

Characteristics of road traffic injuries and potential risk factors in Oman

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A thesis submitted for the degree of
Bachelor of Medical Science with Honours
at the University of Otago, Dunedin
New Zealand

January 2013

Abstract

Background:

Globally, road traffic injuries have increased by almost 46% in the twenty years prior to 2010. This makes road traffic crashes (RTC) the tenth leading cause of death in the world and the leading cause of death of young people. Oman, a wealthy country where motorising is increasing rapidly, has a very high road traffic mortality. In Oman, road traffic deaths and injuries are the main external cause of morbidity in young adults and have a direct effect on the economic and health resources of the country. Road traffic crash research has only recently begun in Oman. The modifiable causes of this problem and most effective response have not yet been well-explored.

Aims:

The main aims of the research described in this thesis were:

- To describe the distribution of road traffic crashes in Oman by time, person and place using the data collected by the Royal Oman Police and examine their assessment of reasons for crashes, from 1985-2010.
- To collect data in order to estimate the prevalence and distribution of known risk factors in road traffic crashes in Oman, focusing specifically on Sohar.

Methods:

Two studies were conducted to achieve the aims of this thesis. Firstly, a retrospective case series used the Royal Oman Police data from 1985-2010. This examined trends in the police data on road traffic crashes across the whole time period and then summarised the most recent available year of data (2010) in more detail.

Secondly, a prospective case series of injured drivers admitted to Sohar Hospital Emergency Department was carried out. Between 20 February 2012 and 20 March 2012, consecutive injured drivers admitted to Sohar Emergency Department were recruited to the study. Questionnaire-based face-to-face interviews were held to collect data on

socio-demographics, circumstances of the crash, and known risk factors for road traffic injuries, including risk behaviours at the time of the crash and usual behaviours.

All admitted injured drivers were recruited apart from the most seriously injured drivers who were taken by ambulance to the capital city Muscat for further investigations, and those who died from their injuries.

Results:

According to Royal Oman Police data (1985-2010), total deaths and injuries from RTCs have increased by almost 300% in Oman since 1985. An element of speeding was reported for all the crashes since 1992. The victims of road traffic crashes were mostly the young age group (21-30 years). More drivers have been killed than any other road user group, constituting 43.8% of total road traffic deaths, and passengers have been the most injured, constituting 48.2% of total road traffic injuries.

In the Sohar study, 250 injured drivers, 75% males and 25% females, were interviewed with a 100% response rate. Interviewed injured drivers were found to have spent long hours on the roads and had driven for long distances. Overall, less than 5% of injured drivers were over the age of 35 years. There was a marked difference in the age distribution of male and female injured drivers. Among men almost half (49.5%) of the injured drivers were 18-25 years old and 45.7% were 25-35. Among women, 95% of injured drivers were 25-35 years old. Generally, male drivers had more traffic violations than female drivers with 83% of males reporting at least three traffic violations over the past five years, whereas almost half of the females reported one or no, traffic violation over the same period. The highest frequency of crashes occurred on Saturdays and Thursdays (18.8% and 17.6% respectively) and the majority of the injured drivers were either familiar or very familiar with the roads on which they crashed.

It was clear that the injured drivers in Sohar routinely ignored the traffic laws and reported risky driving behaviours. For instance, less than 10% of injured male drivers and only 56% of female drivers were wearing their seatbelts at the time of the crash. Also, a high proportion of both male and female drivers were travelling at a speed of 100-140 km/hour at the time of their crash (65.4% male and 58% female drivers). Moreover, 31.4% of injured male drivers and 24% of injured female drivers were using their cell phones at the time of their

crash. When describing their usual driving behaviour, 52.8% of all interviewed drivers reported that they never or almost never wear seatbelts while driving.

Conclusions:

Overall, the incidence of road traffic crash injuries and deaths is high and increasing in Oman with a high prevalence of known risk factors for road traffic injuries even where protective legislation exists. Even though this case series cannot establish that these risk factors cause road traffic injuries in this population, experience from other countries suggests that appropriate legislation and increased enforcement could reduce road traffic injuries in Oman.

Acknowledgements

I would like to thank my supervisor Professor Jennie Connor from the Department of Preventive and Social Medicine for her invaluable support, guidance, time and comments throughout the period of the thesis.

I would also like to thank my co-supervisor in Oman, associate Professor Abdullah Al-Maniri for his help while collecting the data in Oman.

