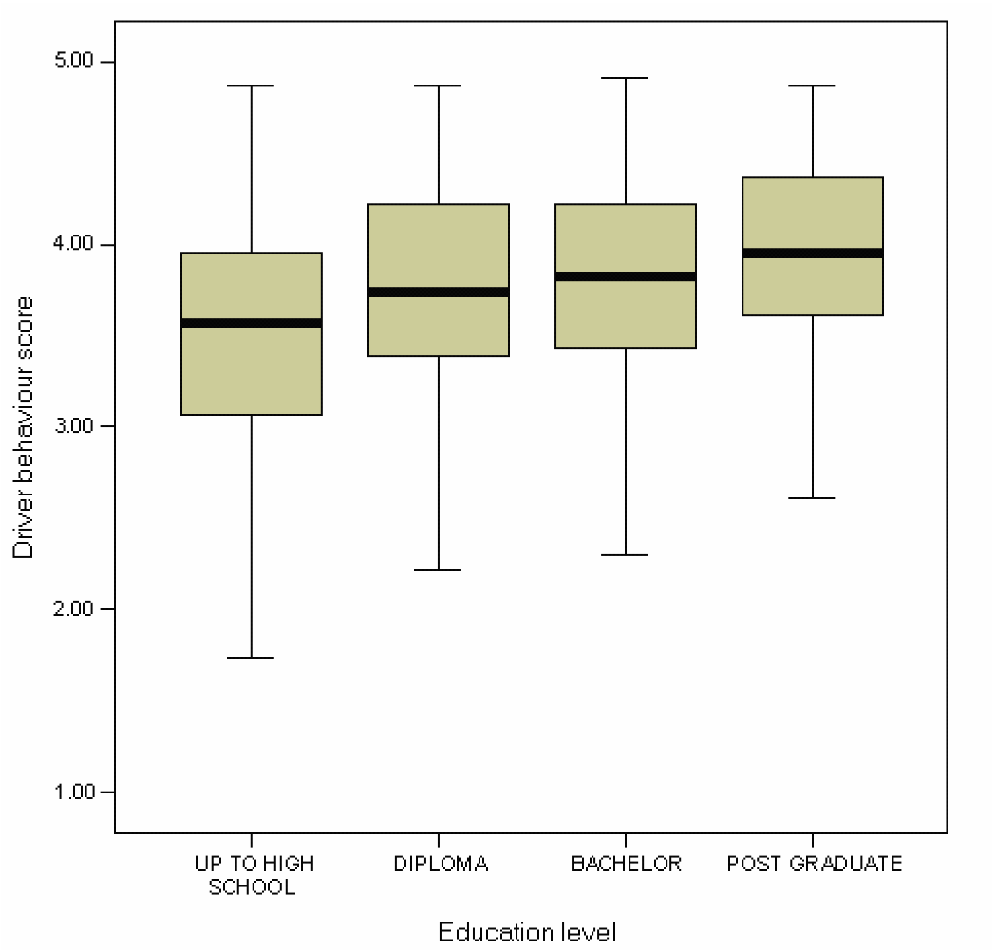

Figure 5.8 Aggressive behaviour means and box plots for education level

However there are more young drivers up to high school level than the other education levels in the sample. (71% of drivers in the age group 18-24 are 'up to high school' level). The ANOVA test was re-run after dropping 500 cases of young drivers of the age ranged 18-24. The result shows a significant difference, **F** (3, 1024) = 4.51, ***p*** = 0.006, but the strength of the relationship between education level and driver behaviour score, as assessed by $\boldsymbol{\eta}^2$, dropped from 7% to 1.2%. This means that the effect of younger age drivers (18-24) on aggressive driving behaviour is more than the effect of the education levels.

Follow-up tests were conducted again to evaluate pair wise differences among the means using Dunnett's C test. The results of these tests, shows that there were significant differences in the means between the groups (Up to High school, Bachelor) and (Up to High school, Postgraduate) only, see Table 5.10b.

Table 5.10b Driver behaviour score among different education levels (after dropping 500 young drivers).

Groups	N	M	SD	Up to High school	Diploma	Bachelor
Up to High school	243	3.74	0.610			
Diploma	215	3.81	0.552	NS		
Bachelor	448	3.87	0.516	*	NS	
Postgraduate	122	3.92	0.537	*	NS	NS

Note: NS = non significant differences between pairs of means, while (*) = significance using Dunnett's C procedure.

Practically, these results imply that further studies should be conducted to identify areas for improving lower education drivers, targeting certain segments of the population for extra training in safe road usage.

5.6.1.6 Experience (Experience versus Driver Behaviour Score)

One-way analysis of variance was conducted to evaluate the relationship between "Experience" and "Driver behaviour score". The hypothesis assumed that less experienced drivers would have more aggressive driving behaviour than more experienced drivers. The independent variable, the experience factor, included three levels: 1-5 years, 6-15 years and more than 15 years. The dependent variable was the driver behaviour score. The lower the driver behaviour score, the more aggressive the behaviour of the driver would be on the road. The ANOVA was significant: $\underline{\mathbf{F}}$ (2, 1525) = 61.336, $\underline{\boldsymbol{p}}$ < 0.0001. The strength of the relationship between Experience and Driver behaviour score, as assessed by $\boldsymbol{\eta}^2$, was less than strong, with the Experience factor accounting for 7.4% of the variance of the dependent variable.

Follow-up tests were conducted to evaluate pair-wise differences among the means. Because the variances among the three groups ranged from 0.24 to 0.405, it was not assumed that the variances were homogeneous, and post hoc comparisons were conducted using Dunnett's C test, a test that does not assume equal variances among the five groups. (It may be noted that in this case we can apply the Bonferroni correction for controlling the type I error.) The results of these tests, as well as the means and the standard deviations for the three groups are reported in Table 5.11a. There were significant differences in the means between all groups. The drivers with the lowest experience (1-5 years) showed the highest aggressive behaviour (mean = 3.48), whereas the drivers with the most experience (more than 15 years) showed the lowest aggressive behaviour (mean= 3.88) (see figure 5.9).

Initially the results of the ONE-WAY ANOVA supported the hypothesis that less experienced drivers have more aggressive driving behaviour than more experienced drivers.

Table 5.11a Driver behaviour score and experience

Groups	N	M	SD	1-5 years	6-15 years
1-5 years	549	3.48	0.63		
6-15 years	512	3.72	0.60	*	
More than 15 years	467	3.88	0.50	*	*

Note: NS = non-significant differences between pairs of means, while (*) = significance using Dunnett's C procedure.

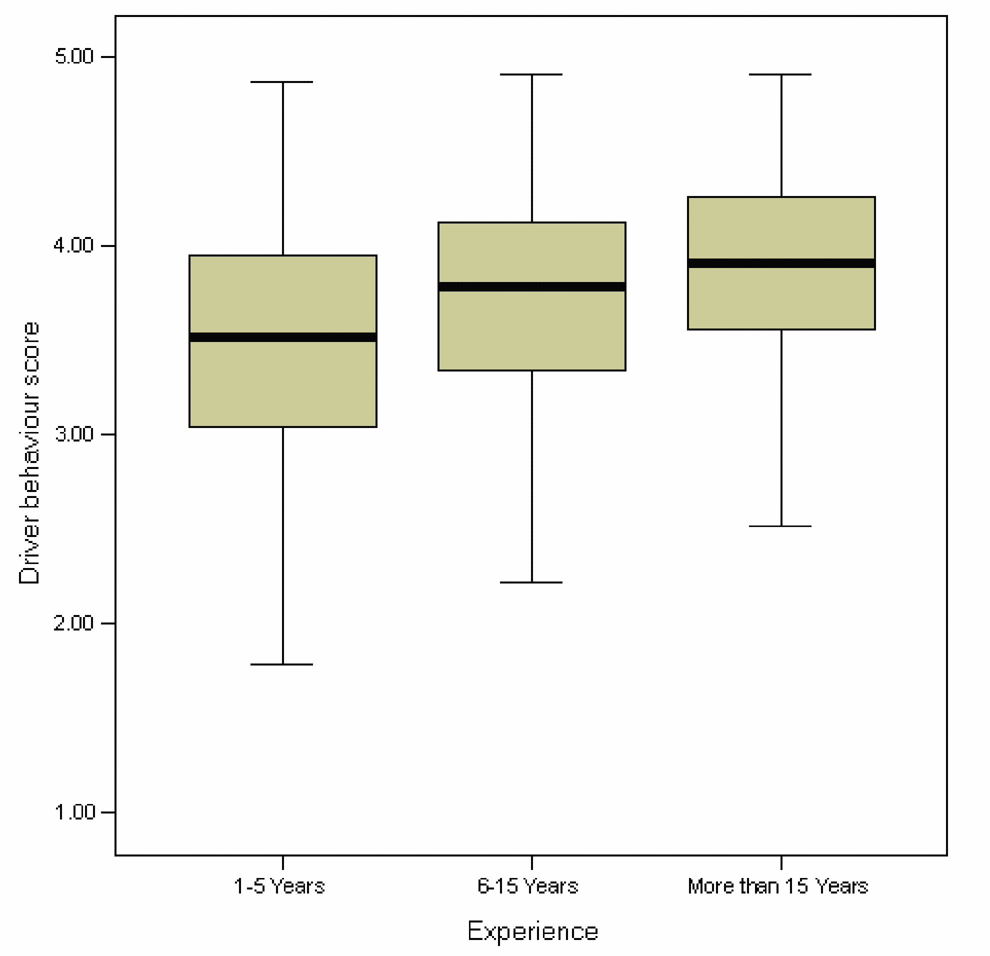

Figure 5.9 Aggressive behaviour means and box plots for experience group

However, age and experience are highly correlated (Pearson correlation = 0.86); the majority of inexperienced drivers are also young (Grayson and Sexton, 2002). (90% of driver age group 18-24 have 1-5 years of driving experience.) The ANOVA test was re-run after dropping 500 cases of young drivers of age range 18-24. As a result, the difference was significant, **F** (2, 1025) = 10.01, $p > 0.001$. The strength of the relationship between experience and driver behaviour score, as assessed by $\boldsymbol{\eta}^2$, dropped from 7.4% to 1.9 %, but the amount of driver experience (1-5 years) becomes a better behaviour in this case (see Table 5.11b). This is because the sample of '1-5 years experience' reduced from 549 to 99, and around 80% of the 99 sample are Non-Kuwaiti (non-Kuwaitis have better driving behaviour). Also, most of drivers in this group (1-5 years of experience) are in the 25-29 age group, which means that they started driving at a later age (20 and above), which might make them better drivers, so this group (1-5 years of experience) is a biased sample.

Follow-up tests were conducted to re-evaluate pair-wise differences among the means using Dunnett's C test. The results of these tests, shows that there were significant differences in the means between the groups (6-15 years, More than 15 years),

Table 5.11b Driver behaviour score and experience (after dropping 500 cases of young drivers).

Groups	N	M	SD	1-5 years	6-15 years
1-5 years	99	3.97	0.56		
6-15 years	462	3.75	0.59	*	
More than 15 years	467	3.88	0.50	NS	*

Note: NS = non-significant differences between pairs of means, while (*) = significance using Dunnett's C procedure.

It might be suggested that mandatory training courses for aggressive drivers should be organised, perhaps after a first dangerous offence has been penalised. There are different forms of driver training, one of which does not exist in Kuwait, but is believed to be effective, namely Hazard Perception Training. Therefore, it is recommended that this type of training be introduced in addition to the usual training courses.

5.6.1.7 Driving education (Driving education versus Driver Behaviour Score)

An independent-sample t-test was conducted to evaluate the hypothesis that drivers who had taken any form of driving education (course) had less aggressive driving behaviour on the road than drivers who had not taken any form of driving education. The test was significant, $t\ (1512) = 6.248$, $p < 0.001$. The results of the independent-sample t-test supported the hypothesis that any form of driving education plays an important role in enhancing the driver's attitude on the road. Drivers who did not have any driving education ($M = 3.64$, $SD = 0.61$, $N=1243$) on average had more aggressive driving behaviour than drivers who had some sort of driving education ($M = 3.89$, $SD = 0.57$, $N=271$) (see figure 5.10). The eta square index (**η^2**) indicated that 2.5% of the variance in aggressive driving behaviour was accounted for by driving education or lack of it.

Driving education is an important factor in driving behaviour yet the results show it to be a relatively small predictor. This is attributed to the fact that many details such as driving education quality, the number of hours or days the person has attended the driving education course, etc., were not included in the analysis.

Only 17.8% of the drivers in Kuwait had had any form of the driver education, and the road safety situation could be improved through making it mandatory for learners to reach an acceptable driving level before they are allowed to sit for the driving test.

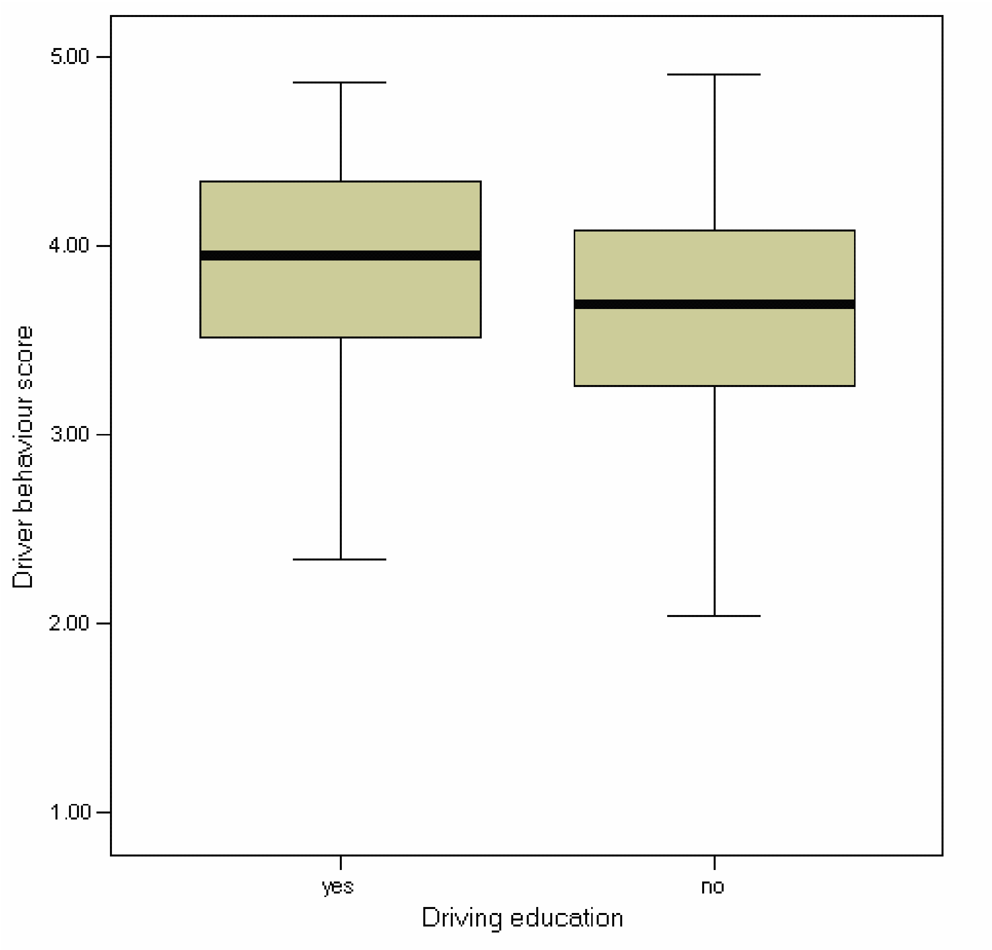

Figure 5.10 Aggressive behaviour means and box plots for driver education (yes or no)

5.6.1.8 Driving training (Driving training versus Driver Behaviour Score)

An independent-sample t-test was conducted to evaluate the hypothesis that drivers who were trained officially have less aggressive driving behaviour on the road than drivers who were not officially trained. The test was significant, t (1402.101) = 9.354, $p < 0.001$. The results of the independent-sample t-test supported the hypothesis that official driving training plays an important role in enhancing drivers' attitudes on the road. Drivers who did not have any official driving training (M = 3.53, SD = 0.64, N=710) had on average more aggressive driving behaviour than drivers who have had official driving training (M = 3.82, SD = 0.55, N= 809) (see figure 5.11). The eta square index (η^2) indicated that 5.6% of the variance in aggressive driving behaviour was accounted for by whether the drivers had been officially trained or not. The lack of details about hours of official driving training and about the quality of official training are the two most important factors preventing a better eta square index **(η^2)** value. The importance of the quality of the driving instructor is also to be considered.

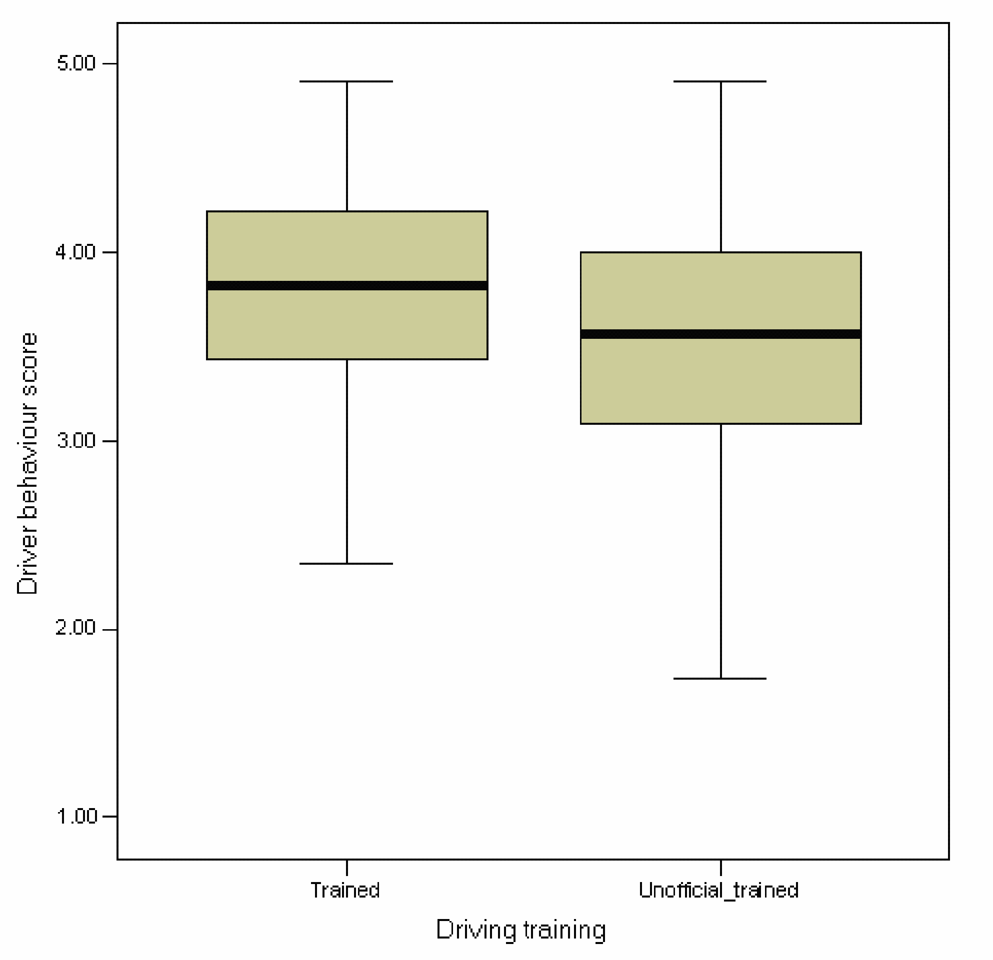

Figure 5.11 Aggressive behaviour means and box plots for driver training (official and unofficial)

5.6.1.9 Overall aggressive driver behaviour score and accident involvement (Accident involvement versus Driver Behaviour Score)

A One-way analysis of variance was conducted to evaluate the relationship between "accident involvement" and "driver behaviour score". The hypothesis assumed that drivers involved in more accidents had more aggressive driving behaviour on the road. The independent variable, accident involvement rate, was measured on three levels: no accident, up to one accident, and more than one accident. The dependent variable was the driver behaviour score. The lower the driver behaviour score, the more aggressive the behaviour would be. The ANOVA was significant, **F** (2, 1525) = 45.74, $p < 0.0001$. The strength of the relationship between accident involvement rate and the driver behaviour score, as assessed by η^2, was medium, with the accident involvement factor accounting for 5.7 % of the variance of the dependent variable.

Follow-up tests were conducted to evaluate pair-wise differences among the means. Because the variances among the three groups ranged from 0.286 to 0.396, it was not assumed that the variances were homogeneous, and post hoc comparisons were conducted using Dunnett's C test, a test that does not assume equal variances among the three groups. The results of these tests, as well as the means and the standard deviations for the three groups, are reported in Table 5.12. There were significant differences in the means among all groups. Drivers with more than one accident showed the most aggressive behaviour (mean = 3.51) whereas drivers with no accidents showed the lowest aggressive behaviour (mean= 3.84) (see Figure 5.12). Thus the results of the ONE-WAY ANOVA supported the hypothesis that drivers involved in more than one accident have more aggressive driving behaviour.

The Speaker at the United Nations on the Inland Transport Committee (2004), Mr. Kiryanov, presented the context of Russia, where the main factor in traffic accidents is aggressive behaviour on the roads. The most frequent serious offences are drunken driving, speeding, driving in the lane intended for the opposite direction, driving without a licence or with a suspended one.

The implications are similar to those for driver attitudes, that drivers (especially younger ones) need more education on road safety and behaviour.

Table 5.12 Aggressive driving behaviour score and accidents

Groups	N	M	SD	No accident	Up to one accident/km
No accident	663	3.84	0.59		
Up to one accident/km	335	3.65	0.54	*	
More than one accident/km	530	3.51	0.63	*	*

Note: NS = non significant differences between pairs of means, while (*) = significance using Dunnett's C procedure.

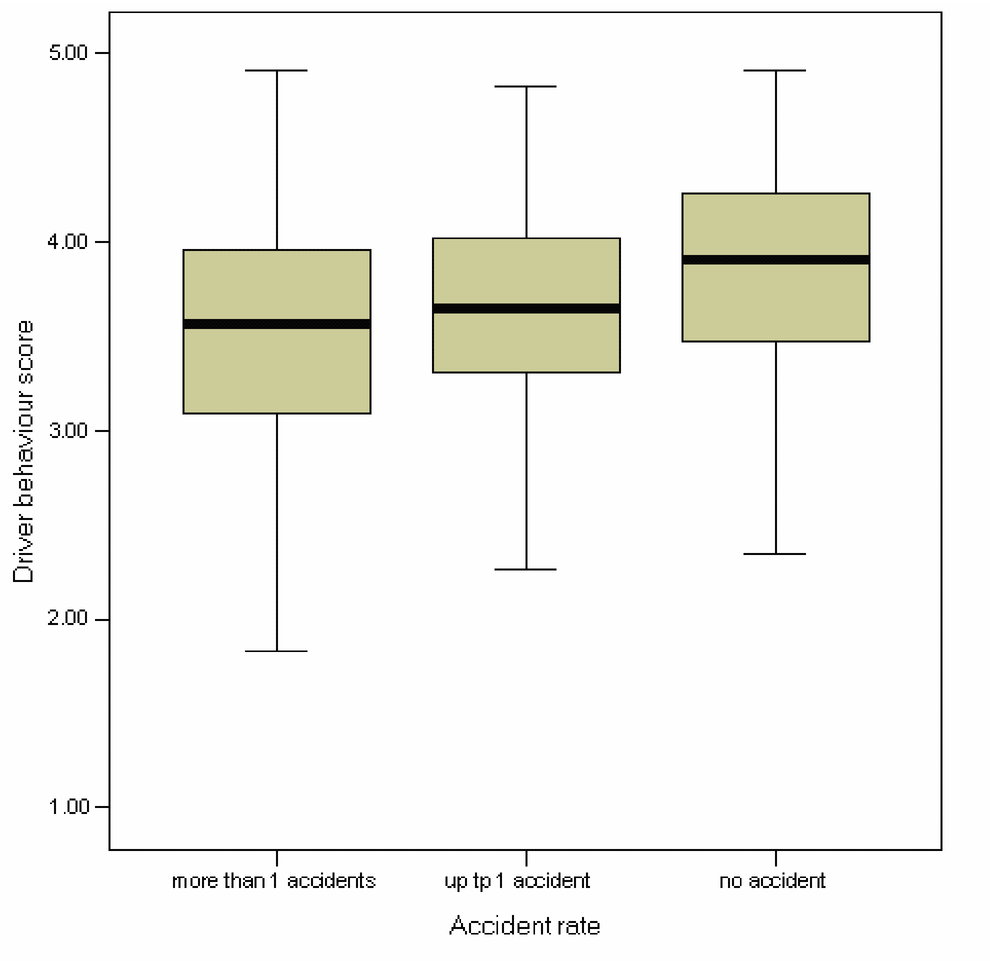

Figure 5.12 Aggressive behaviour means and box plots for accident rate

5.6.2 Accidents with other factors

In this part, the accident involvement rate will be introduced as a categorical dependent variable, and has been categorised into only two levels, no accident, and more than one accident, after dropping 335 cases of up to one accident to compare the extreme groups (no accident, and more than one accident) and apply odds ratio analysis, which requires a 2 by 2 table; so the sample size becomes 1193. The independent variables are Age, Gender, Marital Status, Education Level, Nationality, Driver Experience, Driver Education, Driver Training, and Speed. Cross-tabulations analysis using the Chi-square test (χ^2), the odds ratio, and Cramer's V will be used to investigate the magnitude of the association between accidents and other independent variables with a level of significance of 0.05 ($p < 0.05$). The significance level will be adjusted for the pair-wise comparisons using Holm's Sequential Bonferroni correction after controlling for type I error.

5.6.2.1 Age

A two-way contingency table analysis was conducted to evaluate the hypothesis that age plays a very important role in accident rates; i.e. as the age of the drivers' increases, maturity in driving skills increases, with the result that accident rates decrease. The two variables were age of the driver at four levels (18-29, 30-39, 40-49 and 50-above) and accident rate per 100,000 km driving at two levels (no accident, and more than one accident.

The proportions of drivers involved in 'no accident at all' in the age ranges of 18-29, 30-39, 40-49, and 50-above were 0.392, 0.693, 0.786, and 0.744, respectively. The proportions of drivers involved in 'more than one accident' in the same age ranges were 0.608, 0.307, 0.214 and 0.256, respectively (see table 5.13).

Table 5.13 Cross-tabulation of accident groups and age groups

Age group	**No accident**		**More than one accident/km x 10^5**	
	N	**%**	**N**	**%**
18-29	242	39.2	376	60.8
30-39	203	69.3	90	30.7
40-49	154	78.6	42	21.4
50 & above	64	74.4	22	25.6
Total	663	55.6	530	44.4

Age & accident rate were found to be significantly related: Pearson χ^2 (3, N=1193) = 144.111, $p < 0.001$, Cramer's V = 0.348. Since in this case the Pearson chi-square test has more than 1 degree of freedom, it means it is an omnibus test, which evaluates the significance of an overall hypothesis containing multiple sub-hypotheses. These multiple sub-hypotheses have to be tested using the follow-up tests. The value of Cramer's V shows that the relationship between age & accident rate is medium.

In this case, the results of the chi-square test indicated significant differences between the four age levels. Follow-up tests should be conducted to examine each of the sub-hypotheses. In this case we will be testing the six sub-hypotheses as follows.

The first sub-hypothesis (to be tested) states that drivers in the age range 18-29 are involved in more accidents than drivers of the age range 30-39, and this is statistically significant at 0.05.

The second sub-hypothesis (to be tested) states that drivers in the age range 18-29 are involved in more accidents than drivers in the age range 40-49 and this is statistically significant at 0.05.

The third sub-hypothesis (to be tested) states that the drivers in the age range 18-29 are involved in more accidents than drivers in the age range of 50-above and this is statistically significant at 0.05.

The fourth sub-hypothesis (to be tested) states that the drivers in the age range of 30-39 are involved in more accident than the drivers in the age range of 40- and this is statistically significant at 0.05.

The fifth sub-hypothesis (to be tested) states that drivers in the age range 30-39 are involved in more accidents than drivers of the age range of 50-above and this is statistically significant at 0.05.

The sixth sub-hypothesis (to be tested) states that drivers in the age range 40-49 are involved in more accidents than drivers of the age range of 50-above and this is statistically significant at (.05).

The following table (5.14) shows the results of the six sub-hypotheses. The Holm's Sequential Bonferroni method was used to control type I error at 0.05 across all six comparisons. Only three pair-wise comparisons were found to be significantly different at 0.05.

Table 5.14 Pair-wise Comparison for different age groups

Pair-wise Comparison for different age groups	Pearson Chi-square	*p*-value	Required *p*-value for significance (as per Holm's Sequential Bonferroni correction)	Significance (p-value)	Cramer's V	Odds Ratio	95% confidence interval	
							Lower	Upper
18-29 versus 30-39	72.189	0.000	0.05 / 6 = 0.0083	*	0.281	3.50	2.61	4.71
18-29 versus 40-49	92.528	0.000	0.05 / 5 = 0.01	*	0.337	5.70	3.91	8.31
18-29 versus 50-above	38.196	0.000	0.05 / 4 = 0.0125	*	0.233	4.52	2.71	7.53
30-39 versus 40-49	5.141	0.023	0.05 / 3 = 0.0167	NS	0.103	1.63	1.07	2.48
30-39 versus 50-above	0.842	0.359	0.05 / 2 = 0.025	NS	0.047	1.29	0.75	2.22
40-49 versus 50-above	0.588	0.443	0.05 / 1 = 0.05	NS	0.046	0.79	0.44	1.44

NS → Not Significant

Note: For a 2*2 table, Cramer's V of 0.1, 0.3, and 0.5 represent small, medium and large effect sizes respectively.

Cramer's V also assesses the strength of the relationship between the row & column variables (or what is called effect size).

Thus for the first sub-hypothesis, it was found that drivers of the age groups (18-29 & 30-39) were significantly different with "more than one accident ", Pearson χ^2 (1, N=911) = 72.189, $p < 0.001$, Cramer's V = 0.281. The Odds ratio shows that the odds of having "more than one accident" for drivers of the age group of "18-29" is 3.5 that for drivers of the age group of "30-39". The value of Cramer's V shows that the relationship between age & accident rate is approximately medium.

For the second sub-hypothesis, it was found that drivers of the age groups (18-29 & 40-49) were significantly different with "more than one accident ", Pearson χ^2 (1, N=814) = 92.528, $p < 0.001$, Cramer's V = 0.337. The Odds ratio shows that the odds of having "more than one accident" for the drivers of the age group of "18-29" is 5.7 times that for the drivers of the age group of "40-49". The value of Cramer's V shows that the relation between age & accident rate is more than medium but less than high.

For the third sub-hypothesis, it was found that drivers of the age groups of (18-29 & 50-above) were significantly different with "more than one accident", Pearson χ^2 (1, N=704) = 38.196, $p < .001$, Cramer's V = 0.233. The Odds ratio shows that the odds of having "more than one accident" for drivers of the age group of "18-29" is 4.52 times that for the drivers of the age group of "50-above". The value of Cramer's V shows that the relationship between age & accident rate is a little less than medium.

For the fourth sub-hypothesis, it was found that drivers of the age groups of (30-39 & 40-49) were not significantly different with "more than one accident", Pearson χ^2 (1, N=489) = 5.141, $p = 0.023$ (which is greater than the 0.0167 which is required as per Holm's Sequential Bonferroni correction after controlling for type I error), Cramer's V = 0.103. The Odds ratio shows that the odds of having "more than one accident" for drivers of the age group of "30-39" is 1.63 times that for the drivers of the age group of "40-49". The value of Cramer's V shows that the relationship between age & accident rate is small.

For the fifth sub-hypothesis, it was found that drivers of the age groups of (30-39 & 50-above) were not significantly different with "more than one accident ", Pearson χ^2 (1, N=379) = 0.842, p = 0.359 (which is greater than the 0.025 which is required as per Holm's Sequential Bonferroni correction after controlling for type I error), Cramer's V = 0.047. The Odds ratio shows that the odds of having "more than one accident" for drivers of the age group of "30-39" is 1.29 times that for the drivers of the age group of "50-above". The value of Cramer's V shows that the relationship between age & accident rate is weak.

For the sixth sub-hypothesis, it was found that drivers of the age groups of (40-49 & 50-above) were not significantly different with "more than one accident ", Pearson χ^2 (1, N=282) = 0.588, p = 0.443 (which is greater than the 0.05 which is required as per Holm's Sequential Bonferroni correction after controlling for type I error), Cramer's V = .046. The Odds ratio shows that the odds of having "more than one accident" for drivers of the age group of "40-49" is 0.79 times that for the drivers of the age groups of "50-above". The value of Cramer's V shows that the relationship between age & accident rate is weak.

This shows very clearly that age improves driving attitudes and the net result is fewer accidents with age. More mature drivers drove more carefully or safely, but older drivers (over 50) may have more accidents than middle-aged drivers (age group 40-49) because of a declined in their health, but still fewer accidents than the younger drivers (age group 18-29 and 30-40).

Young drivers are more frequently involved in road accidents than other age groups (BjØrnkau, 2000), being involved in accidents such as driving off the road and head-on collisions with other vehicles, speeding and loss of control (Michels & Schneider, 1984; Trankle, Gelau & Metker, 1990).

Thus overall it was found that drivers are involved in fewer accidents as their age increases. That is, the rate of accidents decreases generally with age. So driver education, training and testing and enforcement could play a role in reducing accidents, especially for young drivers, as was discussed in section 5.6.1.1.

5.6.2.2 Gender

Two-way contingency table analysis was conducted to evaluate the hypothesis that males are more involved in accidents than females. The two variables were males, females and accident rate per 100,000 km driving, at two levels (no accident and more than one accident).

The proportions of male & female drivers involved in 'no accidents at all' were 0.572 & 0.517 respectively. The proportions of male & female drivers involved in 'more than one accident' were 0.428 & 0.483 respectively (see Table 5.15).

Table 5.15 Cross-tabulation of accident groups and gender

Gender	**No accident**		**More than one accident/km x 10^5**	
	N	**%**	**N**	**%**
Male	483	57.2	362	42.8
Female	180	51.7	168	48.3
Total	663	55.6	530	44.4

Gender & accident rate was found not to be significantly related, Pearson χ^2 (1, N=1193) = 2.95, p = .086, Cramer's V = .050. The Odds ratio shows that the odds of having "more than one accident" for female drivers is 1.245 times that for male drivers. This contradicts the hypothesis that males are involved in more accidents than females. The results show that females are involved in more accidents than males.

Surprisingly, males are typically expected to be involved in more accidents, and this is supported both in the police data (Section 3.2.4.7) and in the literature (Section 2.1.3.1). It could be that females are more honest in answering the questionnaire survey than males. Assum (1997 in Norway) found that females have a higher accident risk (accidents per million km) than males, but they have a better attitude towards road safety. In which case, whiles Lourens *et al.* (1999) found that there were no differences in accident involvement between male and female drivers. (This issue will be investigated in the next chapter: the multivariate analysis).

5.6.2.3 Marital status

Two-way contingency table analysis was conducted to evaluate the hypothesis that drivers who are not married (single) are more involved in accidents than drivers who are married. The two variables were single or married and accident rate per 100,000 km driving, at two levels (no accident and more than one accident).

The proportions of drivers involved in 'no accidents at all' were 0.408 & 0.675 for single and married drivers respectively. The proportions of drivers involved in 'more than one accident' were 0.592 & 0.325 for single and married drivers respectively (see Table 5.16a).

Table 5.16a Cross-tabulation of accident groups and marital status

Marital status	**No accident**		**More than one accident/km x 10^5**	
	N	**%**	**N**	**%**
Single	217	40.8	315	59.2
Married	446	67.5	215	32.5
Total	663	55.6	530	44.4

Marital status & accident rate were found to be significantly related: Pearson χ^2 (1, N=1193) = 80.01, $p < 0.000$, Cramer's V = 0.267. The Odds ratio shows that the odds of having "more than one accident" for single drivers is 3.011 times what it is for married drivers.

This initially supports the hypothesis that drivers who are single are involved in more accidents than drivers who are married.

However, as was discussed in section 5.6.1.4, a high proportion of single drivers are young. So, the two-way contingency table analyses were re-run after dropping 476 cases of young drivers in the age range 18-24. The proportions of drivers involved in 'no accidents at all' were 0.621 & 0.704 for single and married drivers respectively. The proportions of drivers involved in 'more than one accident' were 0.379 & 0.296 for single and married drivers, respectively (see Table 5.16b).

Table 5.16b Cross-tabulation of accident groups and marital status (after dropping 476 cases of young driver).

Marital status	**No accident**		**More than one accident/km x 10^5**	
	N	**%**	**N**	**%**
Single	72	62.1	44	37.9
Married	423	70.4	178	29.6
Total	495	69	222	31

Marital status & accident rate were not found to be significantly related: Pearson χ^2 (1, N=717) = 3.14, p = 0.076, Cramer's V dropped from = 0.267 to 0.066. This shows that the age of young drivers (18-24) has more effect in accident involvement than marital status. However, single drivers are still more involved in accident than married drivers. The Odds ratio shows that the odds of having "more than one accident" for single drivers is 1.45 times what it is for married drivers.

This implies that young, unmarried drivers need more education and training, including hazard perception and a feeling of responsibility, as was discussed in Section 5.6.1.4.

5.6.2.4 Education level

Two-way contingency table analysis was conducted to evaluate the hypothesis that education level plays a very important role in accidents rates. That is, a better education level tends to give a lower accident rate. The two variables were education level, at four levels (Up to High school, Diploma, Bachelor, Postgraduate) and accident rate per 100,000 km driving at two levels (no accident, and more than one accident).

The proportions of drivers involved in 'no accidents at all' at Education level Up to High school, Diploma, Bachelor, Postgraduate were 0.494, 0.618, 0.594 and 0.610, respectively. The proportions of drivers involved in 'more than one accident' at the same education levels were 0.506, 0.382, 0.406 and 0.390, respectively (see Table 5.17).

Table 5.17 Cross-tabulation of accident groups and education levels

Education level	**No accident**		**More than one accident/km x 10^5**	
	N	**%**	**N**	**%**
Up to high school	257	49.9	263	50.6
Diploma	128	61.8	79	38.2
Bachelor	228	59.4	156	40.6
Post graduate	50	61	32	39
Total	663	55.6	530	44.4

Education level & accident rate were found to be significantly related: Pearson χ^2 (3, N=1193) = 14.472, p = 0.002, Cramer's V = 0.110. Since in this case the Pearson chi-square test has more than 1 degree of freedom, it means that it is an omnibus test, which evaluates the significance of an overall hypothesis containing multiple sub-hypotheses. These multiple sub-hypotheses have to be tested using the follow-up tests. The value of Cramer's V shows that the relation between the education levels & accident rate is small.

In this case, the results of the chi-square test indicated significant differences among the four education levels. Follow-up tests were conducted to examine each of the sub-hypotheses. The six sub-hypotheses were tested as follows:

The first sub-hypothesis (to be tested) states that drivers up to High school level are involved in more accidents than drivers at Diploma level, and this involvement is statistically significant at 0.05.

The second sub-hypothesis (to be tested) states that drivers up to High school level are involved in more accidents than drivers at Bachelor degree level, and this involvement is statistically significant at 0.05.

The third sub-hypothesis (to be tested) states that drivers up to High school level are involved in more accidents than drivers at Postgraduate level and this involvement is statistically significant at 0.05.

The fourth sub-hypothesis (to be tested) states that drivers at Diploma level are involved in more accident than drivers at Bachelor degree and this involvement is statistically significant at 0.05.

The fifth sub-hypothesis (to be tested) states drivers at Diploma level are involved in more accidents than drivers at the postgraduate level, and this involvement is statistically significant at 0.05.

The sixth sub-hypothesis (to be tested) states that drivers at Bachelor degree level are involved in more accidents than drivers at the postgraduate level, and this involvement is statistically significant at 0.05.

The following table (5.18) shows the results of these six sub-hypotheses. The Holm's Sequential Bonferroni method was used to control for type I error at 0.05 across all six comparisons. Only three pair-wise comparisons were found to be significantly different at 0.05.

Table 5.18 Pair-wise comparison for different education levels

Pair-wise comparison for different education levels	Pearson Chi-square	*p*-value	Required *p*-value for significance (as per Holm's Sequential Bonferroni correction)	Significance (p-value)	Cramer's V	Odds Ratio	95% confidence interval	
							Lower	Upper
up to High school level versus Diploma	9.175	0.002	0.05 / 6 = 0.0083	*	0.112	1.66	1.19	2.30
up to High school level versus Bachelor	8.80	0.003	0.05 / 5 = 0.01	*	0.099	1.50	1.15	1.95
up to High school level versus Postgraduate	3.78	0.052	0.05 / 4 = 0.0125	NS	0.079	1.60	0.99	2.57
Diploma versus Bachelor	0.340	0.560	0.05 / 3 = 0.0167	NS	0.024	0.90	0.640	1.28
Diploma versus Postgraduate	0.018	0.892	0.05 / 1 = 0.05	NS	0.008	0.964	0.571	1.630
Bachelor versus Postgraduate	0.072	0.789	0.05 / 2 = 0.025	NS	0.012	1.07	0.656	1.742

NS → Not Significant

Note: For a 2*2 table, Cramer's V of 0.1, 0.3, and 0.5 represent small, medium and large effect size respectively.

Cramer's V also assesses the strength of the relationship between the row & column variables (or what is called the effect size)

Thus for the first sub-hypothesis it was found that drivers up to High school level and Diploma were significantly related with "more than one accident", Pearson χ^2 (1, N=727) = 9.175, p < 0.001, Cramer's V = 0.112. The Odds ratio shows that the odds of having "more than one accident" for drivers up to High school level is 1.66 times what it is for drivers Diploma level. The value of Cramer's V shows that the relationship between education level (up to High school level and Diploma) & accident rate is small.

For the second sub-hypothesis it was found that drivers up to High school level and Bachelor were significantly related with "more than one accident", Pearson χ^2 (1, N=904) = 8.80, p < .001, Cramer's V = .099. The Odds ratio shows that the odds of having "more than one accident" for drivers at up to High school level is 1.50 times that for drivers at Bachelor level. The value of Cramer's V shows that the relationship between education level (up to High school level and Bachelor) & accident rate is small.

For the third sub-hypothesis it was found that drivers up to High school level and postgraduate level were not significantly related with "more than one accident", Pearson χ^2 (1, N=602) = 3.78, p > 0.052, Cramer's V = 0.079. (which is more than the 0.0125 required as per Holm's Sequential Bonferroni correction after controlling for type I error), The Odds ratio shows that the odds of having "more than one accident" for drivers up to High school level is 1.60 times what it is for drivers at postgraduate level. The value of Cramer's V shows that the relationship between education level (up to High school level and postgraduate level) & accident rate is less than small.

For the fourth sub-hypothesis it was found that drivers at Diploma and Bachelor levels were not significantly related with "more than one accident", Pearson χ^2 (1, N=591) = 0.340, p = 0.56 (which is greater than the 0.0167 required as per Holm's Sequential Bonferroni correction after controlling for type I error), Cramer's V = 0.024. The Odds ratio shows that the odds of having "more than one accident" for drivers at Bachelor level is 1.11 times that for Diploma. The value of Cramer's V shows that the relation between education levels (Diploma and Bachelor) & accident rate is weak.

For the fifth sub-hypothesis it was found that drivers at Diploma and postgraduate levels were not significantly related with "more than one accident", Pearson χ^2 (1, N=289) = 0.018, p = 0.892 (which is greater than the 0.05 which is required as per Holm's Sequential Bonferroni correction after controlling for type I error), Cramer's V = 0.008. The Odds ratio shows that the odds of having "more than one accident" for drivers at postgraduate level is 1.04 times what it is for Diploma level. The value of Cramer's V shows that the relationship between education level (Diploma and postgraduate) & accident rate is weak.

For the sixth sub-hypothesis it was found that drivers at Bachelor degree and postgraduate level were not significantly related with "more than one accident rate", Pearson χ^2 (1, N=466) =0.072, p = 0.789 (which is greater than the 0.025 which is required as per Holm's Sequential Bonferroni correction after controlling for type I error), Cramer's V = 0.046. The Odds ratio shows that the odds of having "more than one accident" for drivers of the Bachelor degree is 1.07 times what it is for postgraduate level. The value of Cramer's V shows that the relationship between education level (Bachelor degree and postgraduate) & accident rate is weak.

Thus, it may be concluded that education level is not a strong factor predicting accidents although, as education levels increases, the rate of accidents (per 100 000 km) decreases (except for Diploma and Bachelor). However, the lower education level (up to high school) appears to be the most involved in accidents, and this because the higher proportion of up to high school drivers are young.

Two-way contingency table analyses were re-run, excluding 476 cases of young drivers of age range 18-24 (see Table 5.19). The result doesn't show a significant relationship between education level and accident involvement: Pearson χ^2 (1, N=717) =0.659, p = 0.883 Cramer's V = 0.030. The dropping of Cramer's V from 0.11 to 0.030 also shows that young drivers has more effect in accident involvement than the effect of education levels, and this agrees with Lourens *et al.* (1999); they found from the driver behaviour questionnaire (DBQ) survey in Netherlands that younger drivers have the highest rate of accidents and level of education is not related to accident involvement.

Table 5.19 Cross-tabulation of accident groups and education levels (after dropping 476 cases of young driver).

Education level	**No accident**		**More than one accident/km x 10^5**	
	N	**%**	**N**	**%**
Up to high school	121	68.4	56	31.6
Diploma	97	64.2	54	35.8
Bachelor	205	66.6	103	33.4
Postgraduate	53	65.4	28	34.6
Total	495	66.4	222	33.6

This implies that further studies should be conducted with samples representing older age and lower education levels for better conclusions.

5.6.2.5 Nationality

Two-way contingency table analysis was conducted to evaluate the hypothesis that Kuwaiti drivers are more involved in accidents than non-Kuwaiti drivers. The two variables were nationality (Kuwaiti or non-Kuwaiti) and accident rate per 100,000 km driving, at two levels (no accident, and more than one accident).

The proportions of drivers involved in 'no accidents at all' were 0.490 & 0 .677 for Kuwaitis and non-Kuwaitis, respectively. The proportions of drivers involved in 'more than one accident' were 0.510 & 0.323 for Kuwaitis and non-Kuwaitis, respectively (see Table 5.20a).

Table 5.20a Cross-tabulation of accident groups and nationality

Nationality	No accident		More than one accident/km x 10^5	
	N	%	N	%
Kuwaiti	378	49	394	51
Non-Kuwaiti	285	67.7	136	32.3
Total	663	55.6	530	44.4

Nationality & accident rate were found to be significantly related: Pearson χ^2 (1, N=1193) = 38.719, p < 0.000, Cramer's V = 0.180. The Odds ratio shows that the odds of having "more than one accident" for Kuwaiti drivers is 2.184 times what it is for the non-Kuwaiti drivers.

This initially supports the hypothesis that Kuwaiti drivers are involved in more accidents than non-Kuwaitis. However, there are more young Kuwaiti drivers than young non-Kuwaiti drivers in the sample (90% of Kuwaiti drivers are in age group 18-24 in the sample) and young drivers have been shown to be more numerous and more accident-prone than older drivers (section 5.6.2.1).

Two-way contingency table analyses were re-run, excluding 476 cases of young drivers in the age range18-24 (see Table 5.20b). As a result, Kuwaitis are still involved in more accidents than non Kuwaiti (33.1% for Kuwaiti and 28.9% for non-Kuwaiti), however, the difference was not significant: Pearson χ^2 (1, N=717) = 1.5, p = 0.22, Cramer's V = 0.046. However, the Odds ratio shows that the odds of having "more than one accident" for Kuwaiti drivers is 1.22 times what it is for the non-Kuwaiti drivers.

Table 5.20b Cross-tabulation of accident groups and nationality (after dropping 476 cases of young driver).

Nationality	No accident		More than one accident/km x 10^5	
	N	%	N	%
Kuwaiti	232	66.9	115	33.1
Non-Kuwaiti	263	71.1	107	28.9
Total	495	69	222	31

It can be concluded that young Kuwaiti drivers have more aggressive driving behaviour and are more involved in accidents. Young Kuwaiti drivers can more easily own new (fast/sporty) car once they reach 18 years resulting in an increase in their proportion on the road network and thus increasing their exposure to accident involvement.

5.6.2.6 Experience

Two-way contingency table analysis was conducted to evaluate the hypothesis that experience plays a very important role in accident rates. That is, more experience results in a decrease in accident rates. There were three levels of experience (1-5 years, 6-15 years, more than 15 years), measured against accident rate per 100,000 km driving, at two levels (no accident, and more than one accident).

The proportions of drivers involved in 'no accidents at all' were 0.405, 0.594 and 0.766 for experience 1-5years, 6-15 years, more than 15 years, respectively. The proportions of drivers involved in 'more than one accident' were 0.595, 0.406 and 0.234, respectively (see Table 5.21).

Table 5.21 Cross-tabulation of accident groups and experience

Experience (years)	No accident		More than one accident/km x 10^5	
	N	%	N	%
1-5	213	40.5	313	59.5
6-15	211	59.4	144	40.6
More than 15	239	76.6	73	23.4
Total	663	55.6	530	44.4

Experience and accident rate were found to be significantly related, Pearson χ^2 (2, N=1193) = 106.473, $p < 0.001$, Cramer's V = 0.299. Since in this case the Pearson chi-square test has more than 1 degree of freedom, it means that it is an omnibus test, which evaluates the significance of an overall hypothesis containing multiple sub-hypotheses. These multiple sub-hypotheses have to be tested using follow-up tests. The value of Cramer's V shows that the relationship between experience & accident rate is medium.

In this case, the results of the chi-square test indicated significant differences among the three levels of experience. Follow-up tests were conducted to examine each of the sub-hypotheses. The three sub-hypotheses were tested as follows:

The first sub-hypothesis (to be tested) states that drivers with 1-5 years' experience are involved in more accidents than with 6-15 years, and this involvement is statistically significant at 0.05.

The second sub-hypothesis (to be tested) states that drivers with 1-5 years' experience are involved in more accidents than with over 15 years of experience, and this involvement is statistically significant at 0.05.

The third sub-hypothesis (to be tested) states that drivers with 6-15 years experience are involved in more accidents than with over 15 years of experience, and this involvement is statistically significant at 0.05.

The following table (5.22) shows the results of the three sub-hypotheses. The Holm's Sequential Bonferroni method was used to control for type I error at 0.05 across all three comparisons. All three pair-wise comparisons were found to be significantly different at 0.05.

Table 5.22 Pair-wise comparison for different level of experience

Pair-wise comparison for different level of experience	**Pearson Chi-square**	***p*-value**	**Required *p*-value for significance (as per Holm's Sequential Bonferroni correction)**	**Significance (p-value)**	**Cramer's V**	**Odds Ratio**	**95% confidence interval**	
							Lower	**Upper**
1-5 versus 6-15	**30.463**	**0.000**	**0.05 / 2 = 0.025**	*	**0.186**	**2.153**	**1.637**	**2.837**
1-5 versus More than 15	**102.771**	**0.000**	**0.05 / 3 = 0.0167**	*	**0.350**	**4.811**	**3.512**	**6.59**
6-15 versus More than 15	**22.293**	**0.000**	**0.05 / 1 = 0.05**	*	**0.183**	**2.24**	**1.595**	**3.130**

NS → Not Significant

Note: For a 2*2 table, Cramer's V of 0.1, 0.3, and 0.5 represent small, medium and large effect size, respectively.

Cramer's V also assesses the strength of the relationship between the row & column variables (or what is called the effect size).

Thus for the first sub-hypothesis it was found that experience of 1-5 years and 6-15 years was significantly related with "more than one accident", Pearson χ^2 (1, N=881) = 30.463, $p < 0.001$, Cramer's V = 0.186. The Odds ratio shows that the odds of having "more than one accident" with experience of 1-5 years is 2.15 times what it is for 6-15 years. The value of Cramer's V shows that the relationship between the experience & accident rate is small to medium.

For the second sub-hypothesis it was found that experience of 1-5 years and more than 15 years was significantly related with "more than one accident", Pearson χ^2 (1, N=838) = 102.771, $p < 0.001$, Cramer's V = 0.350. The Odds ratio shows that the odds of having "more than one accident" with experience of 1-5 years is 4.81 times what it is for drivers with more than 15 years. The value of Cramer's V shows that the relationship between the experience & accident rate is more than medium but less than high.

For the third sub-hypothesis it was found that experience of 6-15 years and more than 15 years was significantly related with "more than one accident", Pearson χ^2 (1, N=667) = 22.293, $p < 0.001$, Cramer's V = 0.183. The Odds ratio shows that the odds of having "more than one accident" with experience of 6-15 years is 2.24 times what it is for the drivers with more than 15 years. The value of Cramer's V shows that the relationship between experience & accident rate is small to medium.

Thus it may be concluded that as driving experience increases, the rate of accidents (per 100,000 km) decreases. However, the main cause of young drivers' accidents has often been regarded as being lack of experience, in other words, inexperienced drivers are also young drivers (Grayson and Sexton, 2002). That is why when the age group of 18-24 is removed from the sample (476 cases) and the two-way contingency table analysis re-run, a significant difference between the driver experience groups remains: Pearson χ^2 (2, N=717) =15.20, p = 0.001 Cramer's V = 0.146.

Two-way contingency table analysis was re-run excluding 476 cases of young drivers of age range 18-24 (see Table 5.23). The proportions of drivers involved in 'no accidents at all' were 0.659, 0.624 and 0.766 for experience 1-5 years, 6-15 years, more than 15 years, respectively. The proportions of drivers involved in 'more than one accident' were 0.341, 0.376 and 0.234, respectively. However, it can be seen that the proportion of drivers with experience of 1-5 years who in involved in more than one accident (34.1%) is less than drivers with experience of 6-15 years (37.6%) because of the biased sample of 1-5 years driving experience, as discussed in section 5.6.1.6, but still the proportion of drivers with experience of more than 15 years is the lowest (23.4%).

Table 5.23 Cross-tabulation of accident groups and experience (after dropping 476 cases of young drivers).

Experience (years)	No accident		More than one accident/km x 10^5	
	N	%	N	%
1-5	60	65.9	31	34.1
6-15	169	62.4	118	37.6
More than 15	239	76.6	73	23.4
Total	663	55.6	530	44.4

"Maturity cannot be accelerated, while the lessons of experience can in principle be taught" (Grayson and Sexton, 2002). There is an implied need for hazard perception training, which aims at improving the ability of new drivers to a level that will produce a significant reduction in accident liability (Grayson and Sexton, 2002).

5.6.2.7 Driver Education

Two-way contingency table analysis was carried out to evaluate the hypothesis that drivers who had not taken any form of driving education (courses) are more involved in accidents than drivers who had. The two variables were driver education (yes or no) and accident rate per 100,000 km driving, at two levels (no accident, and more than one accident).

The proportions of drivers involved in 'no accidents at all' were 0.668 & 0.530 for driving education (yes or no), respectively.

The proportions of drivers involved in 'more than one accident' were 0.332 & 0.470 for driving education (yes or no), respectively (see Table 5.24).

Table 5.24 Cross tabulation of accident groups and driver education

Driver education	**No accident**		**More than one accident/km x 10^5**	
	N	**%**	**N**	**%**
No	509	53	452	47
Yes	147	66.8	73	33.2
Total	656	55.5	525	44.5

Driver education & accident rate were found to be significantly related: Pearson χ^2 (1, $\underline{N}$=1181) = 13.912, $\underline{p} < 0.000$, Cramer's V = 0.109. The Odds ratio shows that the odds of having "more than one accident" for drivers who had not taken any form of driving education is 1.788 times those for drivers who had.

This supports the hypothesis that drivers who have not had any form of driving education are involved in more accidents than those who have. Thus, a driver education course should be compulsory for all drivers in Kuwait before obtaining their driving licence, taking into consideration the evaluation of the effectiveness of the courses.

5.6.2.8 Driver training

Two-way contingency table analysis was conducted to evaluate the hypothesis that unofficially trained drivers are more involved in accidents than officially trained drivers. The two variables were driver training (official, unofficially) and accident rate per 100,000 km driving, at two levels (no accident, and more than one accident).

The proportions of drivers involved in 'no accidents at all' were 0.558 & 0.552 for driving training (official or unofficial) respectively. The proportions of drivers involved in 'more than one accident' were 0.442 & 0.448 for driving training (official or unofficial) respectively (see table 5.25).

Table 5.25 Cross-tabulation of accident groups and driver training

Driver training	**No accident**		**More than one accident/km x 10^5**	
	N	**%**	**N**	**%**
Unofficial practical training	294	55.2	239	44.8
Official practical training	363	55.8	288	44.2
Total	657	55.5	527	44.5

Driver training & accident rate were found not to be significantly related: Pearson χ^2 (1, N=1184) = .043, p =0.836, Cramer's V = .006. The Odds ratio shows that the odds of having "more than one accident" with unofficial training are 1.025 times more which mean almost no difference.

This contradicts the hypothesis that unofficially trained drivers are involved in more accidents than officially trained drivers. The results show almost no difference between officially trained and unofficially trained drivers for accident involvement.

This may imply that driver training is not up to standard and more details should be obtained in order to evaluate it. However, Elvik and Vaa (2004) showed in experimental studies over a one-to-two year period that drivers with training had 11% more crashes per kilometre than drivers without formal training. A possible reason is that driver training focuses on basic skills, such as vehicle control and manoeuvring in traffic, and tends to overlook higher order skills and strategies, and especially self-assessment (Kuiken and Twisk, 2001). Another reason might be that those who are officially trained may not receive good "driver training" in terms of the quantity and the quality available.

Official training, if carried out properly and by qualified instructors, should produce better driving behaviour and consequently safer driving. However, the findings of the study prove the first part (better behaviour) but there is almost no difference with regard to safety. This may be explained by inadequacies in the training program, inexperienced instructors and possibly overconfidence in the officially-trained driver. Therefore, it is recommended that more detailed studies be carried out to verify the results and reach definite conclusions.

5.6.2.9 Speeding

Two-way contingency table analysis was conducted to evaluate the hypothesis that speeding on the motorway plays a very important role in accident rates. I.e. exceeding the speed limit on the motorway leads to more accidents. The two variables were speed at four levels (within the speed limit, 120-130, 130-140 and over 140) and accident rate per 100,000 km driving, at two levels (no accident, and more than one accident).

The proportions of drivers involved in 'no accidents at all' with respect to speed levels (within the speed limit, 120-130, 130-140 and over 140) were 0.70, 0.608, 0.488, and 0.327, respectively.

The proportions of drivers involved in 'more than one accident' with respect to speed levels (within the speed limit, 120-130, 130-140,and over 140) were 0.30, 0.392, 0.512, and 0.628, respectively (see Table 5.26).

Table 5.26 Cross-tabulation of accident groups and speed

Speed on motorway (Km/h)	**No accident**		**More than one accident/km x 10^5**	
	N	**%**	**N**	**%**
Over 140	84	37.2	142	62.8
130-140	144	48.8	151	51.2
120-130	234	60.8	151	39.2
Within the speed limit	201	70	86	30
Total	663	55.6	530	44.4

Speeding & accident rates were found to be significantly related: Pearson χ^2 (3, N=1193) = 65.01, $p < 0.001$, Cramer's V = 0.233. Since in this case the Pearson chi-square test has more than 1 degree of freedom, it means that it is an omnibus test, which evaluates the significance of an overall hypothesis containing multiple sub-hypotheses. These multiple sub-hypotheses have to be tested using follow-up tests. The value of Cramer's V shows that the relation between speed & accident rate is around medium.

In this case, the results of the chi-square test indicated significant differences among the four speeding levels. Follow-up tests had to be conducted to examine each of the sub-hypotheses. In this case the six sub-hypotheses were tested as follows:

The first sub-hypothesis (to be tested) states that drivers who usually do over 140 on the motorway are involved in more accidents than drivers who do 130-140, and this involvement is statistically significant at 0.05.

The second sub-hypothesis (to be tested) states that drivers who do over 140 on the motorway are involved in more accidents than drivers who do 120-130, and this involvement is statistically significant at 0.05.

The third sub-hypothesis (to be tested) states that drivers who do over 140 on the motorway are involved in more accidents than drivers who keep to the speed limit, and this involvement is statistically significant at 0.05.

The fourth sub-hypothesis (to be tested) states that drivers who do 130-140 on the motorway are involved in more accidents than drivers who do 120-130, and this involvement is statistically significant at 0.05.

The fifth sub-hypothesis (to be tested) states that drivers who do 130-140 on the motorway are involved in more accidents than drivers who keep to the speed limit, and this involvement is statistically significantly at 0.05.

The sixth sub-hypothesis (to be tested) states that drivers who do 120-130 are involved in more accidents than drivers who usual keep to the speed limit, and this involvement is statistically significantly at 0.05.

The following table (5.27) shows the results for the six sub-hypotheses. The Holm's Sequential Bonferroni method was used to control for type I error at 0.05 across all six comparisons. Only three pair-wise comparisons were found to be significantly different at 0.05.

Table 5.27 Pair-wise comparison for different speed levels

Pair-wise comparison for different speed levels	Pearson Chi-square	*p*-value	Required *p*-value for significance (as per Holm's Sequential Bonferroni correction)	Significance (p-value)	Cramer's V	Odds Ratio	95% confidence interval	
							Lower	Upper
Over 140 versus 130-140	7.05	0.008	0.05 / 2 = 0.025	*	0.116	1.61	1.13	2.30
Over 140 versus 120-130	31.81	0.000	0.05 / 5 = 0.01	*	0.228	2.620	1.867	3.675
Over 140 versus Within the speed limit	55.32	0.000	0.05 / 4 = 0.0125	*	0.328	3.951	2.730	5.717
130-140 versus 120-130	9.69	0.002	0.05 / 3 = 0.0167	*	0.120	1.625	1.196	2.208
130-140 versus Within the speed limit	27.14	0.000	0.05 / 6= 0.008	*	0.216	2.451	1.744	3.445
120-130 versus Within the speed limit	6.17	0.013	0.05 / 1 = 0.05	*	0.096	1.508	1.090	2.087

NS → Not Significant

Note: For a 2*2 table, Cramer's V of 0.1, 0.3, and 0.5 represent small, medium and large effect size respectively.