Sincere gratitude must also go to the staff at the Department of Preventive and Social Medicine for welcoming me and helping me with the technical issues.

I wish to thank all the people in Oman who made my project successful: the Scholarships Committee at the Ministry of Higher Education and the Ministry of Health Committee for approving my project; the research training centre and all the staff of Sohar Hospital in Oman.

Lastly, I would like to thank my family and friends for their support while in Oman.

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List of abbreviations

RTC	Road Traffic Crashes
WHO	World Health Organization
GNP	Gross National Product
EMR	Eastern Mediterranean Region
GCC	Gulf Corporation Council
UAE	United Arab Emirates
GDT	General Directorate of Traffic
EMS	Emergency Medicine Services
ROP	Royal Oman Police
MOH	Ministry of Health
ED	Emergency Department
USA	United States of America
VKT	Vehicle Kilometres Travelled
UK	United Kingdom
BAC	Blood Alcohol Concentration

Chapter One: Introduction and literature review

1.1. Introduction

The extensive growth in the global economy in the last century has changed many aspects of people's lives including their use of various means of transportation. Transportation has become a significant part of the physical and economic development of societies all over the world. The relationship between the expansion in road networks and economic development is well-established [1]. Continuous expansion in road network construction has accompanied a rapid increase in the population, with a corresponding increase in vehicle numbers [2]. The growth in motor vehicles that follows economic growth usually results in an increase in RTC and consequent injuries and deaths [3]. As a consequence, road traffic injuries have become a major public health problem globally with a large increase in the number of casualties and fatalities [2].

1.2. Road traffic crash injuries as a global health problem:

The all-cause mortality rates show a reduction with countries' development. However, RTC death rates are an exception with higher death rates expected along with economic development [3]. Globally, road traffic crashes are a major cause of death and disability. Annually, about 1.2 million people are being killed in RTCs. The WHO estimated the global mortality rate due to RTCs to be 19 per 100,000 population in the year 2002 and 19.5 per 100,000 population in 2010 [2, 4]. Moreover, for each fatality resulting from a road traffic crash there are numbers of serious injuries, which may lead to permanent disability. The Global Burden of Disease project in 2000 estimated that around 20 to 50 million people are being injured or disabled each year [5]. Furthermore, if no interventions were implemented to decrease road traffic crashes, the fatalities and injuries due to RTCs are expected to increase by about 65% by 2020 compared to 2000 [5]. According to WHO data, road traffic crashes caused about 25% of all deaths from injury worldwide in 2004 [6]. RTCs were ranked as the eleventh leading cause of deaths and the ninth leading cause of disability-adjusted life

years lost in 2002. By 2020, RTCs are expected to rise to become the sixth leading cause of death internationally. Most of the increase is in low-income and middle-income countries, where RTC-related deaths are expected to increase by over 80% on average. [7, 5, 2].

A disproportionate number of RTC-related deaths and disabilities are occurring in developing countries [7]. The low and middle-income countries account for approximately 85% of all global annual road traffic crash fatalities and 90% of the disability-adjusted life years lost due to road traffic crashes [2]. According to Vinand, the fatality rate for children aged 0-14 in low income countries (per 100,000 population) was six times higher than that of children of the same age in high income countries in 1998 [7]. The main victims of road traffic crashes are young adults. More than 50% of all deaths due to RTCs are among young adults within the age range of 15-44 years [8]. In addition, according to the Global Burden of Disease project published in 2012, RTCs are now ranked as the eighth leading cause of death globally [9, 10]. The year 2010 witnessed one million more deaths from injuries than 1990; this 24% rise was attributed to the increase in RTCs by almost 420,600 crashes claiming the lives of 1.3 million people [9, 10].

Road traffic crashes have a substantial impact on the social and economic welfare of nations. In 2002, RTC-related deaths and injuries cost the global community about US\$518 billion [11]. It is estimated that the costs of road traffic crashes account, roughly, for 1% of gross national product (GNP) in low-income countries, 1.5% in middle-income countries and 2% in high-income countries [12]. Such amounts are overwhelming for the economies of low-income and middle income countries and place a major financial burden on their developmental assets [12].

Road traffic crashes are one of the leading causes for sustaining short and long term psychiatric consequences such as post traumatic stress disorder, anxiety disorders and depression [13]. Findings have shown that adolescents and children who survived road traffic crashes continue to suffer from the aforementioned behavioural problems [14, 15]. These problems have been shown to influence certain aspects of victims' quality of life. Individuals' employment, physical health and social well-being are among the most affected areas in RTC survivors [16].