Cramer's V also assesses the strength of the relationship between the row & column variables (or what is called the effect size).

Thus for the first sub-hypothesis it was found that there is a significant difference between drivers who usually do over 140 on the motorway and those who do 130-140: Pearson χ^2 (1, N=521) = 7.05, p = 0.008, Cramer's V = 0.116. The Odds ratio shows that drivers who usually do more than 140 are 1.61 times more likely to have accidents than those who usually do 130-140. The value of Cramer's V shows that the relationship between speeding & accident rate is small.

For the second sub-hypothesis it was found that there is a significant difference between drivers who usually do over 140 on the motorway and those who do 120-130: Pearson χ^2 (1, N=611) = 31.81, p < 0.001, Cramer's V = 0.228. The Odds ratio shows that drivers who usually do more than 140 are 2.62 times more likely to have accidents than those who usually do 120-130. The value of Cramer's V shows that the relationship between the speeding & accident rate had an approximately medium impact.

For the third sub-hypothesis it was found that there is a significant difference between drivers who usually do over 140 on the motorway and those who usually keep to the speed limit: Pearson χ^2 (1, N=513) = 55.32, p < 0.001, Cramer's V = 0.328. The odds ratio shows that drivers who usually do more than 140 are 3.95 times more likely to have accidents than those who usually keep to the speed limit. The value of Cramer's V shows that the relationship between the speeding & accident rate is more than medium but less than high impact.

For the fourth sub-hypothesis it was found that there is a significant difference between drivers who usually do 130-140 on the motorway and those who usually do 120-130: Pearson χ^2 (1, N=680) = 9.69, p < 0.001, Cramer's V = 0.120. The Odds ratio shows that drivers who usually do 130-140 are 1.63 times more likely to have accidents than those who usually do 120-130. The value of Cramer's V shows that the relationship between the speeding & accident rate is small.

For the fifth sub-hypothesis it was found that there is a significant difference between drivers who usually do 130-140 on the motorway and those who usually keep to the speed limit: Pearson χ^2 (1, N=582) = 27.14, p < 0.001, Cramer's V = 0.216. The Odds ratio shows that drivers who usually do 130-140 are 2.45 times more likely to have accidents than those who usually keep to the speed limit. The value of Cramer's V shows that the relationship between the speeding & accident rate is medium.

For the sixth sub-hypothesis it was found that there is a significant difference between drivers who usually do 120-130 on the motorway and those who usually keep to the speed limit: Pearson χ^2 (1, N=672) = 6.17, p = 0.013 Cramer's V = 0.096. The Odds ratio shows that drivers who usually do 120-130 are 1.51 times more likely to have accidents than those who usually keep to the speed limit. The value of Cramer's V shows that the relationship between the speeding & accident rate is small.

It may be concluded that higher speed on the motorway increases the rate of accidents (per 100,000 km). This implies a need for better enforcement of speed regulations, using hidden speed cameras, since they have a significant impact in reducing crashes and casualties (Section 4.2). Heavier penalties for speeding on motorways could also be considered to reduce speeding violations.

Speeding on the motorway was found to be an important factor in the investigation. It can be studied along with other parameters, such as age, gender and nationality. These variables are analysed along with speed as described below.

5.6.2.9.1 Speed and age

Two-way contingency table analysis was conducted to evaluate the hypothesis that age plays a very important role in speeding on the motorway, i.e. younger age group drivers tend to speed more on the motorway than the older drivers. The two variables were age groups with four levels (18-29, 30-39, 40-49, and above 50) and speed with four levels (within the speed limit, 120-130, 130-140 and over 140).

The proportions of drivers who were driving within the speed limit with respect to age groups (18-29, 30-39, 40-49, and above 50) were 0.16, 0.233, 0.345, and 0.411, respectively.

The proportions of drivers with a speed in the range of '120-130 km/h' with respect to age groups (18-29, 30-39, 40-49, and above 50) were 0.276, 0.366, 0.349, and 0.393, respectively.

The proportions of drivers with a speed in the range of '130-140 km/h' with respect to age groups (18-29, 30-39, 40-49, and above 50) were 0.282, 0.291, 0.209, and 0.131, respectively.

The proportions of drivers who are driving with a speed of 'over 140 km/h' with respect to age groups (18-29, 30-39, 40-49, and above 50) were 0.283, 0.11, 0.097, and 0.065, respectively (see Table 5.28).

Speeding & age were found to be significantly related: Pearson χ^2 (9, N=1528) = 138.467, $p < 0.001$, Cramer's V = 0.174.

Table 5.28 Cross-tabulation of age groups and speed

	Within the speed limit		120-130		130-140		Over 140	
Age group	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
18-29	114	15.9	197	27.6	201	28.2	202	28.3
30-39	100	23.3	157	36.6	125	29.1	47	11
40-49	96	34.5	97	34.9	58	20.9	27	9.7
50 and above	44	41.1	42	39.3	14	13.1	7	6.5
Total	354	23.2	493	32.3	398	26.1	283	18.5

5.6.2.9.2 Speed and gender

Two-way contingency table analysis was conducted to evaluate the hypothesis that male drivers are speeding more on the motorway than female drivers. The two variables were gender (males, females) and speed at four levels (within the speed limit, 120-130, 130-140 and over 140).

The proportions of drivers who are driving 'within the speed limit' with respect to gender (male and female) were 0.229, 0.238, respectively.

The proportions of drivers with a speed which is in the range of '120-130 km/h' with respect to gender (male and female) were 0.288, 0.413, respectively.

The proportions of drivers with a speed which is in the range of '130-140 km/h' with respect to gender (male and female) were 0.269, 0.238, respectively.

The proportions of drivers who are driving with a speed of 'over 140 km/h' with respect to gender (male and female) were 0.214, 0.111, respectively (see Table 5.29).

The two variables 'Speed' & 'gender' were found to be significantly related: Pearson χ^2 (9, N=1528) = 33.508, $p < .001$, Cramer's V = .148.

Table 5.29 Cross-tabulation of Gender and speed

Gender	Within the speed limit		120-130		130-140		Over 140	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Male	253	22.9	318	28.8	297	26.9	236	21.4
Female	101	23.8	175	41.3	101	23.8	47	11
Total	354	23.2	493	32.3	398	26.1	283	18.5

5.6.2.9.3 Speed and Nationality

Two-way contingency table analysis was conducted to evaluate the hypothesis that Kuwaiti drivers drive at higher speed on the motorway than the non-Kuwaiti drivers. The two variables were nationality (Kuwaiti, non-Kuwaiti) and speed with four levels (within the speed limit, 120-130, 130-140 and over 140).

The proportions of drivers who are driving 'within the speed limit' with respect to nationality (Kuwaiti and non-Kuwaiti) were 0.159, 0.370, respectively.

The proportions of drivers with a speed in the range of '120-130 km/h' with respect to nationality (Kuwaiti and non-Kuwaiti) were 0.258, 0.446, respectively.

The proportions of drivers with a speed which is in the range of '130-140 km/h' with respect to nationality (Kuwaiti and non-Kuwaiti) were 0.334, 0.121, respectively.

The proportions of drivers who are driving with a speed of 'over 140 KM per hour' with respect to nationality (Kuwaiti and non-Kuwaiti) were 0.250, 0.063, respectively (see Table 5.30).

Speeding & nationality were found to be significantly related, Pearson χ^2 (3, $\underline{N}$=1528) = 229.32, $\underline{p} < 0.001$, Cramer's $\underline{V} = 0.387$.

Table 5.30 Cross-tabulation of nationality and speed

Nationality	Within the speed limit		120-130		130-140		Over 140	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Kuwaiti	159	15.9	258	25.8	334	33.4	250	25
Non-Kuwaiti	195	37	235	44.6	64	12.1	33	6.3
Total	354	23.2	493	32.3	398	26.1	283	18.5

5.6.2.10 Violations

Two-way contingency table analysis was conducted to evaluate the hypothesis that violations play an important role in accident rates, i.e. more dangerous offences lead to more accidents (the most dangerous are exceeding speed limit, racing on the highway, passing red traffic lights, driving on the wrong side of the road, disregard of road markings, sudden entry or stop, and ignoring rights of way). The two variables were violation at three levels (no violation, up to one violation/year and more than one violation /year) and accident rate per 100,000 km driving, at two levels (no accident, and more than one accident).

The proportions of drivers involved in 'no accidents at all' with respect to violation categories (no violation up to one violation and more than one violation) were 0.681, 0.459, and 0.216, respectively.

The proportions of drivers involved in 'more than one accident' with respect to violation categories (no violation up to one violation and more than one violation) were 0.319, 0.541, and 0.784, respectively (see Table 5.31).

Table 5.31 Cross-tabulation of accident groups and violation

Dangerous violations	**No accident**		**More than one accident/km x 10^5**	
	N	**%**	**N**	**%**
No violation	453	68.1	212	31.9
One violation	181	45.9	213	54.1
More than One violation	29	21.6	105	78.4
Total	663	55.6	530	44.4

Violation & accident rates were found to be significantly related, Pearson χ^2 (2, N=1193) = 119.704, $p < .001$, Cramer's V = .317. Since in this case the Pearson chi-square test has more than 1 degree of freedom, it means that it is an omnibus test, which evaluates the significance of an overall hypothesis containing multiple sub-hypotheses.

These multiple sub-hypotheses have to be tested using follow-up tests. The value of Cramer's V shows that the relationship between violation & accident rates is medium.

In this case, the results of the chi-square test indicated significant differences among the three violation categories. Follow-up tests had to be conducted to examine each of the sub-hypotheses. In this case the three sub-hypotheses were tested as follows:

The first sub-hypothesis (to be tested) states that drivers who make 'more than one violation' are involved in more accidents than drivers who make 'up to one violation', and this involvement is statistically significant at 0.05.

The second sub-hypothesis (to be tested) states that drivers who make 'more than one violations' are involved in more accidents than drivers who 'do not have any violation', and this involvement is statistically significant at 0.05.

The third sub-hypothesis (to be tested) states that drivers who make 'up to one violation' are involved in more accidents than drivers who 'do not have any violation', and this involvement is statistically significant at 0.05.

The following table (5.32) shows the results for the three sub-hypotheses. The Holm's Sequential Bonferroni method was used to control for type I error at 0.05 across all three comparisons. All pair-wise comparisons were found to be significantly different at 0.05.

Table 5.32 Pair-wise comparison for different speed levels

Pair-wise comparison for different violation categories	**Pearson Chi-square**	***p*-value**	**Required *p*-value for significance (as per Holm's Sequential Bonferroni correction)**	**Significance (p-value)**	**Cramer's V**	**Odds Ratio**	**95% confidence interval**	
							Lower	**Upper**
More than one violation versus up to one violation	**24.644**	**0.000**	**0.05 / 1= 0.05**	*	**0.216**	**3.077**	**1.949**	**4.865**
More than one violation versus no violation	**100.663**	**0.000**	**0.05 / 2 = 0.025**	*	**0.355**	**7.737**	**4.971**	**12.041**
Up to one violation versus no violation	**50.665**	**0.000**	**0.05 / 3 = 0.0167**	*	**0.219**	**2.515**	**1.945**	**3.250**

NS → Not Significant

Note: For a 2*2 table, Cramer's V of 0.1, 0.3, and 0.5 represent small, medium and large effect size respectively.

Cramer's V also assesses the strength of the relationship between the row & column variables (or what is called the effect size).

Thus for the first sub-hypothesis it was found that there is a significant difference between drivers who commit 'more than one violation' and those who commit 'up to one violation', Pearson χ^2 (1, N=528) = 24.644, $p < 0.001$, Cramer's V = 0.216. The Odds ratio shows that drivers who commit more than one violation are 3.077 times more likely to have 'more than one accident' than those who commit up to one violation. The value of Cramer's V shows that the relationship between violation & accident rates had an approximately medium impact.

For the second sub-hypothesis it was found that there is a significant difference between drivers who commit 'more than one violation' and those who make one violation, Pearson χ^2 (1, N=799) = 100.663, $p < 0.001$, Cramer's V = 0.355. The Odds ratio shows that drivers who commit 'more than one violation' are 7.737 times more likely to have 'more than one accident' than those drivers who commit no violation. The value of Cramer's V shows that the relationship between speeding & accident rates is medium.

For the third sub-hypothesis it was found that there is a significant difference between drivers who commit 'up to one violation' and those who commit no violation: Pearson χ^2 (1, N=1059) = 50.665, $p < 0.001$, Cramer's V = 0.219. The Odds ratio shows that drivers who commit 'up to one violation' are 2.515 times more likely to have accidents than those who commit no violation. The value of Cramer's V shows that the relationship between violation & accident rates had an approximately medium impact.

It may be concluded that more dangerous violations increase the rate of accidents (per 100 000 km). This implies that heavier penalties and compulsory re-training courses / tests need to be applied to reduce accidents, especially for drivers who are involved in more serious violations.

Violations were found to be an important factor in the investigation. They can be studied along with other parameters, such as age, gender and nationality. These variables are analysed along with violation as described below.

5.6.2.10.1 Violations and age

Two-way contingency table analysis was conducted to evaluate the hypothesis that age plays a very important role in violation, i.e. younger age group drivers tend to violate more than the older age group drivers. The two variables were age group at four levels (18-29, 30-39, 40-49, and above 50) and violation at three levels (no violation, up to one violation and more than one).

The proportions of drivers with **no violation** with respect to age groups (18-29, 30-39, 40-49, and above 50) were 0.465, 0.513, 0.590, and 0.645, respectively.

The proportions of drivers with **up to one violation** with respect to age group (18-29, 30-39, 40-49, and above 50) were 0.363, 0.429, 0.385, and 0.346, respectively.

The proportions of drivers with **more than one violation** with respect to age group (18-29, 30-39, 40-49, and above 50) were 0.172, 0.058, 0.025, and 0.009, respectively (see Table 5.33).

Violation & age were found to be significantly related, Pearson χ^2 (6, N=1528) = 81.157, $p < 0.001$, Cramer's V = 0.163.

Table 5.33 Cross-tabulation of age groups and violation

Age group	**No violation**		**Up to one violation**		**More than one violation**	
	N	**%**	**N**	**%**	**N**	**%**
18-29	332	46.5	259	36.2	123	17.5
30-39	220	51.3	184	42.9	25	5.8
40-49	164	59	107	38.5	7	2.5
50 and above	69	64.5	37	34.6	1	1
Total	785	51.4	587	38.4	156	10.2

5.6.2.10.2 Violations and gender

Two-way contingency table analysis was conducted to evaluate the hypothesis that males commit more dangerous violations than females. The two variables were gender (males, females) and violation at three levels (no violation, up to one violation and more than one).

The proportions of drivers with **no violation** with respect to gender (male and female) were 0.498, 0.554, respectively.

The proportions of drivers with **up to one violation** with respect to gender (male and female) were 0.395, 0.365, respectively.

The proportions of drivers with **more than one violation** with respect to gender (male and female) were 0.107, 0.09, respectively (see Table 5.34).

From the results we see that although males commit more offences than females, violation & gender are not found to be significantly related, Pearson χ^2 (2, $\underline{N}$=1528) = 3.968, $\underline{p}$ = 0.138, Cramer's $\underline{V}$ = 0.051.

Table 5.34 Cross-tabulation of gender and violation

Gender	**no violation**		**Up to one violation**		**More than one violation**	
	N	**%**	**N**	**%**	**N**	**%**
Male	550	49.8	436	39.5	118	10.7
Female	235	55.4	151	35.6	38	9
Total	785	51.4	587	38.4	156	10.2

5.6.2.10.3 Violations and nationality

Two-way contingency table analysis was conducted to evaluate the hypothesis that Kuwaitis commit more violations than non-Kuwaitis. The two variables were Kuwaiti, non-Kuwaiti and violation at three levels (no violation, up to one violation and more than one).

The proportions of drivers with **no violation** with respect to nationality (Kuwaiti and non-Kuwaiti) were 0.424, 0.685, respectively.

The proportions of drivers with **up to one violation** with respect to nationality (Kuwaiti and non-Kuwaiti) were 0.434, 0.290, respectively.

The proportions of drivers with **more than one violation** with respect to nationality (Kuwaiti and non-Kuwaiti) were 0.143, 0.025, respectively (see Table 5.35).

Violation & nationality were found to be significantly related, Pearson χ^2 (2, $\underline{N}$=1528) = 111.606, $\underline{p} < 0.001$, Cramer's $\underline{V}$ = 0.260.

Table 5.35 Cross-tabulation of nationality and violation

Nationality	**No violation**		**Up to one violation**		**More than one violation**	
	N	**%**	**N**	**%**	**N**	**%**
Kuwaiti	424	42.4	434	43.4	143	14.3
Non-Kuwaiti	361	68.5	153	29	13	2.5
Total	785	51.4	587	38.4	156	10.2

5.7 Conclusions

It can be concluded that most of the factors found to have an effect on driver behaviour also affected accident involvement. (We know that the relationship between behaviour and accidents is complex, and many factors can have an effect on drivers involved in accidents.) It is surprising that males are not involved in more accidents than females (survey results). Young drivers appear to be more aggressive and have more accident involvement. This is an alarming situation, requiring driver education and training, which appears to be poor in Kuwait. It is also a factor of extreme concern that almost a third of respondents had illegally driven while under-age. This should be addressed by parents and the authorities. Enforcement is an issue that should be of concern, especially for Young Kuwaiti drivers, who appear to be more aggressive in driving, since they do not pay much attention to enforcement. Speed & violations play very important roles in accident occurrence.

In the case of both drivers' aggressive behaviour and accident involvement, age and nationality are the main contributing factors. For accident involvement, speed & violations also play a major part. Driving experience and marital status are also important factors in behaviour and accident involvement, but they are clearly related to age. Surprisingly, gender is not a significant factor, as will be investigated further in the next chapter using multivariate analysis.

Having specified the factors that affect behaviour and accidents, focusing on dealing with these factors can help to improve driver behaviour and road safety in Kuwait.

Chapter 6

6 Multivariate analysis (age, gender and nationality)

6.1 Introduction

Descriptive analysis, as conducted in the previous chapter (Chapter 5) is useful for exploring data and understanding relationships between variables using simple one-way tests to determine how the dependent variable (accident involvement rates or driver aggressive behaviour score) relates to each independent variable taken separately, such as age, gender, etc. Multivariate analysis enables more than one independent variable to be considered simultaneously, allowing better knowledge and understanding of the effects. Generally, a simultaneous analysis of more than two variables can be considered as a multivariate analysis (Hair *et al*., 2006). For example, the relationship between two variables, such as accident involvement rate as the dependent variable and age as the independent variable, taking into account the influence of a second independent variable, such as gender.

In this chapter, two way ANOVA and multivariate contingency tables are used for the multivariate analysis. The driver aggressive behaviour score is the dependent continuous variable in the two way ANOVA technique (Section **6.2**) and the accident involvement rate is the dependent categorical variable in the multivariate contingency tables (Section **6.3**). The previous literature (Section 2.1.3.1) and police accident data (Section 3.2.4.7) would also indicate that gender is also likely to have a substantial effect on accident rate. It is evident that 'age' and 'nationality' are the most important factors in predicting aggressive behaviour and accident involvement and the following analyses have focused on these. SPSS software was used for both multivariate analysis techniques.

From the previous chapter, age gave quite a strong effect on both dependent variables (aggressive behaviour and accident involvement) and nationality also gives a close-to-strong effect on the first dependent variable (aggressive behaviour) after dropping the younger drivers from the sample (476 cases, age group 18-24). The other results for nationality and gender are not quite as strong, but they have been included in the analysis, because they are clear-cut variables (Kuwaiti/ non-Kuwaiti, male/ female). The impact of variables like driver education and training are not so clear, because the data cannot be qualified with quite the same certainty; furthermore, the results were not strong. Education level did not give a strong result either. Marital status and driving experience are highly related to age, so they do not perhaps add interest to the analysis.

Speeding and violations do not require the same kind of analysis. This can be explained by the following logic. The occurrences of accidents at different levels of over-speeding and violations have already been analysed, as has the frequency of accidents among different categories of driver (Age group, Gender, and Nationality). A multivariate analysis of all independent variables will be added in the accident prediction model (Chapter 7).

6.2 Aggressive behaviour score as a dependent variable

6.2.1 Methodology (Two way ANOVA)

Whereas one-way analysis of variance (ANOVA) measures the significant effects from one factor only, two-way analysis of variance (ANOVA) measures the effects of two independent variables simultaneously as they affect the continuous dependent variable. Two-way ANOVA not only assesses each factor on two or more levels, but also the potential interaction between them. *F* tests are performed on the two main effects and the interaction between the two factors. A two-way ANOVA test generates three p-values, one for each factor independently, and one measuring the interaction between the two factors.

If one or more of the overall effects are significant, various follow-up tests are conducted. The choice of which follow-up procedure to conduct depends on which effects are significant. If the interaction effect is significant, follow-up tests can be conducted to evaluate simple main effects, interaction comparison, or both. If the interaction effect is not significant, the focus switches to the main effects.

6.2.2 Results:

6.2.2.1 Two-Way Analysis of Variance of aggressive driving behaviour with Age & gender factors

A Two-Way Analysis of Variance is applied to test the following hypothesis:

First Main Effect: Do the population means on the dependent variable (aggressive behaviour score) differ across levels of the first factor (Age), averaging across the levels of the second factor (Gender)?

Second Main Effect: Do the population means on the dependent variable (aggressive behaviour score) differ across levels of the second factor (Gender), averaging across the levels of the first factor (Age)?

Interaction Effect: Do the differences in the population means on the dependent variable (aggressive behaviour score) among the levels of the first factor (age) vary as a function of the levels of the second factor (Gender)?

A 4*2 ANOVA was conducted to evaluate the effects of "Age" (four age groups) and "gender" on the aggressive behaviour scores of the drivers in Kuwait. The means and standard deviations for the aggressive behaviour scores as a function of the two factors are presented in Table 6.2. The ANOVA results indicated no significant interaction between age and gender, F (3, 1520) = 1.968, p =0.117, partial η^2 =0.004, (Table 6.1 and Figure 6.1 also show that there is no interaction between gender & age groups), but a significant main effect for age: F (3, 1520) = 66.483, p < 0.0001, partial η^2 =0.12, and gender, F (1, 1520) = 6.370, p =0.012, partial η^2 =0.004. The 'gender' main effect indicated that females (M=3.74, SD=0.51) tended to have a slightly better driving behaviour score than males (M=3.66, SD=0.64). The 'age' main effect indicates that as age increases, driving behaviour becomes better (higher score for aggressive behaviour).

The behaviour of drivers in age groups 18-29 was (M=3.45, SD=0.61), in age group 30-39 (M=3.76, SD=0.54), in age group 40-49 (M=4.00, SD=0.48), and in the age group 50 & above (M=4.13, SD=0.47). Thus all drivers, whether male or female, showed an improvement in their driving behaviour with age (Table 6.2)

Overall, the 4*2 ANOVA indicates that both males & females have the best driving behaviour when they are at the age of 50 & above. Follow-up tests were conducted to make pair-wise comparisons between the four age groups, separating the male and female populations and controlling for Type I error. The probability of Type I error (α) was set as 0.05/2 = 0.025 for the male & female populations (controlling for type I error using Holm's Sequential Bonferroni method). Since there are six pairs of groups for age for each value of gender, the various values of Alpha were set as 0.025/6 = 0.004, 0.025/5 =0.005, 0.025/4=0.006, 0.025/3 = 0.008, 0.025/2 = 0.0125, 0.025/1 = 0.025. Thus the lowest value for alpha was set as 0.004.

For the male population only, a significant difference in the driving behaviour score was found between all age groups, $\underline{F}$ (3, 1100) = 80.193, $\underline{p} < 0.001$, partial η^2 =0.179. All pairs of age groups were significantly different at $\underline{p} < 0.001$ except the pair of age groups which was 40-49 and 50-more, for which $p > 0.05$. It may be seen from Table 6.2 that driving behaviour improves with respect to age group, the highest being for the age group '50 & above' and the lowest for the age '18-29'.

For the female population only, a significant difference in the driving behaviour score was found between all ages, $\underline{F}$ (3, 420) = 22.979, $\underline{p} < 0.001$, partial η^2 =0.141. It was found that all pairs of age groups were significantly different at $p < 0.005$ except one pair of age groups 40-49 and 50-more ($p > 0.05$). It may be seen from Table 6.2 that driving behaviour improves with respect age group, the highest score being for the age group '50 & above' and the lowest for the age group '18-29'.

From the above, it can be seen that youth and aggressive behaviour are associated, irrespective of gender.

For drivers of age group 18-29, a significant difference in the driving behaviour score was found between males & females, F (1,712) = 18.837, $\underline{p} < 0.001$, partial η^2 =0.026 (small to medium). For the age group 18-29, the driving behaviour score was higher (better behaviour) for female drivers than for male drivers (Table 6.2).

For drivers of age group 30-39, no significant difference in the driving behaviour score was found between males & females, $F(1,427) = 0.566$, $p = 0.452$, partial $\eta^2 = 0.001$. For the age group 30-39, the driving behaviour score was higher (better behaviour) for female drivers than for male drivers (Table 6.2).

For drivers of age group 40-49, no significant difference in the driving behaviour score was found between males & females, $F(1,276) = 0.895$, $p = 0.345$, partial $\eta^2 = 0.003$. For the age group 40-49, the driving behaviour score was higher (better behaviour) for female drivers than for male drivers (Table 6.2).

For drivers of age group 50-above, no significant difference in the driving behaviour score was found between males & females, $F(1,105) = 1.687$, $p = 0.197$, partial $\eta^2 = 0.016$. For the age group 50 and above, the driving behaviour score was higher (better behaviour) for female drivers than for male drivers (Table 6.2).

The results above show that young males are significantly more aggressive than females; it would appear that they continue to be more aggressive in later years, but not to a significant extent. There are cultural factors involved. First of all, males generally start driving as soon as they reach the age of eighteen. They like to get out and about independently, whereas females tend to have a chauffeur or be accompanied by a parent. Males acquire a car at an early age and spend time out of the house for leisure or business. They tend to have a busy lifestyle, which can lead to tiredness and aggressive behaviour, but maturity tempers this behaviour. Another point is that there is a slight imbalance in the gender distribution in Kuwait (60% male to 40% female), but the population of driving licence holders is very skewed: 78% of them are male.

Table 6.1 Tests of between-subjects effects (Gender & Age)

Dependent Variable: aggressive behaviour

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	98.677(a)	7	14.097	45.895	0.000	0.174
Intercept	7612.930	1	7612.930	24785.345	0.000	0.942
SEX	1.957	1	1.957	6.370	0.012	0.004
AGE	61.261	3	20.420	66.483	0.000	0.116
SEX * AGE	1.814	3	.605	1.968	0.117	0.004
Error	466.875	1520	.307			
Total	21282.692	1528				
Corrected Total	565.552	1527				

a R Squared = 0.174 (Adjusted R Squared = 0.171)

Table 6.2 Means & Standard Deviations for Aggressive Behaviour Score based on gender and age

SEX	AGE	Mean	Std. Deviation	N
1 Male	1 18-29	3.38	0.63	486
	2 30-39	3.75	0.57	312
	3 40-49	3.98	0.51	212
	4 50 & above	4.11	0.48	94
	Total	3.66	0.64	1104
2 Female	1 18-29	3.59	0.53	228
	2 30-39	3.79	0.44	117
	3 40-49	4.05	0.37	66
	4 50 & above	4.28	0.32	13
	Total	3.74	0.51	424
Total	1 18-29	3.45	0.61	714
	2 30-39	3.76	0.54	429
	3 40-49	4.00	0.48	278
	4 50 & above	4.13	0.47	107
	Total	3.68	0.61	1528

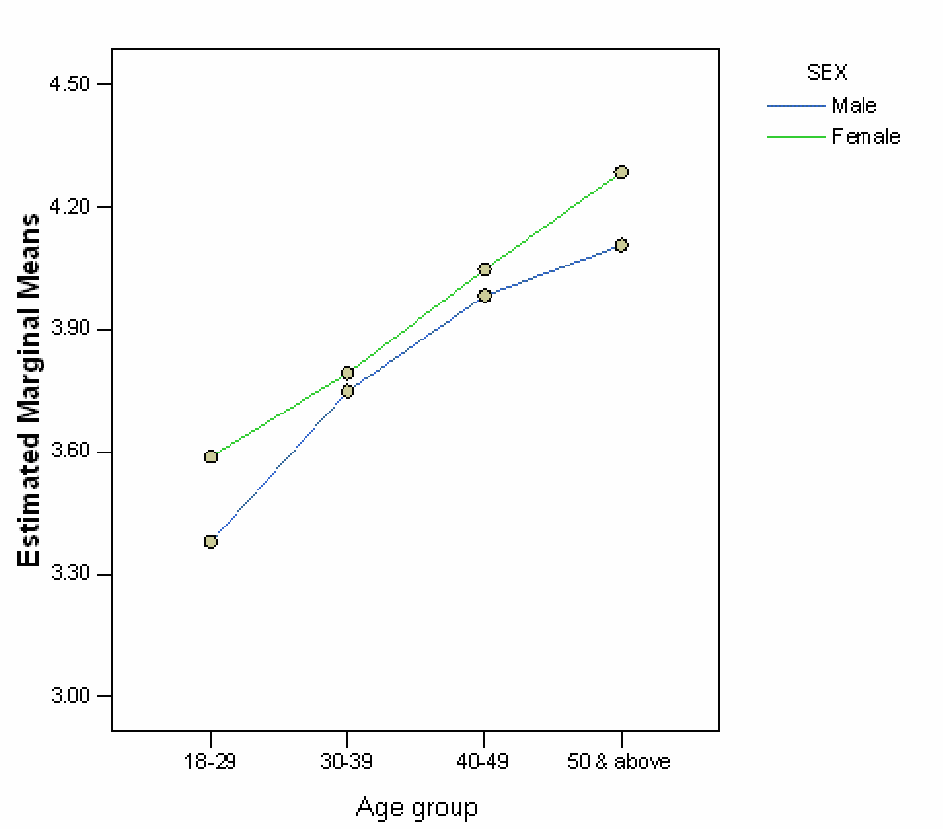

Figure 6.1 Estimated marginal means of aggressive behaviour based on age and gender

6.2.2.2 Two-Way Analysis of Variance of aggressive driving behaviour with Gender & Nationality factors

A Two-Way Analysis of Variance was applied to test the following hypothesis:

First Main Effect: Do the population means on the dependent variable (aggressive behaviour score) differ across levels of the first factor (Gender), averaging across the levels of the second factor (Nationality)?

Second Main Effect: Do the population means on the dependent variable (aggressive behaviour score) differ across levels of the second factor (Nationality), averaging across the levels of the first factor (Gender)?

Interaction Effect: Do the differences in the population means on the dependent variable (aggressive behaviour score) among the levels of the first factor (Gender) vary as a function of the levels of the second factor (Nationality)?