1.3. Aims and methods of the literature review

Aims

- Find and summarise the existing literature on road traffic crashes in Oman and surrounding region.
- Describe the setting for RTC research in Oman.
- Summarise the most recent RTC data available.
- Describe important behavioural risk factors for RTC, from international literature.

Methods

A literature review has to be approached systematically in order to avoid missing essential papers and creating information biases. A systematic approach also helps to avoid invalid or/and insignificant information. For my literature review on the characteristics of road traffic crashes and potential risk factors I started by reading the most recent review articles to inform the choice of keywords.

References: references from review articles were used to identify main keywords and learn more about this topic.

Keywords: the initial keywords list included: “traffic accidents”, “traffic crashes”, “road traffic accidents”, “epidemiology”, “characteristics”, “road traffic injuries”, “public health”, “developing countries”, “GCC countries”, “Eastern Mediterranean Region”, “mortality”, “fatality”, “morbidity”, “disability”, “economy”, “seatbelts”, “cell phones”, “alcohol and driving”, “child safety”, “risk factors”, “fatigue”, “sleep”, “injury severity”, “motorways”.

Sources: searching was performed using the Medline database (Ovid), and Google Scholar search engine.

1.4. Road traffic crashes in the Eastern Mediterranean Region (EMR)

The Eastern Mediterranean Region (EMR) is composed of 22 low-income and middle-income countries. It has a developing region demographic profile (with a GNP of less than US\$ 1700 per capita) and covers 546 million people constituting 8.3% of the world's population [17]. In general, injury prevention has not been a high priority within the region. One of the major challenges to the region is the constantly increasing incidence of road traffic crashes [18]. In 2004, RTCs were the sixth leading cause of death in the region, resulting in 146,000 deaths and 2.8 million injuries. This is higher than the number of deaths caused by diseases such as tuberculosis, malaria and HIV [17].

Wahid stated that the Eastern Mediterranean Region has one of the world's highest traffic fatality rates, mostly due to a lack of adequate pre-hospital medical emergency systems [19]. He also reported that the region has the world's highest fatality rate among those aged 15-29 years with a calculated rate of 34.2 deaths per 100,000 population. This is costing the region an estimated US \$7.4 billion annually. Records show that around 40 million people in the EMR with road traffic-related disabilities do not have access to acceptable rehabilitation services and social integration programs [19].

Many countries in the Eastern Mediterranean region lack simple measures to reduce road traffic injuries. Of the 22 countries in the region, only 40% set a speed limit on the roads in urban areas [17]. A lack of government policies (or even public campaigns) that promote cycling, walking and investing in public transport was observed in more than 90% of the countries in the region. Drink driving is a potent contributor to RTCs, yet no measurements to detect alcohol level are implemented in the majority of the countries. In most of the countries, there are no laws enforcing the use of child restraints, making children the most vulnerable vehicle occupants in an accident. There are opportunities for promotion of walking and cycling, establishing regulations for road safety and enforcing them, measuring alcohol levels on roads and many other health promotions that have been used in other parts of the world to reduce road traffic injuries in the region [17].

1.5. Road traffic crashes in the Gulf Cooperation Council (GCC) countries

The GCC countries, part of the Eastern Mediterranean Region, are located in the Arabian Peninsula, in the south-western region of the Asian continent. They consist of 6 countries namely The Kingdom of Saudi Arabia, The Sultanate of Oman, United Arab Emirates, Kuwait, Qatar and Bahrain. Jordan and Morocco have been invited to join the Council this year. Oil discovery around the middle of the last century has significantly reformed many aspects of life in the Gulf Countries. There was an explosion in immigration with a parallel surge in the number of registered vehicles [20].

Road traffic crashes are recognized as a major cause of mortality and morbidity in the GCC countries and many developing countries. The large number of traffic crashes has caused these countries a substantial wastage of life and national resources [21]. The extent of the problem will be discussed briefly for each country.

Table 1: The Profile of the GCC countries:

Country	Area (km ²)	Percentage of total GCC area (%)	Population
The Kingdom of Saudi Arabia	2,000,000	82.54	27,448,086
The Sultanate of Oman	309,500	12.77	2,782,435
United Arab Emirates	83,600	3.45	7,511,690
Kuwait	17,818	0.74	2,736,732
Qatar	11,427	0.47	1,758,793
Bahrain	707	0.03	1,261,835
Total	2,423,052	100	43,499,571

Note: Data obtained from World Bank (2011 data) [22].