A 2*2 ANOVA was conducted to evaluate the effects of "Gender" and "Nationality" on the aggressive behaviour scores of drivers in Kuwait. The means and standard deviations for Aggressive Behaviour Score as a function of two factors are presented in Table 6.4 The ANOVA indicated a significant interaction between Gender and Nationality, F (1, 1524) = 13.214, $p < 0.0001$, partial $\eta^2 = 0.009$ (very weak) (Table 6.3/Figure 6.2), a significant main effect for Gender, F (1, 1524) = 6.864, $p < 0.0001$, partial $\eta^2 = .004$ (very weak), and for Nationality, F (1, 1524) = 104.891, $p < 0.0001$, partial $\eta^2 = 0.064$ (medium). The Nationality main effect indicated that non-Kuwaitis (M=3.97, SD=0.57) tended to have a better driving behaviour score than Kuwaitis (M=3.53, SD=0.57). The gender main effect indicates that females (M=3.74, SD=0.51) tended to have a better driving behaviour score than Males (M=3.66, SD=0.64). It may be seen in Table 6.4 that Non-Kuwaiti male driver behaviour scores are slightly better than Non-Kuwaiti female driver behaviour scores, whereas Kuwaiti female driver behaviour scores are better than Kuwaiti male driver behaviour scores.

Further significance testing was conducted between Kuwaiti & Non-Kuwaiti populations for each gender. Significance testing was also conducted between male & female populations for each nationality group.

For the Kuwaiti population only, a significant difference in driving behaviour score was found between males & females, F (1, 999) = 42.010, $p < 0.001$, partial $\eta^2 = 0.04$ (approximately medium).

For the non-Kuwaiti population only, no significant difference in driving behaviour scores was found between males & females, F (1, 525) = 0.326, $p = 0.568$, partial $\eta^2 = 0.001$ (very weak).

For the Male population only, a significant difference in driving behaviour scores was found between Kuwaiti & Non-Kuwaiti populations, F (1, 1102) = 222.17, $p < 0.001$, partial $\eta^2 = 0.168$ (Strong).

For the Female population only, a significant difference in driving behaviour scores was found between Kuwaiti & Non-Kuwaiti populations, $\underline{F}$ (1, 442) = 17.166, $p < 0.001$, partial η^2 =0.039 (approximately medium).

It can be seen that the magnitude of the difference assessed by η^2 for gender is generally very weak except for the age group 18-29 (see previous section, where 81.5% of this age group are Kuwaiti). For the Kuwaiti population, the magnitude of the difference assessed by η^2 was small to medium, as there was no significant difference between non-Kuwaiti males and non-Kuwaiti females. Also non-Kuwaiti male driver behaviour scores were better (i.e. less aggressive) than those of Kuwaiti female drivers. To investigate the magnitude of the difference between non-Kuwaiti male drivers and Kuwaiti female drivers, an independent-sample $\underline{t}$ -test was performed.

An independent-sample $\underline{t}$ -test was conducted to examine the difference between non-Kuwaiti male drivers and Kuwaiti female drivers based on the aggressive behaviour scores of drivers in Kuwait. The test was significant, $\underline{t}$ (774.508) = (7.604), $\underline{p} < .001$.

The results of the independent-sample $\underline{t}$ -test indicated a significant difference in the driving behaviour scores between Non-Kuwaiti males and Kuwaiti females, $\underline{F}$ (1, 783) = 55.61, $p < 0.001$, partial η^2 =0.066 (medium). Kuwaiti females ($\underline{M}$=3.687, $\underline{SD}$= 0.502, N= 341) tended to have worse driving behaviour scores than Non-Kuwaiti males ($\underline{M}$=3.98, $\underline{SD}$=0.585, N= 444).

This could be explained by the fact that non-Kuwaitis are more concerned about having to pay fines than Kuwaiti drivers, who generally have better financial status, as discussed in section 5.6.1.3. They may also have had some concerns about the extent of truthful answers despite the confidentially guarantee. There was no significant difference between non-Kuwaiti males and non-Kuwaiti females and this may be because both of them are concerned about paying fines.

Table 6.3 Tests of Between-Subjects Effects (Nationality & Gender)

Dependent Variable: aggressive behaviour

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	82.094(a)	3	27.365	86.261	0.000	0.145
Intercept	12090.773	1	12090.773	38113.616	0.000	0.962
SEX	2.177	1	2.177	6.864	0.009	0.004
NATIONALITY	33.274	1	33.274	104.891	0.000	0.064
SEX * NATIONALITY	4.192	1	4.192	13.214	0.000	0.009
Error	483.458	1524	0.317			
Total	21282.692	1528				
Corrected Total	565.552	1527				

a R Squared = .145 (Adjusted R Squared = .143)

Table 6.4 Means & Standard Deviations for Aggressive Behaviour Score based on nationality and gender

Gender	Nationality	Mean	Std. Deviation	N
1 Male	1.00 Kuwaiti	3.4459	0.58444	660
	2.00 Non-Kuwaiti	3.9810	0.58551	444
	Total	3.6611	0.64083	1104
2 Female	1.00 Kuwaiti	3.6871	0.50275	341
	2.00 Non-Kuwaiti	3.9419	0.50065	83
	Total	3.7370	0.51186	424
Total	1.00 Kuwaiti	3.5281	0.56931	1001
	2.00 Non-Kuwaiti	3.9748	0.57272	527
	Total	3.6822	0.60858	1528

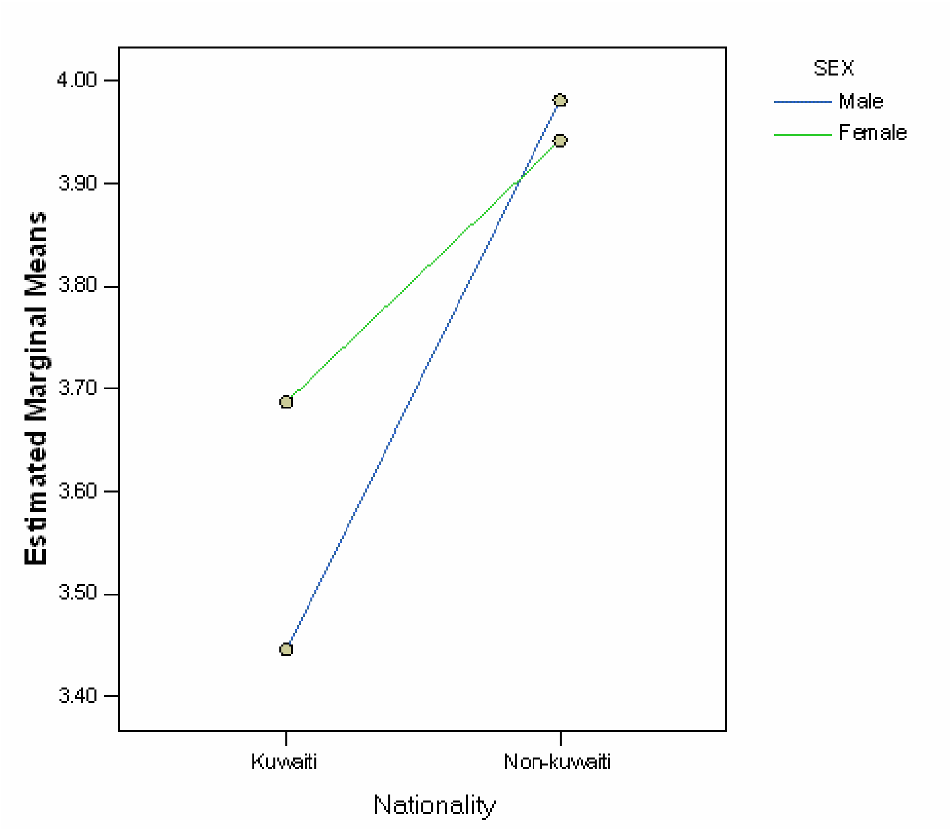

Figure 6.2 Estimated marginal means of aggressive behaviour based on nationality and gender

6.2.2.3 Two-Way Analysis of Variance of aggressive driving behaviour with Age & Nationality factors

A Two-Way Analysis of Variance was applied to test the following hypothesis:
First Main Effect: Do the population means of the dependent variable (aggressive behaviour score) differ across levels of the first factor (Age), averaging across the levels of the second factor (Nationality)?

Second Main Effect: Do the population means of the dependent variable (aggressive behaviour score) differ across levels of the second factor (Nationality), averaging across the levels of the first factor (Age)?

Interaction Effect: Do the differences in the population means on the dependent variable (aggressive behaviour score) among the levels of the first factor (age) vary as a function of the levels of the second factor (Nationality)?

A 4*2 ANOVA was conducted to evaluate the effects of "Age" (four age groups) and "Nationality" on the aggressive behaviour scores of drivers in Kuwait. The means and standard deviations for aggressive behaviour score as a function of two factors are presented in Table 6.6 The ANOVA indicated no significant interaction between age and Nationality, F (3, 1520) = 0.135, p =0.939, partial $\eta^2 \leq 0.0002$. There were no significant interactions between Nationality & Age groups (Table 6.5 and Figure 6.3), but there are significant main effects for age, F (3, 1520) = 53.885, $p < 0.0001$, partial $\eta^2 = 0.096$, and Nationality, F (1, 1520) = 80.421, $p < 0.0001$, partial $\eta^2 = 0.05$. The Nationality main effect indicated that non-Kuwaitis (M=3.97, SD=0.57) tended to have better driving behaviour scores than Kuwaitis (M=3.53, SD=0.57). The Age main effect indicates that as age increases, driving behaviour becomes better. The behaviour of drivers in the age group 18-29 is (M=3.45, SD=0.61), in the age group 30-39 (M=3.76, SD=0.54), in the age group 40-49 (M=4.00, SD=0.48) and in the age group 50 & above (M=4.13, SD= 0.47). Thus all drivers, whether Kuwaiti or non-Kuwaiti, showed an improvement in their driving behaviour with age.

Overall, the 4*2 ANOVA indicates that both Kuwaitis & non-Kuwaitis have their best stated driving behaviour when they are at the age of 50 & above.

Follow-up tests were conducted to make pair-wise comparisons between the four age groups, separating the Kuwaiti and non-Kuwaiti populations and controlling for Type I error. The Alpha was set as 0.05/2 = 0.025 for the Kuwaiti & non-Kuwaiti populations. Since there are six pairs of groups of Age for each value of Nationality, then again the various values of Alpha were set as 0.025/6 = 0.004, 0.025/5 =0.005, 0.025/4=0.006, 0.025/3 = 0.008, 0.025/2 = 0.0125, 0.025/1 = 0.025. Thus the lowest value for alpha was set as 0.004.

For the Kuwaiti population only, a significant difference in driving behaviour scores was found between all ages, F (3, 997) = 39.631, $p < 0.001$, partial η^2 =0.107 (quite strong). It was found that all pairs of age groups were significantly different at $p < 0.001$, except one pair of age groups (40-49, 50-more) ($p > 0.05$). It may be seen in Table 6.6 that driving behaviour improves with respect to age; the highest was for the age group '50 & above' and the lowest was for the age group '18-29'.

For the non-Kuwaiti population only, a significant difference in driving behaviour scores was found among all ages, F (3, 523) = 21.772, $p < 0.001$, partial η^2= 0.111 (approximately strong). It was found that all pairs of age groups were significantly different at $p < 0.001$, except one pair of age groups (40-49, 50-more) ($p > 0.05$). It may be seen from Table 6.6 that driving behaviour improves with respect to age; the highest was for the age group '50 & above' and the lowest was for the age group '18-29'. Age plays a major role in the case of both Kuwaitis and non-Kuwaitis.

For drivers of age group 18-29, a significant difference in driving behaviour scores was found between Kuwaitis & non-Kuwaitis, F (1, 712) = 30.962, $p < 0.001$, partial η^2 =0.042 (approximately medium). For the age group 18-29, driving behaviour scores were better for non-Kuwaiti drivers than for Kuwaiti drivers (Table 6.6).

For drivers of age group 30-39, a significant difference in driving behaviour scores was found between Kuwaitis & non-Kuwaitis, F (1, 427) = 43.092, $p < 0.001$, partial η^2 =0.092 (between medium and strong). For the age group 30-39, driving behaviour scores were better for non-Kuwaiti drivers than for Kuwaiti drivers (Table 6.6).

For drivers of age group 40-49, a significant difference in driving behaviour scores was found between Kuwaitis & non-Kuwaitis, F (1, 276) = 26.712, $p < 0.001$, partial η^2 =0.088 (between medium and strong). For the age group 40-49, driving behaviour scores were better for non-Kuwaiti drivers than for Kuwaiti drivers (Table 6.6).

For drivers of age group 50-above, a significant difference in driving behaviour scores was found between Kuwaitis & non-Kuwaitis, F (1, 105) =17.78, *p* = 0.001, partial η^2 =0.145 (strong). For the age group 50 and above, driving behaviour scores were better for non-Kuwaiti drivers than for Kuwaiti drivers (Table 6.6).

The above results show that Kuwaitis have a significantly worse behaviour score than non-Kuwaitis in all age ranges.

Table 6.5 Tests of Between-Subjects Effects (Nationality & Age)

Dependent Variable: aggressive behaviour

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	122.594(a)	7	17.513	60.097	0.000	0.217
Intercept	13412.561	1	13412.561	46024.917	0.000	0.968
NATIONALITY	23.436	1	23.436	80.421	0.000	0.050
AGE	47.109	3	15.703	53.885	0.000	0.096
NATIONALITY * AGE	.118	3	0.039	0.135	0.939	0.000
Error	442.958	1520	0.291			
Total	21282.692	1528				
Corrected Total	565.552	1527				

a R Squared = 0.217 (Adjusted R Squared = 0.213)

Table 6.6 Means & Standard Deviations for Aggressive Behaviour Score based on nationality and age

KU_NONKU	AGE	Mean	Std. Deviation	N
1 Kuwaiti	1 18-29	3.39	0.58	582
	2 30-39	3.61	0.49	239
	3 40-49	3.85	0.45	132
	4 50 & above	3.93	0.50	48
	Total	3.53	0.57	1001
2 Non-Kuwaiti	1 18-29	3.71	0.66	132
	2 30-39	3.94	0.54	190
	3 40-49	4.13	0.47	146
	4 50 & above	4.29	0.37	59
	Total	3.97	0.57	527
Total	1 18-29	3.45	0.61	714
	2 30-39	3.76	0.54	429
	3 40-49	4.00	0.48	278
	4 50 & above	4.13	0.47	107
	Total	3.68	0.61	1528

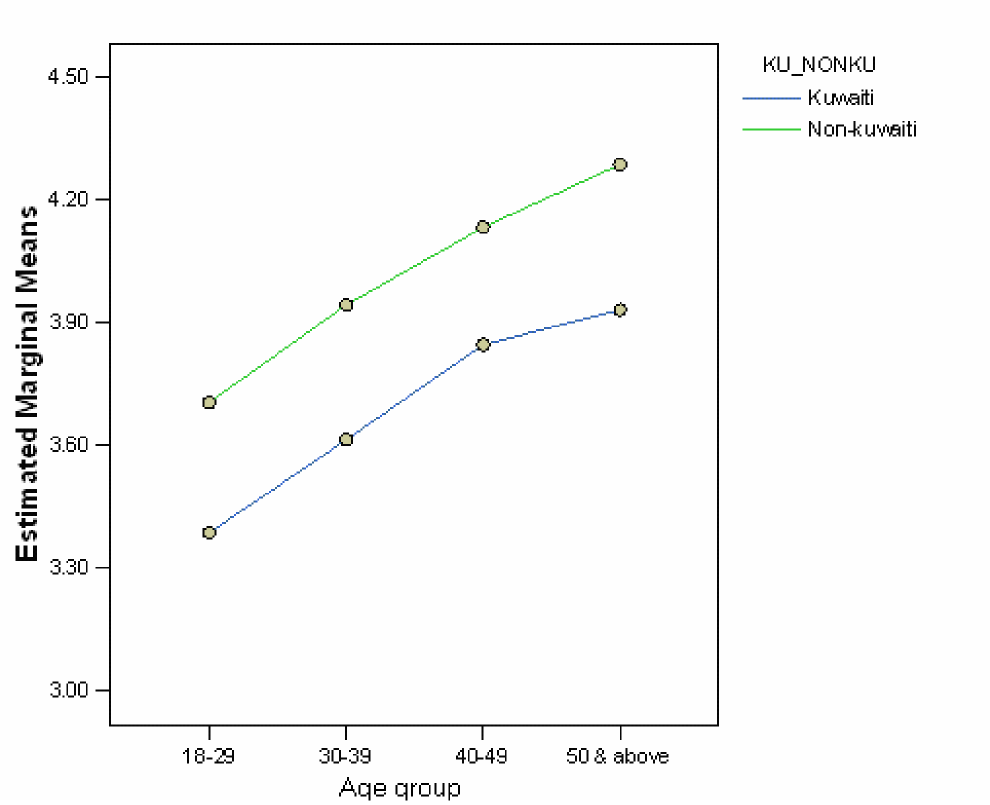

Figure 6.3 Estimated marginal means of aggressive behaviour based on nationality and age

6.3 Accident involvement as a dependent variable

6.3.1 Methodology (Multivariate Contingency Table Analysis using Cross-tabulation and Odds Ratios)

Multivariate contingency tables are generally used to analyse the relationship between more than two variables, most usually categorical variables (Hanneman, website accessed 09.01.08). The possible impact of a third variable on the original two variables is examined. Multivariate contingency tables may be preferred to more elaborate approaches under some circumstances. Multivariate cross-tabulation is a particularly useful device for grasping the key concepts of what it means to statistically control for a third variable by holding it constant. The central ideas of multivariate modelling, partial association and joint association, are easier to grasp in the cross-tabulation than in other models. Although the purpose of cross-tabulation is to understand patterns of association and partial association, it can also be used for causal modelling. It may be used to investigate whether a person self reports to have "no accidents at all" or "more than one accident" (Hanneman, website accessed 09.01.08). The three categorical variables studied were age (18-29, 30-40 and over 40), gender, and nationality (Kuwaiti, Non-Kuwaiti).

6.3.2 Results

This section presents the results from multivariate cross-tabulation of Chi-square & Odds ratios. Several hypotheses were tested such as: (1) are males involved more than females in "more than one accident"? (2) are Kuwaitis involved more than non-Kuwaitis in "more than one accident"? and (3) are young drivers involved more than middle aged or older drivers in "more than one accident"? etc. Partial association and joint association with other variables were used to study accidents in relation to gender, nationality and age, for example the joint associations of gender & nationality, gender & age, and nationality and age.

The study of joint association involved three new variables: the first is *GENDER_NATION,* having four levels ('Female & Non-Kuwaiti', 'Male & Non-Kuwaiti', 'Female & Kuwaiti', 'Male & Kuwaiti'); the second is, *'GENDER_AGE'*, having six levels ('Male & Age=40 & above', 'Female & Age=40 & above', 'Male & Age=30-39', 'Female & Age=30-39', 'Male & Age=18-29', and 'Female & Age=18-29'); the third is *'NATION_AGE'* having six levels ('Non-Kuwaiti & Age = 40 & above', 'Kuwaiti & Age = 40 & above', 'Non-Kuwaiti & Age = 30-39', 'Kuwaiti & Age = 30-39', 'Non-Kuwaiti & Age = 18-29', 'Kuwaiti & Age = 18-29'). Tables 6.7 and 6.8 show various results of partial & interaction effects with respect to nationality (Kuwaiti, non-Kuwaiti), gender (male, female) & age (18-29, 30-39, 40-above).

In calculating the odds ratio for the dependent variable (accidents), the dependent variable 'accident' is recoded in two categories, the first being drivers with 'more than one accident' and the second being drivers 'with no accidents'. The data file was further divided into two groups, Kuwaitis & non-Kuwaitis. The various demographic variables (or independent variables) of interest were gender (with reference category female) and age (with reference category ‘more than 40’).

Table 6.7 Results of partial effects with respect to nationality with age and nationality with gender on accident involvement.

Various categories of drivers	Kuwaitis								Non Kuwaitis							
	More than one accident	No accident	Total	χ2	Sig. (p=)	Odds ratios	95%CI Lower	95%CI Upper	More than one accident	No Accident	Total	χ2	Sig. (p=)	Odds ratios	95%CI Lower	95%CI Upper
Gender																
Male	254	238	492	0.189	0.66	1.067	0.796	1.431	108	245	353	2.920	0.088	0.630	0.369	1.073
Female	140	140	280						28	40	68					
Age group																
18-29	327	183	510	78.430	0.000	7.458	4.571	12.170	49	59	108	11.970	0.001	2.471	1.472	4.150
More than 40	23	96	119						41	122	163					
30-39	44	99	143	4.470	0.035	1.855	1.042	3.304	46	104	150	1.180	0.277	1.316	0.802	2.160
More than 40	23	96	119						41	122	163					

Table 6.8 Results of partial effects with respect to gender with age on accident involvement.

Various categories of drivers	Male								Female							
	More than one accident	No accident	Total	χ2	Sig. (p=)	Odds ratios	95%CI Lower	95%CI Upper	More than one accident	No accident	Total	χ2	Sig. (p=)	Odds ratios	95%CI Lower	95%CI Upper
Age group																
18-29	254	160	414	87.330	0.000	5.461	3.765	7.921	122	82	204	24.690	0.000	4.889	2.525	9.463
More than 40	50	172	222						14	46	60					
30-39	58	151	209	1.570	0.211	1.321	0.854	2.045	32	52	84	3.500	0.061	2.022	0.962	4.250
More than 40	50	172	222						14	46	60					

6.3.2.1Accident involvement based on nationality and gender

A multivariate contingency table analysis was created to evaluate whether more male Kuwaiti drivers than female Kuwaiti drivers were involved in 'more than one accident'. The two variables, 'gender' & 'accidents', were found not to be significantly related: Pearson χ^2 (1, **N**=772) = 0.189, **p** = 0.664. The value of the odds ratio shows that, for male Kuwaiti drivers, the odds of 'more than one accident' is 1.067 times those for female Kuwaiti drivers. This shows that male Kuwaiti drivers and female Kuwaiti drivers are almost equally involved in 'more than one accident'. In the case of Non-Kuwaiti male & female drivers, the two variables gender & accidents were found not to be significantly related: Pearson χ^2 (1, **N**=421) = 2.92, **p** = 0.088. The value of the odds ratio shows that, for Non-Kuwaiti male drivers, the odds of being involved in 'more than one accident' is 0.630 times those for female Non-Kuwaiti drivers. This shows that male Non-Kuwaiti drivers are involved less than female Non-Kuwaitis drivers in 'more than one accident' (see Table 6.7).

There is no straightforward interpretation of this result. Male drivers do more long-distance mileage, and therefore might be expected to have more accidents. However, females who drive shorter distances may be less confident or experienced, and may be more open to admitting that they had accidents that they should have been able to avoid. Also, they may drive more in urban areas, where the accident risk is greatest.

As regards the overall goodness of fit of the model and to test the hypothesis that there is a joint association for the dependent variable 'accidents' with respect to the two independent variables, 'gender' & 'nationality', it was found that Pearson χ^2 (3, **N**=1193) = 41.496, **p** < 0.0001. One measure of joint association is phi = 0.187. It can be thought of as an index of the proportion of variance in 'accidents' due jointly to 'gender' and 'nationality'.

For this special variable called 'GENDER_NATION', which has 4 levels ('Female & Non-Kuwaiti', 'Male & Non-Kuwaiti', 'Female & Kuwaitis' and 'Male & Kuwaiti'), the odds ratio has been calculated for all three levels using 'Male Non-Kuwaiti' drivers as reference (see Table 6.9).

The value of the odds ratio shows that for 'Female Non-Kuwaiti' drivers, the odds of having 'more than one accident' is 1.588 times that for 'Male Non-Kuwaiti' drivers (not significant).

The value of the odds ratio shows that for 'Male Kuwaiti' drivers, the odds of 'more than one accident' is 2.421 times that for 'Male Non-Kuwaiti' drivers (significant).

The value of the odds ratio shows that for 'Female Kuwaiti' drivers, the odds of 'more than one accident' is 2.269 times that for 'Male Non-Kuwaiti' drivers (significant).

The conclusion is that Kuwaiti drivers are more likely to have had 'more than one accident' than non-Kuwaiti drivers. Non-Kuwaiti males have the fewest accidents followed, by Non-Kuwaiti females, followed by Kuwaiti females; Kuwaiti males have the most accidents. The main reason, as suggested earlier, for the safer non-Kuwaiti results is that non-Kuwaitis are more concerned about enforcement.

Table 6.9 Odds ratio for the Gender_Nation variable (taking the non-Kuwaiti male as a reference).

Gender_Nation	More than one accident	No accident	total	χ^2	Sig. (p=)	Odds Ratio
Non-Kuwaiti female	28	40	68	2.919323	0.087	1.588
Kuwaiti male	254	238	492	37.12491	0.000	2.421
Kuwaiti female	140	140	280	24.67492	0.000	2.269
Non-Kuwaiti male (reference)	108	245	353	-------------	-----------	--------

6.3.2.2 Accident involvement based on nationality and age

The following results also refer back to Table 6.7. A multivariate contingency table analysis was conducted to evaluate the differences between **Kuwaiti** drivers in age groups '18-29' and 'over 40', assuming that drivers in the age groups '18-29' would have higher accident involvement. The two variables, 'age' & 'accidents', were found to be significantly related: Pearson $\chi2$ (1, **N**=629) = 78.43, **p** < 0.001. The value of the odds ratio shows that, for drivers aged '18-29' the odds of having 'more than one accident' were 7.458 times greater than for the age group 'over 40' (a very large difference). This shows that younger Kuwaitis drivers (age group 18-29) are much more involved in 'more than one accident' than Kuwaiti drivers in the older age group (over 40).

As regards Non-Kuwaiti drivers in the same age groups (18-29, more than 40), the two variables, 'age' & 'accidents', were found to be significantly related: Pearson $\chi2$ (1, **N**=271) = 11.97, **p** = 0.001. The value of the odds ratio shows that for drivers of age group '18-29' the odds of having 'more than one accident' were 2.471 times that for the drivers of age group 'over 40'. This shows that younger Non-Kuwaiti drivers (age group 18-29) are more involved in 'more than one accident' than Non-Kuwaiti drivers in the older age group (over 40).

The same analysis was used to evaluate the differences between Kuwaiti driver age groups '30-39' and 'more than 40', assuming that the younger age group (30-39) would more frequently have 'more than one accident'. The two variables, 'age' & 'accidents', were found to be significantly related: Pearson $\chi2$ (1, **N**=262) = 4.47, **p** < 0.035. The value of the odds ratio shows that the younger age group (30-39) was 1.855 times more likely to be involved in 'more than one accident'. This shows that younger Kuwaiti drivers (age group 30-39) are more involved in 'more than one accident' than Kuwaiti drivers in the older age group (more than 40).

For Non-Kuwaiti drivers of the same age groups (30-39, more than 40), the two variables, 'age' & 'accidents' were found not to be significantly related: Pearson $\chi2$ (1,

N=313) = 1.18, **p** = 0.277. The value of the odds ratio shows that the likelihood of the younger age group (30-39) having 'more than one accident' was only 1.316 higher. This shows that younger Non-Kuwaiti drivers (age group 30-39) are only slightly more involved in 'more than one accident' than Non-Kuwaiti drivers in the age group ‘more than 40’.

The next results refer to Table 6.10. To study the overall goodness of fit of the model and to test the hypothesis that there is a **joint association** for the dependent variable 'accidents' in relation to the two independent variables 'age' & 'nationality', it was found that Pearson $\chi 2$ (5, **N**=1193) = 157.33, **p** < 0.0001. One measure of joint association is phi = 0.363. It can be thought of as an index of the proportion of variance in 'accidents' due jointly to 'age' and 'nationality'.

For this special variable, 'NATION_AGE', which has six levels ('Non-Kuwaiti & Age = 40 & above', 'Kuwaiti & Age = 40 & above', 'Non-Kuwaiti & Age = 30-39', 'Kuwaiti & Age = 30-39', 'Non-Kuwaiti & Age = 18-29', 'Kuwaiti & Age = 18-29'), the odds ratio is calculated for five levels in relation to Non-Kuwaiti drivers who are in the age group ‘40 & above’ as reference (see table 6.10).

The value of the odds ratio shows that the odds of having 'more than one accident' for 'Kuwaiti drivers in the age group 40 & above’ are 0.713 times those for 'Non-Kuwaiti drivers in the same age group (not significant). Older Kuwaiti drivers have more experience and are accustomed to the Kuwaiti road network and traffic system, and may have better perception and anticipation. This may also be because that age group of Kuwaiti drivers drive their cars less frequently, preferring to employ non-Kuwaiti drivers to do the driving, even though they may have given their mileage according to the reading on the car’s milometer, irrespective of who was driving.

The value of the odds ratio shows that the odds of having 'more than one accident' for 'Non-Kuwaitis aged 30-39' are 1.316 times those of 'Non-Kuwaiti drivers aged 40 & above' (not significant).

The value of the odds ratio shows that the odds of having 'more than one accident' for 'Kuwaiti drivers in the age group 30-39' are 1.322 times those of 'Non-Kuwaiti drivers in the age group of 40 & above' (not significant).

The value of the odds ratio shows that the odds of having 'more than one accident' for 'Non-Kuwaiti drivers in the age group 18-29' are 2.471 times those of 'Non-Kuwaiti drivers in the age group 40 & above' (significant).

The value of the odds ratio shows that the odds of having 'more than one accident' for 'Kuwait drivers in the age group 18-29' are 5.317 times those of 'Non-Kuwait drivers in the age group 40 & above' (significant).

From the above it may be concluded that Kuwaiti drivers in the age group 18-29 are those most likely to have 'more than one accident'. This follows the same trend as in the behaviour scores, except for upper age drivers, for the possible reasons discussed above.

Table 6.10 Odds ratio for Nation_Age variable. (taking the 'Non-Kuwaiti drivers in the age group of 40 & above' as reference).

Nation_AGE	More than one accident	No accident	total	χ^2	Sig. (p=)	Odds ratio
Kuwaiti (40 & above)	23	96	119	1.330	0.249	0.713
Non-Kuwaiti (30-39)	46	104	150	1.183	0.277	1.316
Kuwaiti (30-39)	44	99	143	1.197	0.274	1.322
Non-Kuwaiti (18-29)	49	59	108	11.969	0.000	2.471
Kuwaiti (18-29)	327	183	510	75.676	0.000	5.317
Non-Kuwaiti male (40 & above) (reference)	41	122	163	--------	----------	--------

6.3.2.3 Accident involvement based on gender and age

The following results also refer back to Table 6.8. A multivariate contingency table analysis was conducted to evaluate the differences between **Male** drivers in age groups '18-29' and 'more than 40', assuming that drivers in the age group '18-29' would have higher accident involvement. The two variables, 'age' & 'accidents', were found to be significantly related: Pearson $\chi 2$ (1, **N**=636) = **87.33**, **p** < 0.001. The value of the odds ratio shows that for drivers of age group '18-29' the odds of having 'more than one accident' were **5.461** times greater than for the age group 'more than 40' (a very large difference).

The above indicates that younger male drivers (age group 18-29) are much more involved in 'more than one accident' than male drivers in the older age group (more than 40).

As regards **female** drivers in the same age groups (18-29, more than 40), the two variables, 'age' & 'accidents', were found to be significantly related: Pearson $\chi 2$ (1, **N**=264) = **24.69**, **p** = 0.001. The value of the odds ratio shows that for drivers of age group '18-29' the odds of having 'more than one accident' were **4.89** times that for drivers of age group 'more than 40'.

This shows that younger female drivers (age group 18-29) are much more involved in 'more than one accident' than female drivers in the older age group (more than 40).