1.5.1. In United Arab Emirates

Ever since its independence in 1971, the UAE has experienced a dramatic growth in its national economy, specifically in terms of per capita income. In addition, a substantial amount of money was invested in road construction programs which led to the development of sophisticated road networks linking the corners of the country. These particular developments have attracted many individuals to reside and to seek jobs in different cities of the UAE which resulted in it having the second largest population within the GCC countries, after Saudi Arabia, by the year 2010 [21]. This rapid economic growth along with the considerable increase in the number of vehicles registered has led to a parallel increase in road traffic crashes and resulting casualties, causing it to be a serious public health problem for the country. Road traffic injuries are second major cause of death in UAE [23]. In 2005, the road death toll's average was one road accident death every 15 hours, amongst the highest in the world [24, 25]. The Ministry of Interior's traffic department reported 6,700 crashes, 7,808 injuries and 720 deaths in 2011 [26].

1.5.2. In The Kingdom Of Saudi Arabia

Road traffic crashes have become a major health hazard in Saudi Arabia. Tarmac road networks increased from 239 km in 1952 to more than 40,000 km at the beginning of the third millennium [27]. There was also an increase in the number of cars from 144,000 cars in the early seventies to almost 2.5 million cars by the end of the second millennium. As a result, there was a tragic increase in the number of road traffic crashes and, subsequently the number of deaths and injuries due to these crashes. According to the Traffic General Directorate of Saudi Arabia, on the average, more than 4,100 people are being killed and 28,000 are being injured as a consequence of nearly 29,000 traffic crashes annually [27].

For example, in 2005 alone, the traffic data showed that the number of RTCs was 283,684 which resulted in 5,883 deaths; half of these victims were under 30 of age. Al-Nammi estimated the annual cost of RTC-related casualties to be, approximately, USD 5.6 billion, a loss of 2.2%-9% of the national income. It has been estimated that in Saudi Arabia, one person is killed and four are injured every hour due to RTCs [28].

1.5.3. In Kuwait

Kuwait is a small country with a total area of 17,818 km² and a total population of 2.7 million. A noticeable surge in the level of motorization occurred between 2000 and 2009 and that was represented by the increase in the number of registered vehicles from 801,555 in 2000 to 1,414,925 in 2009 (a 76.5% increase). This rather abrupt change has contributed to an increase in road traffic crashes. From 2000-2009, there was a 121.3% increase in the number of road traffic crashes jumping from 27,696 in 2000 to 61,298 in 2009. Furthermore, road traffic crashes accounted for 3,891 deaths and 11,591 injuries during the same period. The mean annual RTC-related mortality rate was 36 per 100,000 registered vehicles with a 29% total decrease from 2000 to 2009 [29].

1.5.4. In Qatar

In Qatar, injuries are the leading cause of mortality and morbidity, particularly in the productive age group and in children. In 2000, the road traffic crash fatality rate was 14.7 per 100,000 population compared to a fatality rate of 5.7 per 100,000 population in the UK during the same year. 96.5 % of the fatalities were males [30].

According to the Ministry of Interior's Traffic Department, in 2009, there were 688,029 vehicles on the roads. 5,079 road traffic crashes occurred resulting in 1,914 injured and 224 deaths. In 2010, the number of vehicles increased by 9.7% and the number of traffic violations increased by 32.7% of which 40.2% were caused by running red signals. Despite the increase in traffic violations and vehicles registered, there was an 18% decrease in the number of road traffic crashes in 2010 [31].

1.5.5. In Bahrain

Bahrain, with an area of 707 km², is made up of a number of islands in Arabian Gulf off the coast of Saudi Arabia. The population is just over one million making the population density one of the highest in the world (852 persons per square kilometre in 1995). The highway network is quite modern covering most of the populated parts of the country. The roads cover approximately 3,459 km of which 428 km are multilane highway [32].

According to the General Directorate of Traffic (GDT), the number of registered vehicles was 454,191 in 2010. The GDT's report has shown that the number of road traffic crashes has declined from 522 in 2008 to 484 in 2010. It has also reported a decrease in the fatalities caused by RTCs from 84 in 2008 to 75 in 2010. Despite this decline in the number of RTCs and the resulting casualties and fatalities, the figures are still alarming and significantly affect the public in terms of death, disability and cost [33].