The same analysis was used to evaluate the differences between **Male** driver age groups '30-39' and 'more than 40', assuming that the younger age group (30-39) would more frequently have 'more than one accident'. The two variables, 'age' & 'accidents', were found not to be significantly related: Pearson $\chi 2$ (1, **N**=431) = 1.57, **p** = 0.211. The value of the odds ratio shows that the younger age group (30-39) was 1.32 times more likely to be involved in 'more than one accident'.

This shows that younger male drivers (age group 30-39) are slightly more involved in 'more than one accident' than male drivers in the older age group (more than 40).

For **female** drivers of the same age groups (30-39, more than 40), the two variables, 'age' & 'accidents', were found not to be significantly related: Pearson $\chi 2$ (1,

N=144) = 3.5, **p** = 0.061. The value of the odds ratio shows that the likelihood of the younger age group (30-39) having 'more than one accident' was 2.02 higher.

This shows that 'younger female drivers (age group 30-39) are more involved in 'more than one accident' than female drivers in the older age group ‘more than 40'.

The next results refer to Table 6.11. To study the overall goodness of fit of the model and to test the hypothesis that there is a **joint association** for the dependent variables called 'accidents' with respect to two independent variables called 'gender' & 'age', it was found that Pearson $\chi 2$ (5, **N**=1193) = 146.435, **p** < 0.0001. One measure of joint association is phi = 0.350. It can be thought of as an index of the proportion of the variance in 'accidents' that is due to jointly to 'gender' and 'age'.

For this special variable called 'GENDER_AGE', which has six levels ('Male & Age=40 & above', 'Female & Age=40 & above', 'Male & Age=30-39', 'Female & Age=30-39', 'Male & Age=18-29', and 'Female & Age=18-29'), the odds ratio for all five levels with respect to '**Male** drivers in the age group 40 & above' (as reference) was calculated (see table 6.11).

The value of the odds ratio shows that for 'Female drivers in the age group 40 & above', the odds of having 'more than one accident' is 1.047 times than that for 'Male drivers in the age group 40 & above' (not significant).

The value of the odds ratio shows that for 'Male drivers in the age group 30-39', the odds of having 'more than one accident' are 1.321 times greater than for 'Male drivers in the age group 40 & above' (not significant)

The value of the odds ratio shows that for 'Female drivers in the age group 30-39', the odds of having 'more than one accident' are 2.117 times greater than for 'Male drivers in the age group 40 & above'. (significant).

The value of Odds ratio shows that for 'Male drivers in the age group 18-29', the odds of having 'more than one accident' are 5.461 times greater than for 'Male drivers in the age group 40 & above' (significant).

The value of the Odds ratio shows that for 'Female drivers in the age group 18-29', the odds of having 'more than one accident' are 5.118 times greater than for 'Male drivers in the age group 40 & above' (significant).

Overall, it may be concluded from the above that Male drivers who are in the age group 18-29 are the most likely to be in the accident category of ‘more than one accident’. This is supported by the fact that the risk of traffic accidents among young drivers is the highest, especially for young males. However, a decrease in the proportional risk of traffic accidents among young drivers has been shown in Finnish and Swedish young drivers, the risk being on a higher level than other driver groups. The decrease in young drivers’ proportional accident risk has been explained partially by the decrease in the amount of young drivers driving, by the higher quality of driver training and by general traffic safety work. There are also some signs that youths are no longer as interested in cars and driving as they used to be. For example, in Sweden, the proportion of young drivers who obtain a driving licence has decreased dramatically (Laapotti *et al*., 2003). This may not be the case in Kuwait.

Table 6.11 Odds ratios for Gender_Age variable. (taking the 'Male in the age group 40 & above’ as reference).

GENDER_AGE	More than one accident	No accident	total	χ^2	Sig. (p=)	Odds ratio
Female (40 & above)	14	46	60	0.0177	0.894	1.047
Male (30-39)	58	151	209	1.567	0.2106	1.321
Female (30-39)	32	52	84	7.5339	0.006	2.117
Male (18-29)	254	160	414	87.324	0.000	5.461
Female (18-29)	122	82	204	61.378	0.000	5.118
Male (40 & above) (reference)	50	172	222	--------	----------	--------

6.4 Conclusion

Overall, results from the multivariate analyses did not contribute a great deal of new information beyond what was found in the-one way ANOVA and cross-tabulation analysis in Chapter 5, although some additional detail emerged. It was found that young Kuwaitis exhibit more aggressive behaviour; the multivariate analysis showed that Kuwaiti males are the most aggressive. The results also showed that Kuwaiti females are more aggressive than non-Kuwaiti males. Finally, older Kuwaiti males are involved in fewer accidents, probably because they have more experience of driving in Kuwait than older non-Kuwaitis.

It must again be emphasised that the above results are based on self reporting of both behaviours and accidents. This limits the interpretation that can be placed on the outcomes. For example, those with greater accident involvement are probably more likely to have underreported the number of accidents. If this is the case, the significant differences identified above would assume greater importance in identifying remedial measures.

Chapter 7

7 Accident prediction model

7.1 Introduction

The scientific approach in a statistical model can provide a powerful inference that can help planners and decision makers to predict the situation in the future and for further action to solve problems. Choosing the appropriate model depends on the nature of the data. For example, if the data contains a continuous response variable, the linear or multiple linear regression models can be appropriate. However, if the response variable is discrete and relatively rare (i.e. "rare counts events") such as road accidents, as in this research database or even the occurrence of other natural phenomena, including earthquakes, hurricanes and tornados, linear regression models with normal distribution are not appropriate. Instead a generalised linear modelling approach where the error has a Poisson distribution, is more appropriate, through the parameter estimation and model inference is somewhat more involved. Generalised Linear Modelling (GLM) is a powerful extension to familiar linear regression models that proved to be useful in many scientific and engineering fields (Myers *et al.*, 2002).

This chapter presents an overview of accident modelling and accident prediction models using the technique of Generalised Linear Modelling, the methodology of fitting and checking the model, developing an accident prediction model for Kuwait, and its inferences.

7.2 Accident modelling

An event count refers to the number of times an event occurs, such as the number of accidents or earthquakes (Cameron and Trivedi, 1998). Count data consist of non-negative integer values and are encountered frequently in the modelling of accident-related phenomena (Washington *et al.*, 2003). Applying a standard ‘least squares’ regression to the count data, as continuous data, does not give reliable results, because such a regression model yields predicted values that are non-integers and can also predict values that are negative, both of which are inconsistent with count data. These limitations make standard regression analysis inappropriate for modelling count data without modifying the dependent variables.

Count data may be modelled using a number of methods, the most popular of which assume a Poisson or Negative Binomial error distribution. Poisson regression is applied to accidents as count data, because it is a reasonable description of events, which occur both randomly and independently in time.

One characteristic of the Poisson distribution is that the mean of the count process is equal to its variance. When the variance is significantly larger than the mean, the data is said to be over-dispersed and does not follow a pure Poisson distribution. Over-dispersed count data may be successfully modelled using a Negative Binomial model (Myers *et al*., 2002).

7.3 Accident prediction models (using the technique of GLM)

Accident prediction models are mathematical equations that predict accidents as a function of exposure (e.g. traffic flow or mileage) and other variables. An accident prediction model relates accident frequency to mileage and other relevant variables and has been developed using the technique of Generalized Linear Modelling (GLMs) (McCullagh and Nelder, 1983).

Generalized Linear Models were first introduced by Nelder and Wedderburn (1972), and later explained by McCullagh and Nelder (1983). Generalised Linear Models include normal-error linear regression models, exponential, logistic, and Poisson regression models, and some other exponential distribution based models.

Generalised Linear Models can be described as follows:

A) The response variables are independent and follow a probability distribution from the exponential family. The exponential family includes the Normal, Binomial, Poisson, Geometric, Negative Binomial, Exponential, Gamma, and Inverse Normal Distributions (Kutner *et al*., 2005).

B) Generalised Linear Models include a "linear predictor" consisting of predictor variables/factors and their coefficients. $X_i'\beta = \beta_o + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots\dots\dots\dots$

C) The "link function" (g) in the formula below connects the linear predictor to the mean of the response variable: $X_i'\beta = g(\mu_i)$

D) Generalised Linear Models can have non-constant variance.

Accident modelling through GLM methodology has two major components:

1) The systematic component, which relates to expected values of the response variable (accidents) to a variety of explanatory variables/factors;
2) The random component, which takes into account the random variation inherent in the process under study.

The systematic component can be presented in the following form:

$A/T = K\,(\text{Exposure})^{\alpha}\ \Pi \exp(b_i\, x_i)$ ……. (7.1)

A: number of accidents in time T

T: is the time period in which "A" accidents occur

A/T: is the accident frequency

K: is a constant to be estimated by the model

α: exponent of " Exposure" estimated by the modelling

b_i: coefficient estimated by the modelling.

x_i: covariate (factor).

"Exposure" is a term related to a driver's exposure to risk, usually annual mileage or a combination of mileage and number of trips.

Exposure is included as a multiplicative term in the model, to ensure that zero accidents will be predicted from a zero quantitative exposure.

A/T is the accident frequency; this does not follow a Poisson distribution, so to turn the systematic component into a GLM-compatible form, both sides of Equation 7.1 are multiplied by T. Taking the natural logarithm of both sides of the equation finally gives:

$LN(A) = LN(T) + LN(K) + \alpha\, LN(\text{Exposure}) + \Sigma\, b_i\, x_i$ …….. (7.2).

Looking at Equation 7.2, the right hand side is equivalent to the linear predictor. The coefficient of LN (T) is constrained to 1 as an "offset variable". The left hand side of the equation uses the "log" as a link function for solution in GLM methodology.

The random component is very similar to the linear regression case, except that the expectation function is a non-linear function of the parameters. The random component of the statistical model is an error term that has a distribution belonging to the exponential family of distributions, which includes the Normal, Binomial, Poisson, Geometric, Negative binomial exponential, Gamma, and inverse normal distributions.

In the case of accidents, the random component of the statistical model has a Poisson distribution because accidents are rare events. Since, in the Poisson distribution, the variance is equal to the mean, in GLM models (that employ Poisson distribution as the distribution of the errors terms) the variance of the error term equals the mean. Hence, when the mean changes, the variance of the error term will also change and will not be constant. In Generalised Linear Models the distribution of the error term used to match the response variable is the same as that of the error term.

7.4 Fitting and checking the GLMs

7.4.1 Maximum likelihood in GLM

Having specified the error structure, the link function (usually log), the dependent, independent and offset variables in the model, the fitting procedure calculates the maximum likelihood estimates of coefficients of the independent variables. The maximum likelihood estimates of coefficients are generated by similar equations for the weighted least squares regression. The independent variable is replaced by a modified variable $ή + \delta (y - \mu)$.

Where:

ή: is the linear predictor

y: is the observed dependent variable

μ: is the fitted (or predicted) value

δ: $dή/d\mu$ the derivative of the link function.

The weights used in the regression are $1/(\sigma^2 \delta^2)$, where $\sigma^2 = F(\mu)$ is the variance function. Both modified variable and weights depend on fitted values μ which depend on the calculated coefficients. Thus, the iterative procedure for the current cycle estimates using the parameters of the previous cycle until convergence is obtained.

7.4.2 Goodness of fit in GLM

After the model is fitted, estimates of the coefficients, their standard errors and deviance are calculated. Deviance is a measure of goodness of fit. The model is fitted in a step-by-step procedure, for example starting with the null model, which fits only the mean value. At each step, the statistic calculated is the deviance, which gives a measure of the goodness of fit of the current model compared to the full model; thus, the smaller the deviance, the better the fit of the model to the data.

The deviance equation is as follows:

$D(\beta) = -2 \ln [\mathcal{L}(\beta) / \mathcal{L}(\mu)]$

Where:

$\mathcal{L}(\beta)$ = is the likelihood under the model considered

$\mathcal{L}(\mu)$ = is the likelihood of the saturated model, which is taken to be one in which the fitted values coincide with actual observation, and fits the data perfectly. This model will have the same number of unknown parameters as there are observations (Collett, 2002).

$D(\beta)$= is the deviance which has (providing μ is greater than about 0.5 (Maycock and Hall, 1984) an asymptotic χ^2 distribution with N-P-1 degree of freedom (N=number of observations, P= number of parameters).

So, the standardised deviance (scale parameter) = $D(\beta)/(N-P-1)$ will be close to 1.0 for a well fitting model. Where the mean value is less than about 0.5 (for example, when there are a substantial number of zero accidents in the data) and over-dispersion may be present, the Pearson chi-square statistic $\chi^2/(N-P-1)$ can be used as an estimation of the scale parameter Ø.

7.4.3 Over-dispersion in the data

According to the rule of thumb, if the scale parameter exceeds 1.0 by a substantial amount, the lack of fit may be a problem, because of over-dispersion in the data. In other words, a ratio close to 1.0 indicates that over-dispersion is not likely to be a problem. Small amounts of over-dispersion are usually of little concern; however, if the ratio of dispersion is larger than 2, then an adjustment of the standard error may be required (Hardin and Hilbe, 2001). The amount of over-dispersion can be estimated by calculating the ratio (Ø) of the generalised Pearson χ^2 function to the number of degrees of freedom. This provides a revised estimate of the scale parameters. Use of the Negative binomial instead of a Poisson distribution provides an alternative approach in case of over-dispersion.

The statistical procedure for fitting this model has been described fully elsewhere (McCullagh and Nelder, 1989, and Myers *et al*., 2002). Furthermore, computer software that supports the GLM approach has become widely available and easy to use (such as Stata.9).

7.5 Methodology for developing an accident prediction model for Kuwait

In this case study, the dependent variable from the survey questionnaire database was the number of accidents a driver had been involved in over the last 10 years. There were a variety of independent variables, these are:

1) Age (in years)
2) Sex (female = 0, male = 1)
3) Nationality (non-Kuwaiti = 0, Kuwaiti = 1)
4) Education level (non-graduate = 0, graduate = 1)
5) Marital status (single = 0, married = 1)
6) Aggressive driving behaviour score (ranging from 1 =always to 5 =never)
7) Driver education (yes = 0, no = 1)
8) Driver training (yes = 0, no = 1)
9) Usual speed on motorways (within speed limit = 0, exceeding speed limit = 1)
10) Number of dangerous offences per year
11) Years of driving experience

These independent variables are chosen as they are considered to have an effect on accidents. Several trials at running the model with the "driver training" factor included seemed to indicate that those who were officially trained were more involved in accidents than those who were not. This has also been found in the literature (Elvik and Vaa, 2004) (Section 5.6.2.8 of the thesis). This may be because of lack of detail of "driver training" in terms of quantity & quality, as discussed in section 5.6.1.6. This variable has been dropped from the model, as it is considered to be a confounding factor.

7.5.1 Variable selection procedure

The Variable selection procedure can be generally classified into two types: 1) the forward selection procedure and 2) the backward elimination procedure. One modification of the forward procedure and backward elimination is called the stepwise method (testing each stage for variables to be included or excluded). The forward selection procedure starts with only the null model, and introduces variables one by one, including them if they are statistically significant (i.e. selection of the best predictors of the dependent variable). The backward elimination procedure starts with all the independent variables and tests them one by one for statistical significance, dropping those that are not significant (eliminating the weakest predictor of the dependent variable). The procedures are used primarily in regression analysis, though the basic approach is applied in many forms of model selection (Chatterjee *et al*., 2000).

Multicollinearity refers to the situation in which two or more independent variables are at a high degree of correlation, to the extent that certain independent variables can explain others. Forward and backward procedures give nearly the same selection of variables with non collinear data; the backward procedure is better able to handle multicollinearity than the forward procedure (Chatterjee *et al*., 2000).

7.6 Results

The backward procedure was used to determine the 'best' fitting model in terms of both statistical significance (p value < 0.05) and appropriateness of the variable included, using Generalised Linear Modelling with distribution of response variable "Poisson distributed". Stata.9 software was used to run the models. The fullest model with all the available independent variables included (except for driver training). The result is given in table 7.1.

Table 7.1 The fullest accident model with all independent variables.

Dependent variable: accidents per driver per year

Independent variables	Coefficients	Standard Errors	Z value	P value
Age	-0.0262	0.0076	-3.43	0.001
Gender (0 if female, 1 if male)	-0.0170	0.0647	-0.26	0.793
Nationality (0 if non-Kuwait, 1 if Kuwaiti)	0.2070	0.0714	2.90	0.004
Education level (0 if non-graduate, 1 if graduate)	-0.0848	0.0574	-1.48	0.140
Marital status (0 if single, 1 if married)	-0.3625	0.0668	-5.43	0.000
Driver education (0 if yes, 1 if no)	0.1156	0.0795	1.45	0.146
Speed (0 if within the speed limit, 1 if exceed speed limit)	0.1944	0.0733	2.65	0.008
Number of dangerous offences per year	0.0698	0.0109	6.42	0.000
Aggressiveness	-0.20948	0.0480	-4.37	0.000
Experience	-0.0383	0.0080	-4.82	0.000
Exposure	0.0938	0.0417	2.25	0.024
Constant	-0.9363	0.4934	-1.90	0.058
No. of obs. =1528 , Residual df, =1516 Scale parameter =1 Deviance= 2006.06 (1/df) Deviance =1.32 Pearson = 2297.11 (1/df) Pearson =1.52 Variance function: V(u) = u [Poisson] Link function : g(u) = ln(u) [Log]				

As may be seen in Table 7.1 gender is not an important predictor of the number of accidents i.e. not statistically significant in the model. There are other variables which are not statistically significant but the p value for "gender" is the highest (p=0.793); thus gender was dropped first and the model re-run. Table 7.2 shows the coefficients of all remaining predictors as follows.

Table 7.2 Accident prediction model after removing gender.

Dependent variable: accidents per driver per year

Independent variables	Coefficients	Standard Errors	Z value	P value
Age	-0.0260	0.0076	-3.42	0.001
Nationality (0 if non-Kuwait, 1 if Kuwaiti)	0.2117	0.0691	3.06	0.002
Education level (0 if non-graduate, 1 if graduate)	-0.0876	0.0564	-1.55	0.121
Marital status (0 if single, 1 if married)	-0.3613	0.0667	-5.42	0.000
Driver education (0 if yes, 1 if no)	0.1156	0.0795	1.45	0.146
Speed (0 if within the speed limit, 1 if exceed speed limit)	0.1950	0.0732	2.26	0.008
Number of dangerous offences per year	0.0697	0.0108	6.42	0.000
Aggressiveness	-0.2082	0.0477	-4.36	0.000
Experience	-0.0386	0.0079	-4.92	0.000
Exposure	0.0910	0.0402	2.26	0.024
Constant	-0.9295	0.4924	-1.89	0.059
No. of obs. =1528 , Residual df, =1517 Scale parameter =1 Deviance= 2006.13 (1/df) Deviance =1.32 Pearson = 2297.76 (1/df) Pearson =1.51 Variance function: V(u) = u [Poisson] Link function : g(u) = ln(u) [Log]				

The deviance increased by a very small and insignificant amount, from 2006.06 to 2006.13, after dropping the variable "gender", to fit the model slightly better with the predictors (Table 7.2). Generally, the difference in deviance between two nested models with degrees of freedom df_1 and df_2 will be distributed similar to χ^2, with (df_1 - df_2) degrees of freedom, and may be used to assess the significance of removing of one or more term from a model (test of goodness of fit of the model). Thus, an increase in the deviance of at least 3.84 is required for significance at the 5% level.

The variable 'driver education' showed the highest p value (p=0.146) and was not statistically significant. Although "driver education" is an important factor in predicting accidents, it is not statistically significant in the model. One reason may be that details about "driver education" are lacking. The questionnaire asked respondents whether or not they had had any form of driving education (‘yes or no’ question). Only 17.8% of the sample had had any form of driving education, as discussed in Chapter 5. Thus it was dropped and the model re-run to produce Table 7.3.

Table 7.3 Accident prediction model after removing driver education.

Dependent variable: accidents per driver per year

Independent variables	Coefficients	Standard Errors	Z value	P value
Age	-0.0268	0.0076	-3.54	0.000
Nationality (0 if non-Kuwait, 1 if Kuwaiti)	0.2292	0.0682	3.36	0.001
Education level (0 if below bachelor, 1if above)	-0.0867	0.0565	-1.54	0.124
Marital status (0 if single, 1 if married)	-0.3627	0.0667	-5.44	0.000
Speed (0 if within the speed limit, 1 if exceed speed limit)	0.1943	0.0733	2.65	0.008
Number of dangerous offences per year	0.0699	0.0109	6.43	0.000
Aggressiveness	-0.2138	0.0476	-4.49	0.000
Experience	-0.0373	0.0078	-4.8	0.000
Exposure	0.0884	0.0401	2.2	0.027
Constant	-0.7870	0.4820	-1.63	0.103
No. of obs.=1528, Residual df =1518, Scale parameter =1 Deviance = 2008.29 (1/df) Deviance = 1.32 Pearson = 2288.42 (1/df) Pearson =1.51 Variance function: V(u) = u [Poisson] Link function : g(u) = ln(u) [Log]				

The deviance increased, from 2006.13 to 2008.29, after dropping the variable "driver education", as indicated in Table 7.3. The variable 'education level' showed the highest p value (p=0.124) and was not statistically significant and was in turn dropped to reach the final model shown in Table 7.4.

Table 7.4 The final accident prediction model after removing education level.

Dependent variable: accidents per driver per year

Independent variables	Coefficients	Standard Errors	Z value	P value
Age	-0.0266	0.0075	-3.52	0.000
Nationality (0 if non-Kuwait, 1 if Kuwaiti)	0.2257	0.0681	3.32	0.001
Marital status (0 if single, 1 if married)	-0.3482	0.0662	-5.26	0.000
Speed (0 if within the speed limit, 1 if exceed speed limit)	0.1948	0.0399	2.66	0.008
Number of dangerous offences per year	0.0692	0.0109	6.37	0.000
Aggressiveness	-0.2084	0.0474	-4.39	0.000
Experience	-0.0366	0.0077	-4.72	0.000
Exposure	0.0848	0.0399	2.12	0.034
Constant	-0.8398	0.4798	-1.75	0.080
No. of obs. =1528 Residual df = 1519 Scale parameter =1 Deviance = 2010.64 (1/df) Deviance = 1.32 Pearson = 2286.78 (1/df) Pearson = 1.50 Variance function: V(u) = u [Poisson] Link function : g(u) = ln(u) [Log]				

The final model shows that all the predictors contribute significantly. It may also be noted that the deviance increased from 2008.29 to 2010.64. The forward and backward procedures, were also used, and produced the same result for the final model, (see Appendix C for details).

The computed scale parameter is close to one (unity), indicating that there is little evidence of over-dispersion, Hence there is little need to adjust the standard errors.

The standard errors can be corrected for over-dispersion by multiplying by the square root of the scale parameter. This will change the 'z' value and 'p' value, as illustrated in Table 7.5.

Table 7.5 The final accident prediction model after adjusting the standard error for over-dispersion

Dependent variable: accidents per driver per year

Independent variables	Coefficients	Standard Errors	Z value	P value
Age	-0.0266	0.0093	-2.87	0.004
Nationality (0 if non-Kuwait, 1 if Kuwaiti)	0.2257	0.0836	2.70	0.007
Marital status (0 if single, 1 if married)	-0.3482	0.0812	-4.29	0.000
Speed (0 if within the speed limit, 1 if exceed speed limit)	0.1948	0.0899	2.17	0.030
Number of dangerous offences per year	0.0692	0.0133	5.19	0.000
Aggressiveness	-0.2084	0.0582	-3.58	0.000
Experience	-0.0366	0.0095	-3.85	0.000
Exposure	0.0848	0.0490	1.73	0.084
Constant	-0.8398	0.5887	-1.43	0.154
No. of obs. =1528 Residual df = 1519 Scale parameter =1 Deviance = 2010.64 (1/df) Deviance = 1.32 Pearson = 2286.78 (1/df) Pearson = 1.50 Variance function: V(u) = u [Poisson] Link function : g(u) = ln(u) [Log]				

Although "exposure" was just below the 5% level of significance, as it is an important metric with regard to accident risk, it was decided to keep it in the model to maintain the model logic. The results show that the variables explained by the Generalised Linear Model are as follows:

i) Age: the younger the age the greater the number of accidents

ii) Nationality: Kuwaitis were involved in more accidents compared with non-Kuwaitis

iii) Marital status: Single drivers were involved in more accidents than married drivers

iv) Speed: speeding on motorways leads to more accidents

v) Number of dangerous offences per year: the greater the number of dangerous offences per year the higher the number of accidents.

vi) Aggressive driver behaviour score: the more aggressive the driving, the greater the number of accidents.

vii) Experience: the more experienced the driver has in terms of number of years driven, the less involvement there is in accidents.

The final model may be expressed as follow:

$$\mathbf{A} = 0.4318\,(\mathbf{Exposure})^{0.0848}\,.e^{-0.0275\mathbf{B} + 0.226\mathbf{C} - 0.348\mathbf{D} + 0.195\mathbf{E} + 0.0692\mathbf{F} - 0.208\mathbf{G} - 0.0367\mathbf{H}} \quad \ldots (7.3)$$

Where:

B: is Driver age

C: Driver Nationality

D: Marital status

E: Speed

F: Number of dangerous offences per year

G: Aggressive driver behaviour score

H: Experience

No multicollinearity was detected between the independent variables, but it is known from the analysis in Chapter 5 that there are high correlations between age, marital status, and experience. If younger drivers (18-24) are taken out of the analysis, the effect of marital status and experience on accidents drops significantly.

7.6.1 Range of effect on accidents

It is useful to assess the significant variables in the model to have an indication of their sensitivity over the range of data. In order to do this, the effect on accident frequency is tested for each variable, assuming all other variables to be constant. For example, setting the age factor (continuous variable) to minimum and maximum values will give a good indication of the variable's sensitivity over the range of data. To find the effect of the variable 'age' on predicted accidents in the final model (Equation 7.3), the variable age is set at two values: (a) minimum level (18 years old) and (b) maximum level (70 years old). The other variables remain constant in the meantime. The result is a ratio of 4.07, which means that younger drivers (18 years) have on average about 4.07 times more accidents than 70 year-old drivers (see Table 7.6). For discrete variables, where for example only two results are possible, e.g. Kuwaiti / non-Kuwaiti, the values being coded (1) or (0), respectively, the effect on accident frequency is tested according to these two values. The minimum-to-maximum ratios for each continuous variable in the model (or the lowest-to-higher level ratio for the discrete variable), are computed and presented in Table 7.6.

Table 7.6 The minimum-to-maximum (lowest level-to-highest level) for the significant variables in the final model.

Variables	a) min (or lowest level of the variable), and b) max (or highest level of variable)	Ratio of predicted accident
Age	a) 18 years b) 70 years	(Predicted accidents for 18 years)/ (Predicted accidents for 70 years) = 4.07
Nationality	a) non-Kuwaiti (0) b) Kuwaiti (1)	(Predicted accidents for Kuwaitis)/ (Predicted accidents for non-Kuwaitis) =1.25
Marital status	a) single (0) b) married (1)	(Predicted accidents for single)/ (Predicted accident for married) = 1.416
Speed	a) within speed limit (0) b) exceed speed limit (1)	(Predicted accidents for exceed speed limit)/ (Predicted accidents for within speed limit) = 1.22
Dangerous offences	a) 0 offences b) 28 offences	(Predicted accidents for 28 offences)/ (Predicted accidents for no offences) = 6.9
Aggressiveness	a) score of 1.52 b) score of 4.91	(Predicted accidents for score of 1.52)/ (Predicted accidents for score of 4.91) = 2.24
Experience	a) 1 year b) 56 years	(Predicted accidents for 1 years)/ (Predicted accidents for 56 years) = 7.53

As regards the effect of nationality, comparing the higher / lower levels, the ratio is 1.253. That is Kuwaitis are only slightly more involved in accidents than non-Kuwaitis. Marital status also has an effect, with unmarried drivers having 1.42 times more stated accidents than married drivers. In addition, drivers who knowingly exceeded the speed limit on the motorway are predicted to be involved in 1.22 times more accidents than drivers who do not.

Drivers with the highest number of stated dangerous offences per year (28 in the research survey) had 6.9 times more recorded accidents than drivers who had committed no dangerous offences. The aggressive driver behaviour scores show that the most aggressive driver was involved in 2.24 times more accidents than the least aggressive. 'Experience' has the highest ratio (7.53), representing the difference between the lowest number of years of driving experience (1 year) and the highest number in the survey (56 years).

7.6.2 The effectiveness of enforcement

Since the identification of potential remedial measures is one of the objectives of this research, it was important to include the variable which asked about drivers' perceptions of effectiveness of enforcement (Question 57). This question has three options: agree, not sure, and disagree. The sample size was reduced to 1,016, as the 512 who were unsure about the effectiveness of enforcement were dropped from this analysis. The same procedure as applied above was used for the model after dropping the 512 cases, and the model for this case is shown in table 7.7 below.

Table 7.7 The accident prediction model after dropping the 512 cases who were unsure about the effectiveness of enforcement

Dependent variable: accidents

Independent variables	Coefficients	Standard Errors	Z value	P value
Age	-0.0246	0.0089	-2.77	0.006
Nationality (0 if non-Kuwaiti 1 if Kuwaiti)	0.3088	0.0825	3.74	0.000
Marital status (0 if single, 1 if married)	-0.4330	0.0800	-5.41	0.000
Effectiveness of Enforcement (0 if yes, 1 if no)	0.2042	0.0644	3.17	0.002
Speed (0 if within the speed limit, 1 if exceed speed limit)	0.1803	0.0919	1.96	0.050
Number of dangerous offences per year	0.0601	0.0147	4.09	0.000
Aggressiveness	-0.1615	0.0593	-2.72	0.007
Experience	-0.0385	0.0091	-4.21	0.000
Exposure	0.1348	0.0498	2.71	0.007
Constant	-1.6210	0.6013	-2.70	0.007
No. of obs. =1016 Residual df =1006 Scale parameter =1 Deviance = 1290.740556 (1/df) Deviance =1.283042 Pearson = 1497.685905 (1/df) Pearson = 1.488753 Variance function: V(u) = u [Poisson] Link function : g(u) = ln(u) [Log]				

$$\mathbf{A} = 0.198\,(\mathbf{Exposure})^{0.135}\,.e^{-0.0246\mathbf{B} + 0.31\mathbf{C} - 0.433\mathbf{D} + 0.18\mathbf{E} + 0.06\mathbf{F} - 0.161\mathbf{G} - 0.0386\mathbf{H} + 0.204\mathbf{I}} \quad \text{....(7.4)}$$

Where:

B: is Driver age

C: Driver Nationality

D: Marital status

E: Speed

F: Number of dangerous offences per year

G: Aggressive driver behaviour score

H: Experience

I: Effectiveness of enforcement

It can be seen that the same factors are statistically significant, including effectiveness of enforcement, where drivers who consider enforcement to be ineffective experience a greater number of accidents compared to drivers who perceive enforcement to be effective.

7.6.3 Exposure (Mileage)

It appears that the relationship between predicted mean accidents and exposure as measured by driver-km per year is relatively small. A 10% increase in kilometres driven leads to only a 0.85% increase in mean accidents in the final model, and the reason for that might be as follows.

Kuwait is a country with a small land surface area (17,000 square kilometres). Around 8% of this area is inhabited and consists of six governorates close to the coast and close to each other (Ministry of Planning, 2003). Most traffic activity is concentrated in these governorates. The longest distance that can be covered is between Al-Nuwaisib and Al-Salmi (224 kilometres) and journeys between these cities would not be common. According to the data from police stations, around 85% of road accidents in Kuwait occur in the built-up areas on the coastal strip, 13% occur in built-up areas bordering or overlapping rural areas and only 2% occur in rural areas widely away from cities (Police annual statistics). Thus, a simple measure of distance travelled is not likely to be a major factor in road accidents in Kuwait. Those drivers with higher mileage (normally males) typically accumulate most of their kilometres on motorways crossing the country where incidents/accidents are low in number. Although males are more aggressive than females in Kuwait, there is not much difference between them in terms of accident rate. Males drive more kilometres than females, but that lowers their accident rate (accident/ 100,000 Km) (72% of the sample were male).

Most accidents occur in the city, where total mileage driven is likely to be relatively low. Lourens *et al*. (1999) found that there was no difference in accident involvement per mile between male and female drivers in the Netherlands. Janke (1991), California Business, Transportation and Housing Agency (1985), found that there were 2.75 times as many accidents per mile on non-freeways as on freeways. Thus he predicted that “with constant driver competence and prudence, accidents will tend to rise at low and decreasing rates as mileage increases beyond a certain point”.

Whilst annual mileage may be considered to be a very strong predictor of accidents, as higher mileage drivers will have more accidents on average because of greater exposure to risk. However, studies have found that accident frequencies are not proportional to mileage (Af Wåhlberg, 2004). Maycock (1985) found that high mileage drivers have lower accident risk per mile driven than lower mileage drivers. Janke (1991) explained that low mileage drivers drive mainly on busy streets in built-up areas, while high-mileage drivers drive on relatively safe highways with limited accessibility and separate lanes. Lourens *et al*. (1999) also explained that high-mileage drivers have greater driving and safety skills than lower mileage drivers.

Different driver characteristics can affect the relationship between the mean accidents and kilometres driven and driver characteristics represented by demographic and other parameters such as age, gender, license class, traffic system, proposed trip, health status, driver skill, etc. (Janke, 1991). Janke indicated that it is highly likely that these groups have different accident expectations simply because of their different characteristics and the way in which they affect driving competency, regardless of mileage.

Another issue that could affect the relationship between miles and accidents is that mileage data comes typically from self reporting, and therefore is subject to considerable error. Drivers may not remember the exact number of accidents in the last ten years, and annual mileage may change from year to year, but the respondents may just state the annual mileage for recent years. Assum (1997) said that self reporting on accidents and mileage may, in general, pose problems for reliability in the large sample needed to allow for the study of accidents. Janke (1991) said that, "even if more valid ways of estimating mileage were possible, it would still be the case that drivers are not randomly assigned to mileage".

From the above, it appears that miles and accidents are affected by different factors. If these factors were disregarded in the model, it would be appear that a 10% increase in kilometres driven would lead to 2.2% increase in mean accidents

($A=0.016(Exposure)^{0.22}$) (see Table 7.8), but when other factors are added into the model, the final model gives a 10% increase in kilometres driven for only a 0.81% increase in mean accidents ($A=0.432(Exposure)^{0.085}$).

Table 7.8 The empty model with exposure only

Dependent variable: accidents per driver per year

Independent variables	Coefficients	Standard Errors	Z value	P value
Exposure	0.2220	0.0404	5.49	0.000
Constant	-4.1513	0.3998	-10.38	0.000
No. of obs. =1528 Residual df = 1526 Scale parameter =1 Deviance = 2861.07 (1/df) Deviance =1.87 Pearson = 4829.47 (1/df) Pearson =3.16 Variance function: V(u) = u [Poisson] Link function : g(u) = ln(u) [Log]				

7.7 Conclusion

The final model shows that age, nationality, aggressive driver behaviour, dangerous offences, perceptions of effectiveness of enforcement, marital status, speed, and experience are the contributory factors that most lead to accident involvement in Kuwait. Therefore the Kuwaiti government should take action with regard to these factors, long-term remedial measures and programmes, such as improving driver education, training and enforcement to limit reckless driving. The appropriate remedial measures are discussed in clear recommendation in chapter 9.

Chapter 8

8 Driver opinions on remedial measures

8.1 Introduction

Effective remedial measures are one of the main concerns for both road safety authorities and the public. Information gained from responses from the public regarding attitudes towards remedial measures can be an important factor in helping politicians and decision makers where they consider an overall framework for effective remedial measures, as well as when and how they introduce measures.

Decisions on remedial measures should be taken carefully, taking account of the potential effectiveness of each of them to reduce the rate of accidents. However, it should be noted that measures that are successful in achieving significant major benefits in certain countries or areas may not be successful to the same extent in others, due to differences in road user behaviour, vehicles, traffic conditions, road layout and maintenance.

This Chapter presents the results of an investigation into the Kuwaiti drivers' acceptance of various recommendations concerning remedial measures based on the 3 E's, namely Education, Enforcement, and Engineering.

8.2 Overall remedial measures

The second part of the questionnaire (part F), which comprised 17 questions as described in Section 5.2, investigated the acceptance by drivers of remedial measures. These questions covered the majority of possible remedial measures for Kuwait, embodied by the 3 E's, Education, Enforcement, and Engineering, the most well-known remedial measures, as discussed in section 2.2. The questions were mainly adopted from the SARTRE 3 reports (2004), a national survey of Social Attitudes to Road Traffic Risk in 23 European countries, including attitudes towards overall remedial measures. Additional material for the questions was drawn from other references, such as the TRL report on road accident countermeasures (Quimby and Glendinning, 1990), as well as the Social Research Association (2006) and Cauzard and Quimby (2000). The questions derived from these sources were adopted for the Kuwaiti context. The overall mean response to these questions was 2.07 out of 5, which indicated a general agreement for overall remedial measures, where 1 indicates total agreement and 5 total disagreement (see Section 5.2).

The following sections present the effect of driver characteristics on the acceptability of remedial measures.

8.2.1 Effect of age

Age differences were examined by grouping the respondents into 4 age bands: 18-29, 30-39, 40-49, and over 50, comprising 643, 401, 267 and 97 respondents respectively. The results of analysis of variance (One Way ANOVA) presented in Table 8.2 indicate that differences of opinion towards remedial measures were significant between the groups, and that agreement about the need for road safety improvements increased with age (see Table 8.1).

Table 8.1 Overall acceptances of remedial measures between different age groups (Descriptive table)

Age group	Sample size	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
18-29	643	2.1035	0.42685	0.01683	2.0704	2.1365	1.00	3.82
30-39	401	2.0760	0.44257	0.02210	2.0325	2.1194	1.12	4.29
40-49	267	2.0454	0.40229	0.02462	1.9969	2.0939	1.00	3.18
50 & above	97	1.9854	0.40014	0.04063	1.9048	2.0661	1.18	2.88
Total	1408	2.0765	0.42595	0.01135	2.0542	2.0988	1.00	4.29

Table 8.2 ANOVA table for differences in acceptance of overall remedial measures between age groups

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.530	3	0.510	2.823	0.038
Within Groups	253.743	1404	0.181		
Total	255.273	1407			

8.2.2 Effect of gender

Females agreed with the need for remedial measures more than males. The T-test showed that the difference was significant (see Tables 8.3 and 8.4). This is a similar result to that found in the UK (Quimby and Glendinning, 1990)

Table 8.3 Overall acceptance remedial measures according to gender (Group Statistics)

	Sex	Sample size	Mean	Std. Deviation	Std. Error Mean
Overall remedial measures	Male	1003	2.1123	0.42866	0.01354
	Female	405	1.9879	0.40632	0.02019

Table 8.4 Independent Samples T-Test for acceptance of overall remedial measures and gender

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
Variances	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	0.978	0.323	4.999	1406	0.000	0.12431	0.02487	0.07553	0.17309
Equal variances not assumed			5.114	784.808	0.000	0.12431	0.02431	0.07659	0.17202

8.2.3 Effect of nationality

Kuwaitis agreed with the need for remedial measures more than non-Kuwaitis, and the T-test showed that the difference was significant (see Tables 8.5 and 8.6). This could be because non-Kuwaitis compared road safety in Kuwait with their own countries and found it to be better, or Kuwaitis are more aware of the need for remedial measures, since they know their country better.

Table 8.5 Overall acceptances of remedial measures according to nationality (Group Statistics)

	Nationality	Sample size	Mean	Std. Deviation	Std. Error Mean
Overall remedial measures	Kuwaiti	906	2.0553	0.42740	0.01420
	non-Kuwaiti	502	2.1147	0.42104	0.01879

Table 8.6 Independent Samples T-Test for overall of acceptance of remedial measures and nationality

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
Variances	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	0.554	0.457	-2.511	1406	0.012	-0.05940	0.02366	-0.10580	-0.01300
Equal variances not assumed			-2.522	1047.391	0.012	-0.05940	0.02355	-0.10562	-0.01318

8.2.4 Education level

Education level was categorised into five groups, as in section 5.6.5. The result of the analysis of variance (One Way ANOVA) in Table 8.7 shows that differences were significant between the groups. Drivers with a higher level of education agreed more with the need for remedial measures (see Table 8.7), perhaps because they give more thought to such issues and are more aware of them.

Table 8.7 Overall acceptances of remedial measures according to different education level (Descriptive table)

Education standard	Sample size	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
below high school	94	2.2190	0.50642	0.05223	2.1153	2.3227	1.00	4.29
high school	442	2.1239	0.42302	0.02012	2.0844	2.1634	1.18	3.82
diploma	251	2.0070	0.42556	0.02686	1.9541	2.0599	1.06	3.41
bachelor	504	2.0727	0.41068	0.01829	2.0368	2.1087	1.00	3.76
postgraduate	117	1.9482	0.37548	0.03471	1.8795	2.0170	1.12	2.76
Total	1408	2.0765	0.42595	0.01135	2.0542	2.0988	1.00	4.29

Table 8.8 ANOVA table for the differences in acceptance of overall remedial measures according to education levels

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.047	4	1.512	8.510	0.000
Within Groups	249.226	1403	0.178		
Total	255.273	1407			

8.3 Driver attitudes towards specific remedial measures

8.3.1 Engineering

85% of the respondents agreed that the road network in Kuwait generally needs to be developed, and this is obvious, as traffic congestion appears to have increased recently. 89.3% of the respondents believed that there were some hazardous locations on Kuwaiti roads that needed to be dealt with, and which needed black spot studies. There is in turn a need for accurate accident data and evidence from police accident reports. (Success in this domain has been reported in Malaysia, India and other countries (Section 2.25)). 90% of the respondents agreed about the importance of providing or improving pedestrian facilities such as footpaths and pedestrian signals, and that also needs careful study, taking into consideration poor driver behaviour. Traffic calming through devices such as speed humps is another engineering remedy that 78.4% of the respondents agreed with, in order to reduce speeding in urban areas.

A previous study undertaken by Koushki and Al-Kandari (2005) identified a number of hazardous elements and design deficiencies in the road network in Metropolitan Kuwait. A manual photo and video method was used. It found the following hazardous elements: 1) Construction materials on pedestrian walkways and roadways; 2) Electric poles, sign posts and signal posts – close to traffic lanes, exposed and unprotected; 3) Trees – close to traffic lanes, exposed and unprotected; 4) Electric switch boxes, electric transmission towers – close to traffic lanes, exposed and unprotected; 5) Concrete bridge walls – dangerously close to traffic lanes, exposed and unprotected; 6) Concrete ramp/bridge piers – dangerously close to traffic lanes, exposed and unprotected.

8.3.2 Education and Training

Driver education and training tend to be inadequate in most developing countries (Downing *et al*., 1991). The results for Kuwait showed that 85.3% of the respondents agreed that road safety education courses for drivers at school was important, 10.1% were not sure, and 4.1% disagreed, although only 17.8% of the sample had themselves taken driver education courses. 85.9% of the respondents agreed that it is necessary to have practical training by driving instructors, although 46.7% of the sample had had no such training.

8.3.3 Driving tests

79.7% of the respondents agreed that the driving test, both theoretical and practical, needs to be improved (see Chapter 5). The theoretical test must concentrate on eliminating the errors and bad habits most commonly found in drivers. However, Collins (1995) claimed that, in many developing countries, such written knowledge tests are generally ineffective because the questions are seldom changed, so that the answers can be learned by rote and without understanding.

The practical test in Kuwait involves driving for 5 minutes at the testing centre track (not on real roads). The main objective of this test is to test if the driver knows how to park and drive in narrow roads and to ensure that traffic signs such as the stop sign are obeyed (section 3.1.11). In contrast, the practical test in the UK lasts about 45 minutes and is taken on real roads (except motorways) and allows the driver to face a variety of situations on the road, which gives the examiner an opportunity to detect driver errors.

8.3.4 Awareness programmes

40.4% of the respondents believed that road safety awareness programmes are not adequate, 26.2% were not sure, and 33.4% disagreed; i.e. only one third of respondents were of the opinion that the programmes were adequate. Thus, many researchers have recommended that adequate campaigns, supported by enforcement, can improve driver knowledge and attitudes towards better driving, as was stated in Section 2.23.

8.3.5 Enforcement

It is important to determine driver attitudes towards enforcement, as such information may help the police to be more effective in deciding on their enforcement practice. The results showed that 74.6% of respondents agreed that the enforcement system in Kuwait needs to be improved in terms of applying the regulations more strictly. Also, 86.2% of the respondents agreed that more police patrols are needed on the road in order to reduce violations. (We know from the GLM model that drivers who are guilty of more serious violations are involved in more accidents.)

Speed camera enforcement and red light cameras were introduced recently in Kuwait, as described in Chapter 3. 69% of the respondents agreed that speed camera enforcement is an important measure to reduce speed. 84.6% of the respondents agreed that red light cameras would reduce accidents at signalised intersections. These are important findings, as speeding and passing red lights were two of the main causes of casualties, according to police accident reports.

70.9% of the respondents agreed that the law, which requires retests for drivers who have caused a serious accident in the first two years of driving should be applied more rigorously. 83.2% of respondents agreed with suspension of drivers who had committed several dangerous offences. However, these regulations are not applied seriously in Kuwait.

Introducing penalty points for offences in Ireland resulted in a significant reduction in road collisions and consequent injuries and fatalities. The reductions in road deaths occurred immediately after the launch of penalty points for speeding and other offences in October, 2003. The issuing of penalty points focuses drivers on key safety concerns, such as dangerous overtaking, failure to obey traffic lights, stop signs, give-way signs, and vehicles crossing central white lines on roads (www.transport.ie, accessed 31/03/2007).

Answers varied as regards raising fines and the minimum driving age. 51% agreed that increasing fines would reduce driver violations, 21.3% were not sure, and 27.7% disagreed (but the answer was different according to nationality). 46.6% agreed that raising the minimum age from 18 to 20 would help to reduce road accidents, 15.1% were not sure and 38.4% disagreed.

8.4 Link between driver behaviour and remedial measures

8.4.1 Speed

Some remedial measure questions have been linked to ones related to attitude, to identify what was acceptable to those who considered themselves to be aggressive drivers in some situations. For example, one of the most direct questions concerning speeding on the motorways is linked with particular remedial measure questions, giving the following results:

1) 65% of drivers, who always or usually drive over the speed limit on motorways, agreed that enforcement needs to be improved in terms of applying the regulations more strictly, 19.4% were not sure and 15.6% disagreed.

2) 74.2% of drivers, who always or usually drive over the speed limit on motorways, agreed with the need for police patrols on the roads in order to reduce violations; 15.6% were not sure and 10.3% disagreed.
3) 59% of drivers, who always or usually drive over the speed limit on motorways, agreed that speed camera enforcement would reduce speeds, hence accidents; 21% were not sure and 20% disagreed.

Another question concerned driving above the speed limit in built-up areas:
1) 65.4% of drivers, who always or usually drive above the speed limit in built-up areas, agreed that speed humps are important in reducing speed in urban areas; 16.7% were not sure and 17.9% disagreed.
2) 60.3% of drivers, who always or usually drive above the speed limit in built-up areas, agreed that enforcement needs to be improved in terms of applying the regulations more strictly, 20.5% were not sure and 19.2% disagreed.
3) 75% of drivers, who always or usually drive above the speed limit in built-up areas, agreed with the need for police patrols on the roads in order to reduce violations; 10.3% were not sure and 14.7% disagreed.
4) 56.8% of drivers, who always or usually drive above the speed limit in built-up areas, agreed that speed camera enforcement would reduce speeds, hence accidents; 18.1% were not sure and 25.1% disagreed.

8.4.2 Changing lane (swerving)

1) 63.1% of drivers, who always or usually changed lane, weaving from left to right or right to left, agreed that enforcement needs to be improved in terms of applying the regulations more strictly; 21% were not sure and 15.9% disagreed.

2) 76.6% of drivers, who always or usually change lane, weaving from left to right or right to left, agreed with the need for police patrols on the roads in order to reduce violations; 13.1% were not sure and 10.3% disagreed.

8.4.3 Passing amber lights

1) 64.9% of drivers, who always or usually continue driving on the amber signal, agreed that enforcement needs to be improved in terms of applying the regulations more strictly; 18.3% were not sure and 16.8% disagreed.

2) 74.4% of drivers, who always or usually continue on the amber traffic signal, agreed with the need for police patrols on the roads in order to reduce violations; 12.2% were not sure and 13.4% disagreed.

3) 78.6% of drivers, who always or usually continue on amber, agreed that red light cameras would reduce accidents at signalised intersections; 12.2% were not sure and 9.2% disagreed.

8.4.4 Passing red lights

1) 63.4% of drivers, who always or usually drive through red traffic signals, agreed that enforcement needs to be improved in terms of applying the regulations more strictly; 18.7% were not sure and 17.9% disagreed.

2) 73.9% of drivers, who always or usually drive through red traffic signals, agreed with the need for police patrols on the roads in order to reduce violations; 14.9% were not sure and 11.2% disagreed.

3) 79.2% of drivers, who always or usually drive through red traffic signals, agreed that the red light cameras would reduce accidents at signalised intersections; 11.9% were not sure and 8.9% disagreed.

From these results it can be concluded that most of aggressive drivers committing the most dangerous offences in Kuwait accept remedial measures, which they think may reduce violations. It appears that they are breaking the law because they do not think that they will be caught, and because the level of enforcement is weak in Kuwait.

8.5 Comments and suggestions

Out of 1,528 respondents, 493 made comments and suggestions at the end of the questionnaire. The suggestions and comments were classified and organised to give the following results (Table 8.9 below):

Table 8.9 Comments and suggestions

	Comments	Frequency	Rank	Percentage
1	It easy to obtain a licence (through irregular channels)	148	3	13.68
2	Police officers not qualified enough	52	7	4.81
3	The rule can be twisted to get fines dropped	129	4	11.92
4	Vehicle numbers should be limited	19	13	1.76
5	Road design needs improvement	170	1	15.71
6	Strict enforcement is needed	165	2	15.25
7	More driver awareness programmes are needed	129	4	11.92
8	Traffic congestion needs to be reduced	38	11	3.51
9	Public transport needs developing	17	14	1.57
10	Rush hour can be improved by; staggering office and school times	21	12	1.94
11	More police patrols are needed	49	8	4.53
12	Vehicle safety regulation need improvement	44	9	4.07
13	Traffic regulations need updating	54	6	5.00
14	Police cause traffic congestion through inefficient direction	8	15	0.74
15	Other	39	10	3.60

Road design improvement was ranked as the most effective measure by 170 (15.7%) of respondents, followed by the need for strict enforcement (165, 15.2%), and the need to deal with easy to-obtain-licences (irregular channels) (148, 13.7%), twisting the regulations in attempts to get fines dropped (129, 12%), and driver awareness programmes (129, 12%). There were other comments, as shown in Table 8.9, but the above five comments were the most frequent. As regards twisting the regulations in attempts to get fines dropped, fines have recently become difficult to waive with the new computerized system dealing with violations, but drivers' attitudes were still negative.

8.6 Conclusion

Drivers in Kuwait generally agreed with most of the suggested remedial measures. They stated that they would accept more enforcement, even the aggressive drivers. They claimed that the most frequent road safety problems in Kuwait are: 1) Road design; 2) The need for strict enforcement; 3) Ease of obtaining licence (through irregular channels); 4) Twisting the regulations in an attempt to get fines dropped; 5) The need for driver awareness programmes. Thus, properly promoted remedial measures are likely to be accepted.

Chapter 9

9 Conclusions, Recommendations and Future Work

9.1 Conclusions

This thesis has attempted to take steps towards improving road safety in Kuwait. The overall aim of the research was to identify the nature and characteristics of road traffic accidents in the country and associated driver attitudes and behaviours, so as to be able to identify the most appropriate remedial measures. The general objectives of the study were (I) to review the scale and character of road accidents in Kuwait, (II) to understand road accidents in Kuwait in relation to driver attitudes and behaviour, and (III) to recommend remedial measures. The first two objectives will be dealt with in the current section (9.1), while the third objective will be covered in the recommendations section, 9.2.

The study comprised a comprehensive investigation of road safety in Kuwait and the present results are based on a detailed analysis of police accident reports. Driver behaviour and attitudes towards road safety were investigated in depth through a questionnaire survey. The questionnaire asked for opinions on the acceptability of remedial measures. The study drew on international experience from both developed and some developing (or emerging) countries. The analysis of the collected data showed the following (main points highlighted in bold):

- **The state of road safety in Kuwait has generally deteriorated over the last few years**. The accident rate has steadily increased, as have the number of fatalities (not the fatality rate). The fatality rate per 100 million vehicle-kilometres travelled in Kuwait has been estimated to be higher compared to European countries, the U.S. and Japan (section 3.1.10).

- **Reported traffic violations in Kuwait have been increasing continually.** The predominant violations were speeding, going through a red light, parking in non-parking zones, not wearing a seatbelt, driving on the wrong side of the road, car safety violations, and driving without a licence, which was also supported by the questionnaire data analysis. This increase was a result of introducing automated speed and red light cameras, but this has not had a positive effect on accident rates.

- **The findings of this study reveal that the common cause of accidents is related to careless driving** (accidents, according to the police interpretations). This includes lack of attention (distraction, carelessness, etc.), changing lanes (swerving), ignoring rights of way, not leaving enough distance, passing red lights, speeding and hit-and-run incidents.

- **Although speeding was not identified as one of the most frequent causes of injury accidents, according to police reports, it is the most frequent of violations** (Section 3.1.11). Based on the questionnaire survey, 61.7% of the respondents always, usually, or sometimes drive over the speed limit on the motorway, whilst 18.5% drive over 140 km/h. Also, the data analysis shows that generally higher speed on motorways leads to more accidents (Section 5.6.2.9).

- **Young drivers are disproportionately involved in accidents**. Drivers under 28 years of age were involved in 39% of accidents (police accident reports). They were found to be more often at fault and to be involved in more injury accidents. Young drivers were also found to be more aggressive and involved in more accidents compared to other age groups (descriptive and multivariate analysis of the questionnaire), and that is also proven by the accident prediction model (GLM). Young drivers are more involved in speeding and dangerous violations. This implies a great need for driver education and training, 85.3% of the respondents agreeing that road safety education courses for drivers at school are needed, and 85.9% of the respondents agreeing that it is necessary to have relevant practical training by driving instructors, although only 17.8% of the sample had themselves taken driver education courses and 46.7% had no such training. Around 36.1% of the drivers drive illegally before obtaining a driving licence.

- **One of the main findings of the study was that Kuwaiti drivers are more aggressive and more involved in accidents**. Kuwaiti drivers are also more involved in speeding and dangerous violations. Non-Kuwaiti drivers are more concerned about paying fines, as Kuwaiti drivers have better financial status.

- **Driver training is minimal, and this is encouraged by the fact that the theoretical and practical tests are so simple**. In addition, there was no specific hazard perception training or testing. A driving licence can be obtained by unqualified drivers through influential bodies, which is one of the main concerns that the respondents commented on at end of the questionnaire. It was pointed out that it is easy to obtain a driving licence through irregular channels.

- **There is a need for comprehensive driver awareness programmes.** From the results it was found that 40.4% of the respondents agreed that the road safety awareness programme is inadequate and 26.2% were unsure. The need for driver awareness programmes was one of the most frequent comments at the end of the questionnaire. There are very few traffic awareness programmes, whether in state schools or advertised in the media. In fact, apart from the annual Gulf Cooperation Council (GCC) traffic week, there is nothing of note in the way of driver education.

- **Traffic law in Kuwait is comprehensive but it is not applied seriously.** Enforcement is not strict or is considered weak. Comments in the questionnaire suggested that the respondents favoured measures to prevent the twisting of regulations by those who attempt to get their fines dropped and a greater need for strict enforcement. 31% of the respondents believed that enforcement is ineffective and 38.3% thought that it is effective, but more of the former have been involved in accidents, as has been proven from the accident prediction model (GLM).

- Engineering measures were not the focus of this study, but **some of the engineering-related questions from the questionnaire survey revealed the need to investigate engineering issues**, such as better road design and maintenance. 85% of the respondents agreed that the road network in Kuwait generally needed to be developed, and 89.3% of the respondents believed that there were some hazardous locations on Kuwaiti roads that needed to be addressed. In addition, road design improvements were considered to be one of the most effective measures by 15.7% (Section 8.5). A study of the road network in Metropolitan Kuwait had also found a number of hazardous elements and design deficiencies (Section 8.3.1).

9.2 Recommendations

The results of the study reveal that for such a high income country, accident and fatality rates in Kuwait are alarmingly high compared to those in developed countries of similar per capita income. This calls for the need to develop a national strategy in order to improve the road safety situation. To achieve this, the problem has to be recognised and fully appreciated by politicians and other decision makers, and sound databases are needed.

Having specified the safety deficiencies, the next task is to develop alternative remedial measures to alleviate these deficiencies. Improving road safety in Kuwait should include the application of both low-cost accident reduction measures on existing roads and the incorporation of safety principles in the design and construction of new ones. Enforcement also needs to be more effective, with education, training and awareness programmes to eliminate bad driving habits. The main remedial measures recommended are as follows:

- The Ministry of Education should set up appropriate courses at different state school levels to prepare students in order to improve bad driver behaviour and attitudes. These should teach the right topics, to the right target groups, such as safety awareness for young children and advice to older children before they begin driving. This was found to achieve satisfactory results, such as in the United States, when improving courses in high schools for drivers resulted in fewer accidents and driving violations (section 2.2.2). The courses could aim to teach road safety and awareness, as well as respect for the law.

- Comprehensive driving education (lessons and practical training) should be compulsory for all adult drivers in Kuwait, as is the case in some developed countries, such as Finland and Germany (Section 3.1.13). This can further help to improve driver behaviour and attitudes. During the driving education courses, students can also acquire the necessary awareness of correct driving attitudes, knowledge and skills which are covered in the driving test

- Driving schools and private companies (offices) must also concentrate, using qualified instructors in practical training, on eliminating bad habits and dangerous manoeuvres. In Denmark, drivers who received training in a number of basic requirements in the new education programme had lower risk than those whose education did not meet the requirements (section 2.2.2). An effective publicity campaign is also needed to encourage safe driver behaviour and to improve attitudes towards traffic regulations.

- It is recommended that hazard perception training and testing programmes are introduced in Kuwait to compensate for the lack of driving experience of young drivers. The training and testing programmes should concentrate on fundamental behaviours, such as driving within the speed limit, respecting pedestrian crossings and keeping a safe driving distance. Fisher *et al*. (2006) found that a hazard perception training program resulted in substantial improvements in the scanning behaviour of young drivers.

- Hazard perception training using a driver simulator should be made mandatory as part of training and licensing requirements in Kuwait, especially for young, novice drivers, to give them some experience of unusual hazard situation which is difficult and dangerous on the real road, and to identify weaknesses for them to remedy driving tasks.

- Driving licences should not be awarded unless new drivers have reached the minimum driving standard. The government should tackle the question of unqualified drivers obtaining licences, through strict legislation and close monitoring of driving tests.

- The theory test should also be comprehensive and include many items such as in UK and other developed countries, in order to assess whether new drivers have the basic knowledge about driving. More questions need to be added to the theory test under time restrictions. A computerised theory test is preferable to save time and alternate the questions randomly.

- The hazard perception test can be included as part of the compulsory theory test, as it is in the UK, to ensure that the drivers have quick reactions to risk to themselves, to their passengers and other road users.

- The practical test should be carried out on normal roads to assess drivers in the real situations. Several items should be checked over a longer duration (around 40 minutes as in the UK), to give examiners a better chance to detect mistakes. Practical test score can be given, as in UK (and other developed countries), where one serious mistake and 15 minor mistakes is considered a fail.

- Based on the data analysis, young drivers in Kuwait are the most involved in accidents. A graduated licence program could be implemented in Kuwait to put restrictions on young drivers in terms of carrying passengers, curfews (around midnight) and a probationary period with a conviction-free driving record. This system achieved a successful reduction in crashes and injuries of between 5-31% among 15-17 year-old drivers in the U.S.A, Canada, and New Zealand (Fildes and Langford, 2002).

- Increasing public awareness about the magnitude of road hazard problems is required. Community venues, like mosques, and parents at home can play a role. The mass media should be used for publicity to raise public awareness. Many researchers have concluded that mass media support of road safety campaigns can improve knowledge and attitudes. Such measures will have a much greater effect in reducing fatalities and serious injuries when they are combined with enforcement, as has been achieved in countries like Singapore (Section 2.2.3).

- It is evident that the introduction of road safety remedial measures, such as pedestrian crossings in the current situation, is unlikely to have a significant effect on reducing pedestrian traffic accidents. However, road safety remedial measures, supported by an appropriate pedestrian education in school and traffic enforcement generally, could have some benefit. Furthermore there is a large population of non-Kuwaitis in the country, so education for them through the media and in their own language would be beneficial.

- The government should note that drivers in Kuwait accept enforcement in terms of stricter and greater police presence on the roads, even those who consider themselves to be aggressive drivers, but the law should be applied in a fair way, since one of the most frequent comments was about twisting the regulations in attempts to have fines dropped.

- Many studies in developed and in some developing countries have shown that an effective enforcement system has led to changes in driver behaviour and the most rapid reduction in deaths and injury. Indeed, it was found in Egypt that increasing patrols, heavier penalties and radar speed control has led to the total number of accidents being reduced by more than 50% on two major inter-urban roads (Section 2.2.4).

- The Kuwaiti enforcement strategies should be designed to target high-risk behaviour. This was found to be effective in Israel, on the introduction of a comprehensive enforcement project on 700 km of inter-urban roads. One finding in this project was a general reduction in violation rates for most of the targeted behaviours and a significant reduction in both severe accidents and severe casualties (Section 2.2.4).

- A day-fine system should be explored for application in Kuwait to ensure equal severity of fines, given large disparities in incomes. Kuwaiti drivers have better financial status, and find no hardship in paying fines.

- The introduction of speed cameras on some of the main motorways in Kuwait may not result in a large change in driver attitudes towards speeding. Therefore, a police presence on most Kuwaiti motorways is required. 79.9% of respondents agreed that a greater police presence on the roads will reduce driving violations. Also, the Kuwaiti police should introduce indirect enforcement, such as hidden cameras in different locations on Kuwaiti motorways, since this has been found to have a significant impact in reducing crashes and casualties (Section 4.2). Changing driver attitudes towards speeding should be taken as a priority action.