Table 2: Annual incidence of RTC injuries and deaths in Gulf countries, per 100,000 population (Calculated from most recent available data)

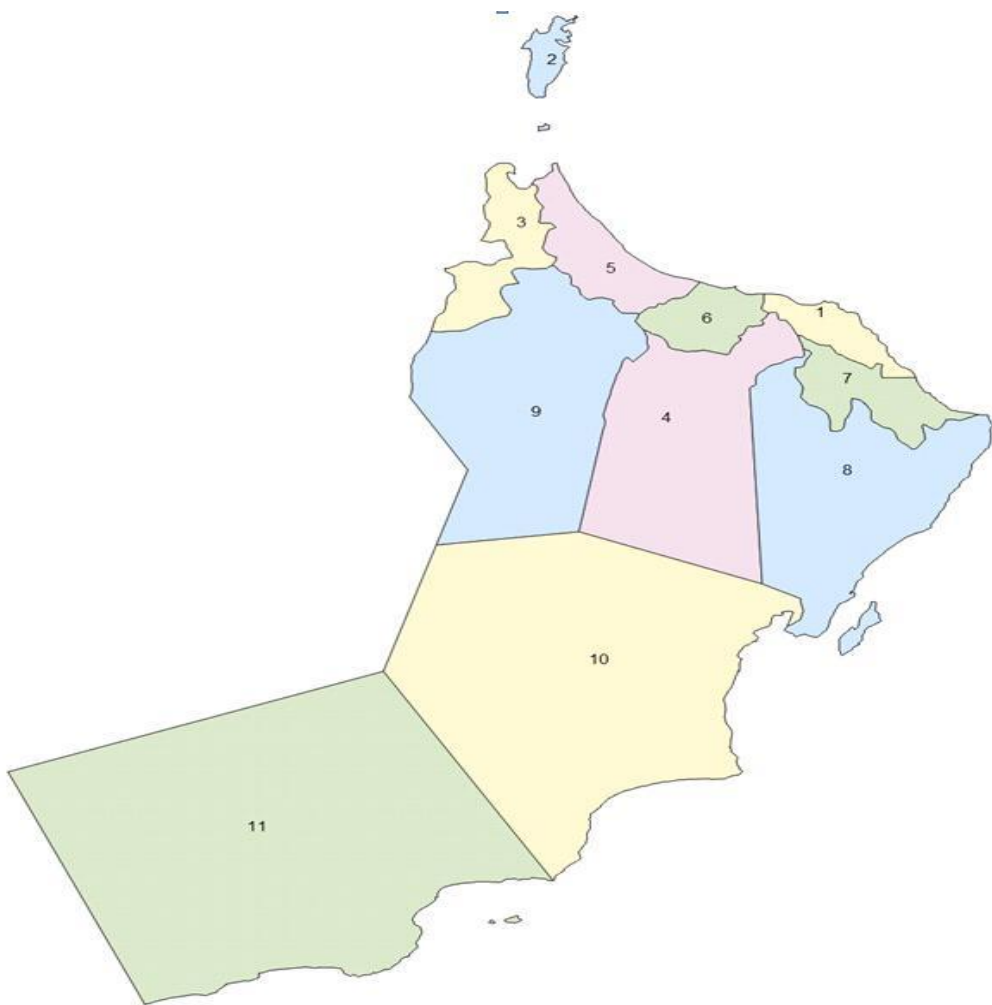
Country	Annual Incidence of RTC Injuries	RTC Mortality Rate	Reference
The Sultanate of Oman	401 (2011)	37 (2011)	-
The Kingdom of Saudi Arabia	146 (2004)	28.6 (2004)	[19]
Qatar	274 (2010)	13.4 (2010)	[34]
UAE	99 (2011)	22 (2007)	[26, 35]
Bahrain	9.0 (2000)	6 (2010)	[2, 31]
Kuwait	19.4 (2009)	11.8 (2009)	[36]

The incidence rate was calculated from published estimates of injury numbers and population in the year indicated. There were no data available by age or sex. It is obvious that Oman has the highest rates of mortality and injury compared with the neighbouring Gulf countries.

1.6. Overview of the Sultanate of Oman

Table 3: Overview of the Sultanate of Oman:

Information	Statistics
Total Area of the Sultanate of Oman	309,500 km2
Total length of Roads	59363 km



Note: Data obtained from Ministry of Tourism, Oman [37].