- The findings of this study reveal that there is a need to improve the accident reporting system and to build up an accurate and relevant database in order to provide a reliable system for storing, retrieving and analysing data.

- Road design improvement and a black spot study should be taken into consideration by the Kuwaiti government, since research in many countries has shown that road planning, design and engineering countermeasures can lead to significant accident reductions and reductions in the severity of injuries. Also, driver behaviour can be influenced by road engineering design (Section 2.2.5).

- The police should give greater priority to liaising with hospitals and thus collect more detailed and accurate information on serious road crash victims, i.e. those who are hospitalised. The police and the medical profession should work together to reduce under-reporting.

- Kuwait should take advantage of developments in computer technology and make use of available software, such as the Microcomputer Accident Analysis Package (MAAP), which has been developed for analysing and sorting accident data. It has been used successfully in organising databases in some developing countries, including India and Jordan (Section 2.2.5).

- There is also an urgent need for a system to record accident location accurately. This was found to be imprecise in police accident reports. Other studies have reported three common methods of pinpointing accident locations, namely:

  1) Grid co-ordinates (for urban and rural roads)
  2) Link/Node, (for urban roads)
  3) Kilometre posts (for rural roads).

- Road accidents can occur as a result of a sequence of events, and most of them are interrelated; their relationships are far more complex than is apparent from police reports, where 51% of accidents are stated to be caused by lack of attention. The reasons behind lack of attention by many drivers are unclear, since drinking alcohol is prohibited by law in Kuwait. Hence, there is a need to redesign the reporting system to identify specific accident causes. Also, police accident investigators should be more concerned about the details needed in reports. This would ease any attempt to study road safety in Kuwait and to recommend proper solutions.

In general, based on the data analysis, driver behaviours and attitudes are worse among younger drivers. Driver behaviours and attitudes are a complex issue, requiring the Kuwaiti government to focus on attitude change in the long term, which should involve proper education, training and enforcement.

Currently, the improvement of road safety, and of driver behaviour and attitudes, in particular, is the responsibility of different organisations. The two Cs (Coordination and Cooperation) are important in tackling the problem, taking into consideration that there is no one remedy to improve driver behaviour or attitudes. The five Es (Education, Enforcement, Engineering, Encouragement and Evaluation) and the two Cs (Coordination and Cooperation) need to be applied together in order to reduce accidents.

Decisions upon remedial measures should be evaluated carefully, considering the effectiveness of each remedial measure in reducing the rate of accidents under similar conditions. However, it should be noted, that measures that are very successful in achieving significant major benefits in certain countries, or parts of a country, may not be that successful in another country or part of a country, due to the complexity of the inter-relationships that exist between the traffic variables and driver attitudes.

9.3 Future work

It is recommended that future research is carried out to provide more insight into the road safety problem in Kuwait, which can help to diagnose better solutions to reducing accident rates and fatalities.

- Road safety engineering research, such as on accident black spot studies, needs to be conducted in Kuwait to identify hazardous locations and identify low-cost remedies and their effectiveness, and this requires a detailed, well-organised and accurate database.

- Studies of estimated accident costs and the value of prevention should be carried out to provide evidence for the decision makers about the magnitude of the problem and the urgent need for remedial action.
- A study of the effect of premiums for car insurance and taxes on petrol should be carefully conducted, which may play a major role in improving driver behaviour, road accidents and traffic capacity.
- More in-depth investigation is required regarding actual driving behaviour, by monitoring drivers remotely (CCTV).
- A monitored before-and-after study of driver behaviour is recommended to evaluate the remedial measures (Engineering, Education, and Enforcement) and their effect on drivers before implementation.
- It will be worthwhile to employ simulators in the research on risk assessment and hazard perception, which are important factors related to driving performance in terms of accident frequencies and errors committed in driving.
- An in-depth investigation is required to study safety aspects related to pedestrian accidents, to determine the needs of pedestrians, and what facilities should be introduced to meet those needs.
- A greater sample size and a much more accurate estimation of distances travelled by individual drivers are required to validate the accident prediction model and recommend any necessary modification.
- In order to obtain more reliable data, it is recommended that an on-site investigation at the accident site takes place, where details of the accident and the factors causing it are collected on-site soon after the accident is reported. This can be achieved by coordination with the traffic police department in charge of accident investigation.

9.4 Limitations

The research data collected was based on police accident reports and a supplementary questionnaire survey. The police accident records are usually the main source of accident report data, providing information on location, vehicle movements and contributing factors, but usually based on police interpretation. The usual main concern in their investigation is who has broken the law. A problem with under-reporting has long been recognised, especially of those accidents which are non-fatal. Both factors could affect the reliability of the data.

Although the questionnaire survey allows a wide range and sample distribution, it is difficult to obtain responses from a representative cross-section of the target population. Verification of the accuracy of the questionnaire responses might in some cases be difficult, some respondents might not remember the exact number of accidents that they had been involved in and the annual kilometres driven.

Appendix A

The Police Report Form (Accident Details)

Police station name:
Investigator name:
Case #:
Accident time: time: day time or evening: date:
Weather condition: dusty, rainy, cloudy, clear
location: Street name or (number): Area name: Roundabout name: Parking area: Nearest fixed object to the road:
Road types:
A- Link: 1-Dual road with median 2-Single one-way road without median 3-Single two-way road with median
4-Road divided into two sections by panted lines 5-Road divided into three sections by panted lines
B-Junction: 1-Signalized intersection 2-Unsignalized intersection 3-Signlized collector road intersect with major road
4-Unsignlized collector road intersect with major road 5-Signalized roundabout 6-Unsignalized roundabout 7-Entrance
Road surface condition: wet dry sandy

Accidents type: 1-Vehicle-vehicle 2-Hitting light stand 3-Hitting tree or railing 4-Hitting a wall
5-Hitting an obstruction on the road 6-Overturning 7-Falling from higher level 8-Pedestrian accident
9-Hitting an animal

Number of vehicles involved:

	driver name	nationality	age	gender	driver licence #	licence plate	make	made in	type
first vehicle									
second vehicle									
third vehicle									
forth vehicle									

Injury involved:

	name	age	gender	death	severe injury	slight injury	the position of the injured person at the time of accident
first driver							
second driver							
third driver							
forth driver							
fifth driver							
sixth driver							
seventh driver							

Accident Cause:

Some missing Information

Precise accident locations						
lighting condition						
Road service type:		bitumen	gravel	earth	concrete	
Seat belt						
Speed limit						
Road service quality	smooth		potholed	rutted	corrugated	
road width						
general road description	straight and flat		curved only		inclined only	curved and inclined
shoulder width and type	paved	unpaved	no shoulder			
Type of injury in details						
pedestrian details						
vehicle damage location						
vehicle loading						
vehicle light						
passenger action						

Appendix B

Definitions of Slightly Injured

Australia	Medical treatment is required but not admittance to hospital
Belgium	Injury in an accident, but not fatal or serious
Canada	Non-fatal injuries after a traffic collision occurring on a public roadway that dose not result in hospitalisation for a 24 hour .period
Czech Republic	Injury but not serious.
Denmark	All injured road users that are not seriously injured
Finland	Serious and slight injury are not separated in Finland
France	Accident victims needing medical treatment with or without hospitalisation. Hospitalisation, should be no longer than 6 days
Germany	All injured road users who are not seriously injured
Great Britain	Minor injury such as sprains, bruises or cuts which do not necessarily require roadside attention, Including slight shock requiring roadside attention
Greece	Injury of minor character such as sprains, bruises or cuts. Probable outpatient treatment in a hospital or by a doctor
Hungary	Secondary injuries such as sprains or bruises
Ireland	Injury of a minor character such as a sprain or bruise.
Italy	No definition available.

Japan	Injury requiring medical treatment for up to 30 days
Korea	Injuries that require medical treatment for less than 3 weeks and more than 5 days. (Minor injuries require medical treatment for less than 5 days.)
Luxembourg	Injuries needing medical out-patient treatment.
Netherlands	Injury admitted to hospital as an in-patient (possibly as out-patient).
New Zealand	Injuries of a minor nature such as sprains or bruises
Norway	Minor injuries in a traffic accident, normally requiring only minor medical treatment and not leading to permanent medical disablement (negligible injuries such as bruises or scratches, etc., are not included).
Poland	Injury in a traffic accident of a minor character, e.g. sprains, bruises that prevent the victim from working for a period of less than 7 days.
Portugal	Any person needing medical treatment after an accident, without hospitalisation.
Spain	Injury in a traffic accident to which the "seriously injured" definition cannot be applied.
Sweden	Injury but not serious.
Switzerland	Injuries with small effect on personal mobility, not requiring to leave the site of the accident. Probable outpatient treatment in hospital or by doctor (for example abrasions without substantial loss of blood.).
United States	A police-reported non-incapacitating injury.
UN/ECE	Secondary injuries such as sprains or bruises. Persons complaining of shock, but who have not sustained other injuries, should not be considered in the statistics as having been injured unless they show very clear symptoms of shock and have received medical treatment or appeared to require medical attention.

Source: IRTAD (1998)

Definitions of Seriously Injured

Australia	Injuries from a road crash required admittance to hospital.
Austria	Injury leading to deterioration in health and inability to work for a period of more than 24 days. There is always admission to hospital
Belgium	Hospitalisation for at least 24 hours.
Canada	Injury in a traffic collision that occurs on a public roadway, which is non-fatal injuries but results in hospitalisation, including for observation only, for a period of at least 24 hours.
Czech Republic	Serious failure of health or serious illness, as judged by the attending physician.
Denmark	Intracranial injury, skull fracture, face or eye injury, injury to the trunk (chest and/or abdomen), injury to the spine and/or pelvis, fracture/dislocation or severe sprain of the shoulder, arm or hand, fracture/dislocation or severe sprain to the hip, leg or foot; serious injuries in more than one main region, and burns.
Finland	Serious and slight injury are not separated in Finland
France	Accident victim needing hospitalisation for more than 6 days.
Germany	Injury requiring in-patient treatment (for at least 24 hours).
Great Britain	An injury for which a person is detained in hospital as an inpatient or any of the following injuries : fractures, concussion, internal injuries, crushing, severe cuts and lacerations, severe general shock requiring medical treatment, injuries causing death 30 or more days after the accident.
Greece	Injuries such as head injuries, multiple wounding, mutilation, minor concussion danger to life
Hungary	Fractures, concussions, internal lesions, crushing, severe cuts and laceration, severe general shocks requiring medical treatment and any other serious lesion entailing detention in hospital, in general requiring more than 8 days healing, are considered as serious injuries.
Ireland	Injury for which the victim is detained in hospital as an in-patient or any of the following injuries: fractures, concussion, internal injury, crushing, severe cuts and lacerations, severe general shock requiring medical treatment.

Italy	No definition available
Japan	Persons who require medical treatment for more than 30 days.
Luxembourg	Hospitalisation for more than 24 hours
Korea	Injuries that require medical treatment for more than 3 weeks.
Netherlands	injury requiring admittance to hospital as an in-patient.
New Zealand	Fractures, concussion, internal injuries, crushing, severe cuts and lacerations, severe general shock necessitating medical treatment and any other injury requiring hospital attention.
Norway	Traffic injury which requires at least one day of hospitalisation and/or leading to 0-30% medical disablement, but no danger of death. Dangerously injured persons suffer injuries in traffic accidents, leading to 30-100% medical disablement , or are in real danger of death, including those who die 30 or more days after the accident
Poland	Injuries such as fractures, concussion, internal injuries, severe general shock requiring hospitalisation for more than 7 days.
Portugal	Injury in an accident requiring hospitalisation.
Spain	Hospitalization for over 24 hours resulting from injuries caused by a traffic accident.
Sweden	See Standard Definition by ECE
Switzerland	Severe visible injuries, disabling normal activities at home for at least 24 hours (loss of consciousness, fractures, hospitalisation lasting more than 1 day).
United States	A police-reported incapacitating injury.
ECE	Fractures, concussion, internal lesions, crushing, severe cuts and laceration, severe general shock requiring medical treatment and any other serious lesion entailing hospitalisation.

Source: IRTAD (1998)

Appendix C

```
GLM  Wednesday July 30 10:01:49 2008   Page 1

                                            Statistics/Data Analysis

                                               User: jamal
                                            Project: accidents

                                      9.2   Copyright 1984-2006
  Statistics/Data Analysis                  StataCorp
                                            4905 Lakeway Drive
                                            College Station, Texas 77845 USA
                                            800-STATA-PC        http://www.stata.com
                                            979-696-4600        stata@stata.com
                                            979-696-4601 (fax)

 Single-user Stata for Windows perpetual license:
        Serial number:  1990539236
          Licensed to:  Jamal Almatawah
                        University of Southampton

 Notes:
       1.  (/m# option or -set memory-) 1.00 MB allocated to data
       2.  New update available; type -update all-

1 . cd e:
 E:\

2 . insheet using statafinal3.txt
 (51 vars, 1528 obs)

3 . glm accidents age sexzero kunonkuzero edulevelzero mstatuszero drivingeduzero speed2 fineperyear a
 > ehavour experince lnavekm, family(poisson) link(log) offset(lnt)

 Iteration 0:   log likelihood = -2071.4828
 Iteration 1:   log likelihood = -2020.9916
 Iteration 2:   log likelihood = -2020.4911
 Iteration 3:   log likelihood = -2020.4903
 Iteration 4:   log likelihood = -2020.4903

 Generalized linear models                          No. of obs      =       1528
 Optimization     : ML                              Residual df     =       1516
                                                    Scale parameter =          1
 Deviance         =  2006.061716                    (1/df) Deviance =    1.32326
 Pearson          =  2297.111846                    (1/df) Pearson  =   1.515245

 Variance function: V(u) = u                        [Poisson]
 Link function    : g(u) = ln(u)                    [Log]

                                                    AIC             =   2.660328
 Log likelihood   = -2020.490343                    BIC             =  -9108.818
```

accidents	Coef.	OIM Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0262081	.0076488	-3.43	0.001	-.0411995	-.0112166
sexzero	-.0169953	.0647329	-0.26	0.793	-.1438696	.1098789
kunonkuzero	.2070239	.0714496	2.90	0.004	.0669853	.3470625
edulevelzero	-.0848196	.0574453	-1.48	0.140	-.1974103	.0277712
mstatuszero	-.3625447	.0667933	-5.43	0.000	-.4934572	-.2316322
drivingedu~o	.1155828	.0795533	1.45	0.146	-.0403387	.2715043
speed2	.1944256	.0732678	2.65	0.008	.0508235	.3380278
fineperyear	.0697631	.0108598	6.42	0.000	.0484782	.091048
agreesive_~r	-.2094719	.047977	-4.37	0.000	-.303505	-.1154387
experince	-.0383309	.0079573	-4.82	0.000	-.0539268	-.0227349
lnavekm	.0937983	.0416706	2.25	0.024	.0121254	.1754713
_cons	-.9363488	.4934022	-1.90	0.058	-1.903399	.0307018
lnt	(offset)					

```
4 . glm accidents age  kunonkuzero edulevelzero mstatuszero drivingeduzero speed2 fineperyear agreesi
> ur experince lnavekm, family(poisson) link(log) offset(lnt)

Iteration 0:   log likelihood = -2071.4748
Iteration 1:   log likelihood = -2021.0302
Iteration 2:   log likelihood = -2020.5254
Iteration 3:   log likelihood = -2020.5247
Iteration 4:   log likelihood = -2020.5247

Generalized linear models                          No. of obs      =       1528
Optimization     : ML                              Residual df     =       1517
                                                   Scale parameter =          1
Deviance         =  2006.130524                    (1/df) Deviance =   1.322433
Pearson          =  2297.762294                    (1/df) Pearson  =   1.514675

Variance function: V(u) = u                        [Poisson]
Link function    : g(u) = ln(u)                    [Log]

                                                   AIC             =   2.659064
Log likelihood   = -2020.524747                    BIC             =  -9116.081
```

accidents	Coef.	OIM Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0260483	.0076229	-3.42	0.001	-.0409888	-.0111077
kunonkuzero	.2117801	.0691424	3.06	0.002	.0762635	.3472966
edulevelzero	-.0876028	.0564742	-1.55	0.121	-.1982902	.0230846
mstatuszero	-.361353	.0666743	-5.42	0.000	-.4920322	-.2306738
drivingedu~o	.1156076	.0795607	1.45	0.146	-.0403285	.2715436
speed2	.1949311	.0732451	2.66	0.008	.0513733	.338489
fineperyear	.0697005	.0108538	6.42	0.000	.0484276	.0909735
agreesive_~r	-.2082387	.0477365	-4.36	0.000	-.3018005	-.1146768
experince	-.0386505	.0078617	-4.92	0.000	-.054059	-.0232419
lnavekm	.0909666	.0402073	2.26	0.024	.0121618	.1697715
_cons	-.9295269	.492421	-1.89	0.059	-1.894654	.0356005
lnt	(offset)					

```
5 . glm accidents age  kunonkuzero edulevelzero mstatuszero speed2 fineperyear agreesive_behavour exp
> avekm, family(poisson) link(log) offset(lnt)

Iteration 0:   log likelihood = -2072.1833
Iteration 1:   log likelihood = -2022.0967
Iteration 2:   log likelihood =  -2021.607
Iteration 3:   log likelihood = -2021.6064
Iteration 4:   log likelihood = -2021.6064

Generalized linear models                          No. of obs      =       1528
Optimization     : ML                              Residual df     =       1518
                                                   Scale parameter =          1
Deviance         =  2008.293742                    (1/df) Deviance =   1.322987
Pearson          =  2288.422567                    (1/df) Pearson  =   1.507525

Variance function: V(u) = u                        [Poisson]
Link function    : g(u) = ln(u)                    [Log]

                                                   AIC             =   2.659171
Log likelihood   = -2021.606356                    BIC             =   -9121.25
```

accidents	Coef.	OIM Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0268476	.0075822	-3.54	0.000	-.0417085	-.0119866
kunonkuzero	.2292185	.0681952	3.36	0.001	.0955583	.3628786
edulevelzero	-.0867745	.0564824	-1.54	0.124	-.197478	.023929
mstatuszero	-.3627045	.0667232	-5.44	0.000	-.4934796	-.2319293
speed2	.194389	.073265	2.65	0.008	.0507923	.3379858
fineperyear	.0698966	.0108722	6.43	0.000	.0485875	.0912057
agreesive_~r	-.2138417	.0476437	-4.49	0.000	-.3072217	-.1204618
experince	-.0373565	.0077895	-4.80	0.000	-.0526237	-.0220894
lnavekm	.0883851	.0400925	2.20	0.027	.0098053	.1669649
_cons	-.7869972	.4820304	-1.63	0.103	-1.731759	.157765

```
         lnt |  (offset)
------------------------------------------------------------------------------
```

```
6 . glm accidents age  kunonkuzero  mstatuszero speed2 fineperyear agreesive_behavour experince lnavel
  > y(poisson) link(log) offset(lnt)

Iteration 0:   log likelihood = -2072.7201
Iteration 1:   log likelihood =  -2023.262
Iteration 2:   log likelihood = -2022.7839
Iteration 3:   log likelihood = -2022.7832
Iteration 4:   log likelihood = -2022.7832

Generalized linear models                          No. of obs      =       1528
Optimization     : ML                              Residual df     =       1519
                                                   Scale parameter =          1
Deviance         =  2010.647415                    (1/df) Deviance =   1.323665
Pearson          =  2286.786107                    (1/df) Pearson  =   1.505455

Variance function: V(u) = u                        [Poisson]
Link function    : g(u) = ln(u)                    [Log]

                                                   AIC             =   2.659402
Log likelihood   = -2022.783193                    BIC             =  -9126.228
```

accidents	Coef.	OIM Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0266269	.0075718	-3.52	0.000	-.0414674	-.0117863
kunonkuzero	.2257913	.0681027	3.32	0.001	.0923124	.3592701
mstatuszero	-.348268	.0661918	-5.26	0.000	-.4780015	-.2185346
speed2	.1947629	.0732476	2.66	0.008	.0512003	.3383256
fineperyear	.0692293	.0108644	6.37	0.000	.0479354	.0905232
agreesive_~r	-.2084354	.0474637	-4.39	0.000	-.3014625	-.1154083
experince	-.0366645	.0077676	-4.72	0.000	-.0518887	-.0214403
lnavekm	.0847849	.039956	2.12	0.034	.0064725	.1630973
_cons	-.8398122	.4798422	-1.75	0.080	-1.780286	.1006612
lnt	(offset)					

```
7 . glm accidents age  kunonkuzero  mstatuszero speed2 fineperyear agreesive_behavour experince lnavel
  > y(poisson) link(log) offset(lnt) scale (1.505455)

Iteration 0:   log likelihood = -2072.7201
Iteration 1:   log likelihood =  -2023.262
Iteration 2:   log likelihood = -2022.7839
Iteration 3:   log likelihood = -2022.7832
Iteration 4:   log likelihood = -2022.7832

Generalized linear models                          No. of obs      =       1528
Optimization     : ML                              Residual df     =       1519
                                                   Scale parameter =          1
Deviance         =  2010.647415                    (1/df) Deviance =   1.323665
Pearson          =  2286.786107                    (1/df) Pearson  =   1.505455

Variance function: V(u) = u                        [Poisson]
Link function    : g(u) = ln(u)                    [Log]

                                                   AIC             =   2.659402
Log likelihood   = -2022.783193                    BIC             =  -9126.228
```

accidents	Coef.	OIM Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0266269	.0092904	-2.87	0.004	-.0448358	-.008418
kunonkuzero	.2257913	.08356	2.70	0.007	.0620167	.3895658
mstatuszero	-.348268	.0812153	-4.29	0.000	-.5074471	-.189089
speed2	.1947629	.0898726	2.17	0.030	.0186159	.3709099
fineperyear	.0692293	.0133303	5.19	0.000	.0431023	.0953562
agreesive_~r	-.2084354	.0582365	-3.58	0.000	-.3225769	-.094294
experince	-.0366645	.0095306	-3.85	0.000	-.0553441	-.0179848
lnavekm	.0847849	.0490248	1.73	0.084	-.011302	.1808718
_cons	-.8398122	.5887519	-1.43	0.154	-1.993745	.3141203

```
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         lnt |    (offset)
------------------------------------------------------------------------------
 (Standard errors scaled using dispersion equal to square root of 1.505455)

8 . stepwise, pr (.05): glm accidents age sexzero kunonkuzero edulevelzero mstatuszero drivingeduzero
  > ineperyear agreesive_behavour experince lnavekm, family(poisson) link(log) offset(lnt)
                      begin with full model
p = 0.7929 >= 0.0500  removing sexzero
p = 0.1462 >= 0.0500  removing drivingeduzero
p = 0.1245 >= 0.0500  removing edulevelzero

Generalized linear models                          No. of obs      =      1528
Optimization     : ML                              Residual df     =      1519
                                                   Scale parameter =         1
Deviance         =  2010.647415                    (1/df) Deviance =  1.323665
Pearson          =  2286.786107                    (1/df) Pearson  =  1.505455

Variance function: V(u) = u                        [Poisson]
Link function    : g(u) = ln(u)                    [Log]

                                                   AIC             =  2.659402
Log likelihood   = -2022.783193                    BIC             = -9126.228

------------------------------------------------------------------------------
             |                 OIM
   accidents |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -.0266269   .0075718    -3.52   0.000    -.0414674   -.0117863
     lnavekm |   .0847849    .039956     2.12   0.034     .0064725    .1630973
 kunonkuzero |   .2257913   .0681027     3.32   0.001     .0923124    .3592701
agreesive_~r |  -.2084354   .0474637    -4.39   0.000    -.3014625   -.1154083
 mstatuszero |   -.348268   .0661918    -5.26   0.000    -.4780015   -.2185346
   experince |  -.0366645   .0077676    -4.72   0.000    -.0518887   -.0214403
      speed2 |   .1947629   .0732476     2.66   0.008     .0512003    .3383256
 fineperyear |   .0692293   .0108644     6.37   0.000     .0479354    .0905232
       _cons |  -.8398122   .4798422    -1.75   0.080    -1.780286    .1006612
         lnt |   (offset)
------------------------------------------------------------------------------

9 . stepwise, pe (.05): glm accidents age sexzero kunonkuzero edulevelzero mstatuszero drivingeduzero
  > ineperyear agreesive_behavour experince lnavekm, family(poisson) link(log) offset(lnt)
                      begin with empty model
p = 0.0000 <  0.0500  adding  age
p = 0.0000 <  0.0500  adding  fineperyear
p = 0.0000 <  0.0500  adding  agreesive_behavour
p = 0.0000 <  0.0500  adding  mstatuszero
p = 0.0004 <  0.0500  adding  experince
p = 0.0005 <  0.0500  adding  kunonkuzero
p = 0.0059 <  0.0500  adding  speed2
p = 0.0338 <  0.0500  adding  lnavekm

Generalized linear models                          No. of obs      =      1528
Optimization     : ML                              Residual df     =      1519
                                                   Scale parameter =         1
Deviance         =  2010.647415                    (1/df) Deviance =  1.323665
Pearson          =  2286.786107                    (1/df) Pearson  =  1.505455

Variance function: V(u) = u                        [Poisson]
Link function    : g(u) = ln(u)                    [Log]

                                                   AIC             =  2.659402
Log likelihood   = -2022.783193                    BIC             = -9126.228
```

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accidents	Coef.	OIM Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0266269	.0075718	-3.52	0.000	-.0414674	-.0117863
fineperyear	.0692293	.0108644	6.37	0.000	.0479354	.0905232
agreesive_~r	-.2084354	.0474637	-4.39	0.000	-.3014625	-.1154083
mstatuszero	-.348268	.0661918	-5.26	0.000	-.4780015	-.2185346
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kunonkuzero	.2257913	.0681027	3.32	0.001	.0923124	.3592701
speed2	.1947629	.0732476	2.66	0.008	.0512003	.3383256
lnavekm	.0847849	.039956	2.12	0.034	.0064725	.1630973
_cons	-.8398122	.4798422	-1.75	0.080	-1.780286	.1006612
lnt	(offset)					

```
10 . save "C:\Documents and Settings\JamalA\My Documents\ttt.dta"
   file C:\Documents and Settings\JamalA\My Documents\ttt.dta saved

11 .
```

Appendix D

COLLEGE OF TECHNOLOGICAL STUDIES

1976

كلية الدراسات التكنولوجية

University of Southampton, UK

Dear Sir/Madam

The object of this questionnaire is to reveal various attitudes towards car driving for a sample of the drivers in Kuwait, in order to propose steps for improving road safety.

Please read the questions carefully and answer them as truthfully as you can. This information will be confidential and will be used for research purposes only.

Prepared by: Jamal AL- Matawah

2005

Instructions: Please place a ☑ box in the which best describes your answer and or fill in the space where needed.

Part A: General Information

Age:......

Gender: Male ☐ Female ☐

Nationality:……………….. Residential Area: ……………

Occupation:………………. Work place:…………………

Education Level: Below High school ☐ High school ☐ Diploma ☐ Bachelor ☐ Postgraduate ☐

Marital Status: Single ☐ Married ☐

How many children do you have (if any)? ………..

Household salary (Monthly income) :

No salary ☐ less than 200 ☐ 200- 400 ☐ 400-600 ☐ 600-800 ☐

800-1000 ☐ 1000- 1200 ☐ 1200-1400 ☐ 1400-1600 ☐ 1600-2000 ☐

Over 2000 KD ☐

Part B: Car Use

1-For how many years have you been driving?...............

2- When did you get your Kuwaiti driving licence (year)?…………

3-What type of vehicle do you usually use?

Saloon ☐ Van ☐ Jeep ☐ Pick-ups ☐ Trucks ☐

Bus(as driver) ☐ Motorcycles ☐ Others (please specify) ……….

4- And what make and model?..
Year of manufacture?..................

5-Who owns the car that you usually use?
Yourself ☐ parent ☐ brother/sister ☐ other relative ☐

husband/wife ☐ employer ☐ other(please specify)……………

6-What is the most common reason for your journeys? (**Give an estimation as a percentage)**

Reasons	percentage
Working purposes	
Social (or leisure) (e.g. visiting relatives or friends)	
Domestic (e.g. shopping, giving lifts)	
other (please state …………………………………….	
Total	**100%**

7-Estimate the number of kilometres you drive annually

less than 5,000 ☐ 5,000-10,000 ☐ 10,000-15,000 ☐ 15,000-20,000 ☐

20,000- 25,000 ☐ 25,000-30,000 ☐ 30,000-35,000 ☐ 35,000- 40,000 ☐

Over 40,000 ☐

Part C: Driver Education:

8- Did you have any road safety education at school? Yes ☐ No ☐
If **yes**, when ………………………………………
And where…………………………………………

9-Did you have any theoretical driving education at school before you obtained a driving licence? Yes ☐ No ☐
If **yes**, when ……………………………
And where………………………………

10-How did you learned to drive?
By myself ☐ parents ☐ with your relative ☐ Friend ☐ driving instructor ☐
driving school ☐ other…………..)
For how long?........................

11- Did you drive *illegally* on the road before obtaining your driver licence? Yes ☐ No ☐
If yes, how old were you when you started driving ----------

Part D: Accident and Motoring Offences

Theses tables are used for answering questions 12,13 only

Table A

Accident type:
1-Vehicle-vehicle
2- Road side obstacles
3- Overturning
4- Pedestrian accident
5 Other (please state ……………)

Table B

Accident cause:
1- Lack of attention
2- Speeding
3- Changing lane (Swerving)
4- Ignoring priority of way
5- Not leaving enough distance
6- Passing the red signal
7- Puncture or defects
8- Pedestrian error
9- Reckless driving
10- Other (please state…..)

Table C

Type of Violation
1-Exceeding speed limit
2-Racing on the highway (speeding on main road)
3-Passing red traffic lights
4-Driving on the wrong side of the road
5-Driving without insurance
6-Car safety violations
7-Disregard for road markings
8-Sudden entry or stop
9- Ignoring priority of way
10-Not-wearing a seat belt
11-Traffic code violations
12-Parking on pavements
13-Damaged licence or plate
14-Driving without a licence
15-Driving with expired driving licence or vehicle registration
16-Driving without holding a driving licence
17-Parking in a no parking zone
18-Other violations…………

12- How many road accidents have you been involved with as a driver on the last **ten years**?

	Date: (year)	Was anybody Injured?		Was it Your fault?		Accident type (Table -A)	Accident cause (Table -B)	Accident Location	
								Area	Street
1		Yes	No	Yes	No				
2		Yes	No	Yes	No				
3		Yes	No	Yes	No				
4		Yes	No	Yes	No				
5		Yes	No	Yes	No				
6		Yes	No	Yes	No				

13-Have you had any traffic fines on the last **five years**?

	Type of fines (Table -C)	Year	Frequency
1			
2			
3			
4			
5			
6			
7			
8			
9			

Part E: Driver Behaviour

*place a tick in the appropriate box: √

	5 Point scale questions (always, usually, sometimes, rarely, never) or give factual answers according to what you did not what you think *Notice: questions15a ,16a ,37a need to be answered in the appropriate place*	1 Always	2 Usually	3 Sometimes	4 Rarely	5 Never
14	How often are you in a hurry to get somewhere when you are driving	6%	22.3%	46.1%	20.2%	5.4%
15	How often do you drive above the speed limit in build-up areas	2%	8.2%	22.6%	34.6%	32.6%
15a	If you do, How much **over** the speed limit **(in build-up areas**) would you travel? 10-20 ☐ 20-30 ☐ 30-40 ☐ over 40 Km/h ☐					
16	How often do you drive more than the speed limit on the motorway	6.9%	21.9%	32.8%	23%	15.3%
16a	If you do so, at what speed would you travel (**on the motorway**)? 120-130 ☐ 130-140 ☐ 140-150 ☐ 150-160 ☐over160 Km/h ☐					
17	How often do you use fast acceleration and/or heavy braking as part of your normal driving?	1.5%	6.1%	21.6%	39.5%	31.3%
18	How often do you find that the distance required to stop is longer than you expected?	4.7%	10.8%	32.4%	29.9%	22.3%
19	How often do you slow down before the speed camera and speed after it?	23.6%	17.7%	24.9%	16.7%	17%
20	How often do you overtake or change lane, weaving from left to right or right to left?	6%	13.2%	29.7%	32.9%	18.1%
21	How often do you turn or change lanes or overtake without using the indicators?	4.4%	11.9%	21.1%	28.1%	34.5%
22	How often do you **fail** to check the blind – spot before overtaking?	5.5%	7.7%	13.9%	24.9%	48%
23	How often do you drive too closely to the vehicle in front?	2.8%	8.1%	22%	33.9%	33.1%
24	How often do you drive up to amber traffic signals at speed (when you think that you can make it before the red signal appears)?	6.8%	14.8%	32.3%	28.3%	17.9%
25	How often do you drive through red traffic signals (especially as the light has started to change) when you think that it is safe to do so?	2.4%	6.4%	14.8%	27.8%	48.6%
26	How often do you overtake on the inside in order to reach a green traffic light in time	2.8%	7.5%	16.8%	24.6%	48.4%
27	How often do you make a U turn when another driver who has the right of way is too close to you?	1.8%	3.4%	13.3%	25.7%	44.2%
28	How often do you **fail** to stop or give way at a stop sign?	4.8%	8.5%	14.9%	29.1%	42.7%
29	How often do you drive **without** giving way to cars having the right of way at roundabouts?	3.3%	3%	11.8%	27.8%	54.1%
30	How often do you join a major road without given priority of way?	4.9%	6.1%	14.8%	26.4%	47.8%
31	How often do you **fail** to stop for pedestrians at a zebra crossing?	7.2%	9.9%	20%	24%	38.9%
32	How often do you sound your horn or react by showing anger (or gesturing with your hand) when another driver does something that upsets you?	11.6%	17.9%	30.1%	27%	13.4%
33	How often do you drive while using the mobile phone?	15.1%	24%	34.4%	19.3%	7.3%

	place a tick in the appropriate box: √	1 Always	2 Usually	3 Sometimes	4 Rarely	5 Never
34	How often do you drive when distracted (by loud music, arguments with a passenger)?	3.9%	9.3%	24%	34.6%	28.1%
35	How often do you realise afterwards that you were driving faster than you thought you were?	4.1%	12%	30%	31.7%	22.2%
36	How often do you overtake at the last minute before reaching the exit you want?	2.8%	6.2%	22%	38%	31.1%
37	How often do you drive **without using** the seatbelt?	14.6%	18%	19.7%	19.6%	28.1%
37a	What was the reason for not wearing the seatbelt? Not necessary ☐ forgot ☐ because of my cloths ☐ Irritate ☐ other…………….					
38	How often do you go over the curb to change direction when you see that the road is blocked?	2%	3.2%	9.9%	21.2%	63.7%
39	How often do you park in a black and yellow zone (double yellow line in UK) or in a non-parking zone?	1.6%	3.3%	17.2%	34.5%	43.4%
40	How often do you drive too close to the driver in front and flash your headlights on full beam in order to make them give away to you?	6.1%	8.7%	22.6%	28.8%	33.8%

Part F: Remedial measures: your opinions

	Place a tick in the appropriate box: √	1	2	3	4	5
	Extremely agree to extremely disagree (give your opinion) (what do you think) (Extremely agree, Agree, Neither, Disagree, Extremely disagree) *Notice: question 43a need to be answered in the appropriate place*	Extremely agree	Agree	Neither	Disagree	Extremely disagree
41	The road network in Kuwait needs to be improved.	50.2%	34.8%	7.2%	6.4%	1.4%
42	There are some hazardous locations (or black spots) on Kuwaiti roads that need to be dealt with (treated).	48.8%	40.5%	9.7%	.8%	.3%
43	It is important for the government to provide pedestrian footpaths and pedestrian signals.	48.4%	41.6%	8.1%	1.1%	.9%
43a	Would I walk if pedestrian facilities were provided? yes ☐ no ☐ If no, then why?...					
44	Speed humps are important in reducing speed in urban areas.	37.4%	41%	11.7%	7.4%	2.5%
45	The enforcement system in Kuwait needs improving (applying the regulation more strictly) to reduce road accidents.	45.7%	29.6%	13.8%	7.3%	3.6%
46	Raising the fines would reduce driver violations.	23.9%	27.1%	21.3%	17.3%	10.4%
47	Having more police patrols on the roads would reduce driver violations.	40.7%	36.2%	13.4%	6.9%	2.8%
48	Speed camera enforcement would reduce speed violation.	30%	39%	15.7%	11.3%	4%
49	Red light cameras will reduce traffic light violation at signalized intersections.	47.3%	37.3%	9.3%	3.9%	2.2%
50	Raising the driving age from 18 to 20.	27.7%	18.9%	15.1%	21.3%	17.1%

Place a tick in the appropriate box: √

		1 Extremely agree	2 Agree	3 Neither	4 Disagree	5 Extremely disagree
51	There are enough road safety awareness programmes in Kuwait either at school or for the general public or in the media.	13.3%	20.1%	26.2%	24.9%	15.5%
52	It is important to have road safety education courses for drivers, passengers, or pedestrian at school level.	46.2%	39.6%	10.1%	3%	1.1%
53	It is necessary (or relevant) to have good practical training by a Driving instructor.	51.2%	35.7%	9.1%	3.4%	.7%
54	The driving test, either the theoretical or the practical, needs to be Improved.	43.2%	36.5%	14.4%	4.8%	1.2%
55	A retest driving licence for drivers who have caused a serious accident in their first two years.	38.1%	32.8%	15.9%	9.8%	3.5%
56	A suspension for drivers who commit several serious offences.	51.2%	32%	8.6%	4.8%	3.4%
57	The police enforcement system in Kuwait is effective.	11.3%	27%	30.7%	18.2%	12.7%

Suggestions and Comments:

....

Thank you for your co-operation.

COLLEGE OF TECHNOLOGICAL STUDIES

University of Southampton, UK

أخي الكريم / أختي الكريمة

تحية طيبة وبعد

تهدف هذه الاستبانة إلى معرفة بعض جوانب قيادة المركبة لدى شريحة من سكان دولةالكويت، من أجل العمل على تشخيص واقع السلامة المرورية، وسبل علاجها.

نأمل منكم الإجابة على **كل بنود الاستبانة**، **بدقة وصراحة**، فالمعلومات التي ستقدمونها لن تستخدم إلا لأغراض البحث العلمي، لكي تخرج النتائج بشكل يعبر عن الواقع .

إعداد/ أ. جمال أحمد المطاوعة

2005

هذا الاستبيان يحتوي على عدة أجزاء تخص قيــادة المركبـة، إقرأ الأسئلة بتمعن ثم أجب عليها بروية.
وعند اختيار الإجابة يرجى وضع علامة☑ في المربع وإملأ الفراغ بالإجابة المناسبة في المكان المخصص

** الجزء الأول - البيانات*

العمر: ....

الجنس: ذكر ☐ أنثى ☐

الجنسية:....................... المنطقة السكنية:.......................

المهنــة:....................... مقــر العمـــــل:.......................

المستوى التعليمي: دون الثانوي ☐ ثانوي ☐ دبلوم ☐ جامعي ☐ دِراسات عُليا ☐

الحالة الاجتماعية: أعزب ☐ متزوج ☐

هل لديك أولاد ؟ نعم ☐ لا ☐ كم عددهم ؟...............

مستوى الدخل(الراتب الشهري):

لا يوجد ☐ أقل من 200 ☐ 400-200 ☐ 600-400 ☐ 800-600 ☐ 1,000-800 ☐

1,200-1,000 ☐ 1,400-1200 ☐ 1,600-1,400 ☐ 2,000-1,600 ☐ أكثر من 2,000 د.ك ☐

** الجزء الثانـي – استخدام المركبة*

1- منذ كم سنة وأنت تقود المركبة ؟.............

2- في أي سنة استلمت رخصة القيادة الكويتية ؟.............

3- أي نوع من السيارات تستخدم **عادةً**؟ صالون – ☐ فان ☐ جيب ☐ وانيت ☐
شاحنة ☐ باص ☐ دراجة نارية ☐ غيرها(أذكر)........

4- أسم المركبة ..../.................(مثال: تيوتا/ كامري)

سنة الصنع(موديلها)..................

5- من الذي يملك مركبتك (التي تقودها) ؟ أنا ☐ والديك ☐ أخ / أخت ☐ أحد الأقرباء ☐
زوج / زوجة ☐ صاحب العمل ☐ غيرهم............

6- ما هو السبب الرئيسي لاستخدامك المركبة؟ (حدد بالنسبة المؤية على أن يكون **<u>المجموع 100%</u>**)

الاسباب	**النسبة المئوية**
أ- للعمل أو (المدرسة/ الكلية)	
ب – زيارات اجتماعية و ترفيهية(زيارة أصدقاء وأقارب)	
ج- التزامات عائلية منزلية (شراء مستلزمات البيت والتوصيل).	
د- غيرها حدد	
المجموع	**100%**

7- عدد الكيلومترات التي تقطعها سنوياً تقريباً : اقل من 5,000 ☐ 10,000-5,000 ☐ 15,000-10,000 ☐
20,000-15,000 ☐ 25,000-20,000 ☐ 30,000-25,000 ☐
35,000-30,000 ☐ 40,000-35,000 ☐ اكثر من 40,000 ☐

<u> الجزء الثالث – التربية المرورية</u>*

8- هل درست عن السلامة المرورية في المدرسة(مراحل: ابتدائي أو متوسط أو ثانوي)؟ نعم ☐ لا ☐
إذا كانت الإجابة نعم فأين؟...........................
و متى؟...........................

9- هل درست دراسة نظرية عن قيادة المركبة في المدرسة (مراحل: ابتدائي أو متوسط أو ثانوي)
قبل حصولك على رخصة القيادة؟ نعم ☐ لا ☐
إذا كانت الإجابة نعم فأين ؟ ....
و متى؟ ....

10- كيف تدربت على قيادة المركبة قبل حصولك على رخصة القيادة ؟
بنفسي ☐ الأهل ☐ مدرب مختص ☐ مدرسة خاصة ☐ أخرى........... ☐

10A - ولمدة كم تدربت ؟...................................

11- هل كنت تقود السيارة *بطريقة غير قانونية* قبل حصولك على رخصة القيادة؟ نعم ☐ لا ☐
اذا كانت الاجابة (نعم) فكم كان عمرك آنذاك؟...................

يتبع

هذه الجداول تستخدم للإجابة على سؤال رقم 12 ، 13 *فقط*

جدول (أ)

	نوع الحادث
1	اصطدام مركبات
2	اصطدام بجسم صلب (أوعائق)
3	إنقلاب
4	دهس
5	أخرى ....

	جدول (ب)
	سبب الحادث
1	عدم إنتباه
2	سرعة
3	إنحراف (تغير الحارة)
4	عدم إعطاء حق الأولوية
5	عدم ترك مسافة كافية
6	تجاوز الإشارة الحمراء
7	خلل في الإطارات
8	خطأ المشاة
9	الرعونة والتهور
10	أخرى ....

جدول (ج)

	نوع المخالفة
1	السرعة فوق المعدل
2	الرعونة والتسابق في الطريق
3	تجاوز الإشارة الحمراء
4	القيادة عكس السير
5	القيادة بدون تأمين
6	مخالفة شروط الأمن والمتانة
7	عدم إتباع الخطوط الارضية
8	الطلوع أو الوقوف المفاجأ
9	عدم إعطاء حق أولوية المرور
10	عدم ارتداء حزام الامان
11	مخالفة قواعد وآداب المرور
12	الصعود على الرصيف
13	تلف الرخصة أو الدفتر أو اللوحة
14	القيادة بدون رخصة
15	عدم تجديد رخصة القيادة والدفتر
16	عدم حمل الدفتر أو الرخصة
17	ممنوع الإنتظار أو الوقوف
18	أخرى ....

12- وضّح من خلال الجدول التالي عدد حوادث المرور التي كنت طرفاً فيها في السنوات **العشر** الماضية؟

م	التاريخ	هل حدثت اي إصابات		هل كنت السبب في الحادث		نوع الحادث *(جدول- أ)*	سبب الحادث *(جدول- ب)*	موقع الحادث	
	السنة							المنطقة	الشارع
1		نعم	لا	نعم	لا				
2		نعم	لا	نعم	لا				
3		نعم	لا	نعم	لا				
4		نعم	لا	نعم	لا				
5		نعم	لا	نعم	لا				
6		نعم	لا	نعم	لا				

13- هل حصلت على مخالفات في السنوات **الخمس** الماضية؟ نعم ☐ لا ☐ إذا كانت الإجابة نعم اذكر نوع المخالفة

م	نوع المخالفة *(جدول – ج)*	السنة	عدد المرات
1			
2			
3			
4			
5			
6			
7			
8			
9			

** الجزء الخامس – مواقف أثناء القيادة*

	***أجب على الأسئلة التالية بوضع علامة ☑ حسب المؤشرات التالية:** **1- دائمًا 2- غالباً أو أغلب الأحيان 3- بعض الأحيان 4- نادراً(قليلاً) 5- أبداً** **(لتعكس اجاباتك الحقائق (وليست آراء) أي ماتقوم بفعله وليس حسب رأيك)** مع مراعاة الإجابة على الأسئلة رقم 15A – 16A – 37A في المكان المخصص لها*	1 دائماً	2 غالباً	3 بعض الأحيان	4 نادراً	5 أبداً
14	هل تكون مستعجلاً أثناء قيادتك للمركبة ؟					
15	هل تتجاوز السرعة في المناطق السكنية؟					
15A	إذا كنت تتجاوز السرعة **في المناطق السكنية** فكم مقدار تجاوزك **فوق** السرعة القانونية ؟ 10 -20 ☐ 20 -30 ☐ 30-40 ☐ أكثر من 40 كم/ساعة ☐					
16	هل تتجاوز السرعة في الطرق السريعة؟					
16A	إذا كنت تتجاوز السرعة **في الطرق السريعة** فكم هي سرعتك؟ 120 -130☐ 130-140☐ 140- 150 ☐ 150-160☐ أكثر من 160كم/ساعة ☐					
17	هل تزيد سرعتك ثم تضغط على الفرامل (البريك) بشكل مفاجأ أثناء قيادتك للمركبة ؟					
18	هل تجد أن المسافة المطلوبة لايقاف المركبة هي أطول من توقعاتك؟					
19	هل تقلل السرعة قبل كاميرات ضبط السرعة ثم تسرع بعد تجاوز الكاميرا ؟					
20	هل تتجاوز أو تبدل بالحارات من اليمين إلى اليسار أو العكس بصورة متكررة؟					
21	هل تقوم بالالتفاف أو تغيير الحارات دون استخدام اشارات اليمين أواليسار؟					
22	هل تتأكد من المنطقة العمياء (المنطقة التي لا يمكن رؤيتها من خلال المرايا الجانبية) قبل التجاوز من حارة إلى أخرى ؟					
23	هل تقترب بشدة من المركبة التي أمامك أثناء القيادة ؟					

يتبع

		1	2	3	4	5
		دائماً	غالباً	بعض الأحيان	نادراً	أبداً
24	هل تسرع عندما ترى أن الاشارة الضوئية لونها أصفر حيث إنك تظن أن باستطاعتك عبور الاشارة قبل تحولها للون الأحمر؟					
25	هل تتجاوز الاشارة الحمراء(خصوصاً في بداية تحولها من اللون الأصفر إلى اللون الأحمر) حيث تعتقد أن الطريق آمن ؟					
26	هل تتجاوز المركبة التي أمامك لتتخطى الاشارة الضوئية قبل تحولها للون الأحمر؟					
27	هل تقوم بالإستدارة (فوق تحت- ⋂) عند فتحه الإستدارة في حاله وجود سيارة قريبة قادمة من الطريق الرئيسي ؟					
28	هل تقف عند لوحة (قف) لإعطاء حق أولوية الطريق لغيرك؟					
29	هل تعطي حق أولوية المرور للمركبات القادمة من اليسار في الدوار ؟					
30	هل تدخل من طريق فرعي إلى طريق رئيسي دون إعطاء أولوية المرور لمركبات الطريق الرئيسي؟					
31	هل تقف عند حارة عبور المشاة للسماح لهم بالعبور ؟					
32	هل تستخدم البوق(هرن) أو تظهر غضبك لتصرف لا يعجبك من سائق آخر أو أحد المشاه في الطريق؟					
33	هل تقود السيارة وأنت تستخدم الهاتف النقال؟					
34	هل تسهوا وأنت تقود السيارة (بسبب الموسيقى العالية – جدال مع ركاب آخرين- أخرى)؟					
35	هل تتفاجأ بأنك تقود السيارة بسرعة أكثر مما كنت تتوقع؟					
36	هل تقوم بالتجاوز المفاجأ في آخر لحظة أثناء قيادتك للسيارة للوصول إلى المخرج الذي تريده؟					
37	هل تستخدم حزام الأمان ؟					
37A	ما هو سبب عدم ارتدائك لحزام الامان؟ اعتقد إنه غير ضروري ☐ النسيان ☐ بسبب الملابس ☐ يضايقني ☐ غيرها: حدد					
38	هل تصعد فوق الرصيف لتغيير اتجاهك عندما ترى أن الاتجاه الذي تريده مزدحم؟					
39	هل توقف سيارتك عند منطقة ممنوع الوقوف أو عند الأرصفة الصفراء والسوداء؟					
40	هل تقترب من المركبة التي أمامك وتفتح أضواء السيارة على الضوء العالي كي يفسح لك الطريق؟					

يتبع

* *الجزء السادس - الآراء*

	أجب على الأسئلة التالية بوضع علامة ☑ حسب المؤشرات التالية:** **1- أوافق بشدة 2- أوافق 3- غير متأكد 4- لا أوافق 5- لا أوافق بشدة** ***(ولتعكس إجابتك رأيك الواضح والصريح)،مع مراعاة الإجابة على سؤال رقم 43A في المكان المخصص	1 **أوافق بشدة**	2 **أوافق**	3 **غير متأكد**	4 **لا أوافق**	5 **لا أوافق بشدة**
41	شبكة الطرق في الكويت تحتاج إلى تطوير.					
42	هناك بعض المواقع الخطرة في الطرق أو عند التقاطعات تحتاج إلى تغيير أو اصلاح.					
43	من المهم أن توفر الدولة ممرات أو اشارات لعبور المشاة.					
43A	هل سوف تمشي في الأماكن المخصصة لعبور المشاة إذا تم توفيرها؟ نعم ☐ لا ☐ إذا كانت الإجابة - لا- فلماذا ؟..	[redacted]				
44	المطّبات مهمة لتخفيف سرعة المركبات .					
45	تطوير نظام مخالفات المرور في الكويت (تطبيق القوانين بحزم أكثر) سوف يقلل من حوادث المرور.					
46	زيادة رسوم المخالفات سوف تقلل من مخالفة السائقين للقوانين المرورية.					
47	تواجد دوريات المرور في الطرق سوف يقلل من إرتكاب المخالفات.					
48	مخالفات السرعة عن طريق كاميرات ضبط السرعة سوف تقلل من مخالفات السرعة.					
49	الكاميرات الضابطة عند الاشارات الضوئية سوف تقلل من تجاوز الإشارة الحمراء.					
50	رفع العمر المسموح به للحصول على رخصة قيادة من 18 إلى 20 سنة .					
51	هناك برامج توعية مرورية كافية في الكويت سواء في المدارس أو في الإعلام العام.					
52	ضرورة وجود مواد تدرس في المدرسة عن السلامة المرورية في الطريق.					
53	من الضروري لكل سائق الحصول على تدريب قيادة عملي جيد على يد معلم متخصص في قيادة المركبات.					
54	ضرورة تطوير اختبار القيادة النظري والعملي.					
55	عمل اختبار قيادة ثاني لسائقي المركبات الذين تسببوا بحوادث مرورية جسيمة في أول سنتين من حصولهم على رخصة القيادة .					
56	سحب رخصة القيادة لفترة مؤقتة (حرمان مؤقت) للسائق الذي يرتكب عدة مخالفات خطيرة في السنة.					
57	نظام تطبيق المخالفات المرورية في الكويت فعّال.					

يتبع

هل تود إضافة أي اقتراحات فيما يخص السلامة المرورية أو غيرها؟

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Appendix E

The information presented in tabular form below represents a break-down of how driving training and testing scores were attributed in the study. The assessments were divided into three categories: Driving training, Driving information and Driving testing. Each category was assigned a maximum of 100 points, based on the TRL assessment that has been employed in Saudi Arabia and Bahrain. For my assessment in Kuwait, I divided the TRL maximum scores in the left-hand column into scores reflecting my view of the conditions pertaining: very poor, poor, fair, good or very good. Thus, in the case of category one, subsection (b) ('Distinctive plates for learners and new drivers'), the maximum TRL score attributable is 8, which leads to a grading distribution of 0 (very poor), 2 (poor), 4 (fair), 6 (good) and 8 (very good). The highlighted cells indicate the actual scores attributed. In the case of this subsection, Distinctive plates for learners are available for learners and new drivers but may not be used for unofficial trainee.

A look at category (ii), subsection (b) shows a TRL maximum of 10. This leads to an even grading distribution of 0 (very poor), 2.5 (poor), 5 (fair), 7.5 (good) and 10 (very good). All other subsections have their scores evenly attributed in the same way.

Driving training evaluation form:

	Max Score	Very poor	Poor	Fair	Good	Very good
(i) Trainee and new drivers clearly identifiable and restricted						
(a) Provisional licence only awarded after a knowledge test	**4**	0	1	2	3	4
(b) Distinctive plates for learners and new drivers	**8**	0	2	4	6	8
(c) Speed restrictions for learners and new drivers	**8**	0	2	4	6	8
(ii) Driving schools provide good training for instructors						
(a) Driving instructors trained, tested, approved and monitored	**25**	0	6.25	12.5	18.75	25
(b) Instructor tests assess teaching ability	**10**	0	2.5	5	7.5	10

(c) Instructor's manual setting out syllabus and methods	**15**	0	3.75	7.5	11.25	15
(iii)Tuition given in real traffic conditions						
(a) Early tuition on quiet roads	**6**	0	1.5	3	4.5	6
(b) Later tuition includes rural, night driving, overtaking, parking and emergency actions	**12**	0	3	6	9	12
(c) Advanced course available with bonus schemes	**10**	0	2.5	5	7.5	10
(d) Observed good driver behaviour	**9**	0	2.25	4.5	6.75	9

Driving information evaluation form:

	Max Score	Very poor	Poor	Fair	Good	Very good
(i) Information available on driving rules procedures and law						
(a) Highway code	**48**	0	12	24	36	48
(b) Driving Manual	**24**	0	6	12	18	24
(c) Leaflets on key topics	**8**	0	2	4	6	8
(ii) Information available on driving test and licence procedures						
(a) Leaflets available	**20**	0	5	10	15	20

Driving testing evaluation form:

	Max Score	Very poor	Poor	Fair	Good	Very good
(i) Driving test examines all key areas related to road safety						
(a) Physical/medical fitness Assessed	**8**	0	2	4	6	8
(b) Knowledge of highway code assessed	**8**	0	2	4	6	8
(c) Control skills assessed on/off road	**8**	0	2	4	6	8

(d) Procedural advanced skill assessed on road	**16**	0	4	8	12	16
(ii) Driving test is conducted in uniform and objective way						
(a) Examiners tested, trained and monitored	**12**	0	3	6	9	12
(b) Examiners use form to record faults	**9**	0	2.25	4.5	6.75	9
(c) On-road routes standardized to include key manoeuvres and hazard	**9**	0	2.25	4.5	6.75	9
(iii) More rigorous tests for professional drivers						
(a) On-road tests longer than for car drivers	**4**	0	1	2	3	4
(b) On-road tests use appropriate class of vehicle	**10**	0	2.5	5	7.5	10
(c) Knowledge test includes extra items appropriate to Profession	**6**	0	1.5	3	4.5	6
(iv) Feedback given to failed drivers						
(a) Written statement of reasons for failure	**10**	0	2.5	5	7.5	10

Appendix F

The table below shows the driver evaluation form issued by the Ministry of the Interior for the purposes of procedures before a driver is granted a licence. It should be borne in mind that drivers are not evaluated or tested in practice on most of these items. For example, number 7 is not tested, because there are no pedestrians; there is no other traffic nearby and no way to control for speed within the confines of the test circuit.

Practical	Theoretical
1- Correctly turning on and off the engine and seatbelt usage	1- Basic traffic signs
2- Using the mirrors and indicators before moving off	2-Traffic laws
3- Performing hill starts	3- Car mechanics
4- Reverse parking and negotiating a narrow stretch of road	
5- Reversing in a straight lane	
6- Stopping in a correct manner at traffic lights	
7- Obeying traffic signs and respecting pedestrians	
8- Correct estimation of stopping distances and keeping in lane	
9- Controlled manoeuvring and respecting priorities at junctions	
10- General priority of way	
11- Entering in a correct from major to minor roads and vice versa	
12- The correct position while driving on public roads	
13- Reaction time in emergency situations; obeying the speed limits	

Professionals that are exempt from rules concerning low income or recently arrived non-Kuwaiti applicants for driving licences

1-Drivers working for government organisations
2- Drivers working for private households
3-Consultants, judges, legal experts, and lawyers
4- Medical doctors or pharmacists
5- Faculty members
6- Teachers, teaching assistants and social workers
7- Engineers and assistant engineers
8- Non-Kuwaiti wives of Kuwaiti
9- Non-Kuwaiti divorcees (ex-wives of Kuwaitis)
10- Non-Kuwaiti husbands of Kuwaitis
11- Imams (Mosque leaders) and Muezzin (those who call to prayer)
12 Government librarians
13 Nurses, ambulance attendants and radiologists
14- Journalists and reporters
15- Managers and accountants
16 - Coaches and athletes
17- Pilots and air stewards
18- Housemaids
19- Students
20- Business representatives
21 Undertakers

Appendix G

The UK

Practical	Theoretical
1. Take the necessary precautions before getting in or out of the vehicle.	1- Alertness
2. Before starting the engine, carry out safety checks on doors, seats and head restraints, seat belts and mirrors.	2-Attitude
3. Start the engine and move off.	3-Safety and your vehicle
4. Select the correct road position for normal driving.	4- Safety margins
5. Use proper observation in all traffic conditions.	5- Hazard awareness
6. Drive at speed suitable for road and traffic conditions.	6- Vulnerable road users
7. Change gear promptly to all risks.	7- Other types of vehicle
8. Change traffic lanes.	8- Vehicle handling
9. Pass stationary vehicles.	9- Motorway rules
10. Meet, overtake and cross the path of other vehicles.	10- Rules of the road
11. Turn right and left at junctions, including crossroads and roundabouts.	11- Road and traffic signs
12. Drive ahead at crossroads and roundabouts.	12- Documents
13. Keep a safe separation distance when following other traffic.	13- Accidents
14. Act correctly at pedestrian crossings.	14- Vehicle loading
15. Show proper regard for the safety of other road users with particular care towards the most vulnerable.	
16. Drive on both urban and rural roads, and where possible on dual carriageways, keeping up with the flow of the traffic where it is safe and proper to do so.	
17. Comply with traffic regulations and traffic signals given by the police, traffic wardens and other road users.	
18. Stop the vehicle safely, normally and in an emergency, without locking the wheels.	
19. Turn the vehicle in the road to face the opposite way using the forward and reverse gears.	
20. Reverse the vehicle into a side road keeping reasonably close to the kerb.	

21. Parallel parking while driving in a reverse gear.	
22. Park the vehicle in a multi-storey car park or other parking bay, on the level, uphill and downhill, both in forward and reverse directions.	
23. Cross all types of railway crossings	

Finland

Practical	Theoretical
1-Handling of the vehicle	1. The basics of driver education
2-Control of the traffic situation	2. Fundamental conditions for safe driving
3-Consideration of pedestrians, bicyclists, moped riders etc	3. Traffic accidents and risks for the driver
4-Flexibility and methodical course of action	4. Vehicles and risks, economical ways of driving, vehicle maintenance
5-Ability to detect and avoid risks	5. Special qualities of other road users, comprehending signals
6-Economical ways of driving	6. Acting under difficult or exceptional conditions, traffic insurance, pollution
	7. Dangers to the environment and other road users
	8. Actions in case of an accident
	9. Road signs
	10. To plan a driving route

Germany:

Practical	Theoretical
1. Starting and moving off	1. Traffic regulations regarding signs
2. Driving on roads with heavy traffic	2. The human factor, driver responsibilities, such as the importance of respectful and considerate behaviour towards other road users, the effects of alcohol, drugs and tiredness
3. Driving on a one-way street with the possibility of turning left	3. Fundamental aspects regarding the appropriate distance between vehicles, braking distance and vehicle stability under different road conditions
4. Driving and changing lanes	4. Risk factors associated with different road conditions with special regard to changes in weather at different occasions
5. Driving on roads with two lanes or more in each direction	5. The special risks associated with lack of experience regarding vulnerable road users like children, pedestrians, cyclists, etc.
6. Driving at or stopping pedestrian crossings	6. Common and special regulations regarding documents related to the use of a vehicle, primary actions at the scene of a traffic accident, issues of safety regarding load and passengers, car inspection and vehicle insurance
7. Driving past stops for public means of transport	7. Factors regarding the safety of the driver, passengers and other
8. Give right of way at, junction	
9. Drive onto roads with priority rules	
10. Obeying stop signs at Junction	
11. “traffic lights”	
12. Left turn on roadways with oncoming traffic	
13. Right or left turn with special consideration for cyclists in a parallel lane	
14. Driving past crossings with bending right of way	
15. Driving outside of a built-up area on roads with bends	
16. Driving outside of a built-up area with	

the possibility of overtaking	
17. Basic driving tasks outside of the traffic flow	
18. Driving on the Autobahn	

USA (Virginia)

Practical	Theoretical
1- Left turns.	1-traffic signs
2-Right turns.	2-motor vehicle laws
3- Intersections that involve stopping and then driving straight through.	3-safe driving techniques
4- Intersections that involve driving straight through without stopping.	4-general knowledge
5- Lane changes required.	
6- Curves.	
7- Railroad crossings	
8- Turning a fan (or radio) on and off while driving.	

Japan

Practical	Theoretical
1- Adjusting the seat belt and fastening the seat belt.	1 traffic signal
2- Looking in the mirrors, checking over the shoulder for blind spots and using the indicator before turning right or left and changing lane.	2 traffic regulation
3- Stopping with the front bumper behind the line at a traffic light or stop sign (stopping beyond the line or too soon is considered a failure).	
4- Not hitting the curb when turning into a narrow street or on an S-bend. This is also considered a failure.	

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