The Sultanate of Oman is located on the south-eastern corner of the Arabian Peninsula occupying an area of 309,500 km2, the second largest of the GCC countries after Saudi Arabia. It shares borders with the kingdom of Saudi Arabia to the west, the Omani Gulf and Arabian Sea to the east, the United Arab Emirates to the north and the republic of Yemen to

the south [37]. The country is divided into ten governorates as follows (numbered from 1-11 according to the map above):

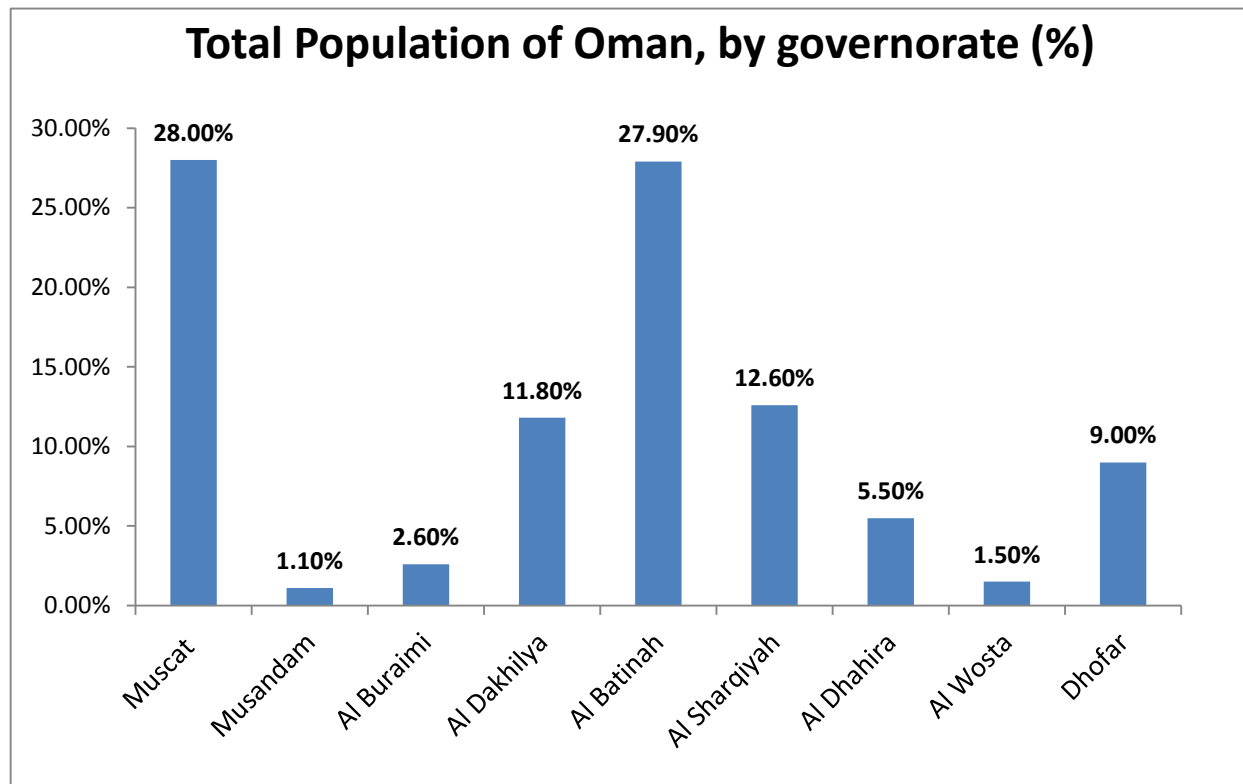
1. Muscat Governorate which contains the capital city Muscat.
2. Musandam Governorate
3. Al Buraimi Governorate
4. Al Dakhilya Governorate
5. Al Batinah north Governorate which contains the prospective study city Sohar.
6. Al Batinah south Governorate
7. Al Sharqiyah north Governorate
8. Al Sharqiya south Governorate
9. Al Dhahira Governorate
10. Al Wosta Governorate
11. Dhofar Governorate

Note: Data obtained from Ministry of Tourism, Oman [37].

According to the latest census which was carried out by the National Center for Statistics and Information, in 2010 Oman had a population of 2.77 million people, a density of 9.0 persons per square kilometre. However, 816,143 residents, nearly 30% of the population were expatriates. Males exceeded females at a ratio of 138 males to every 100 females, compared with 128 males to every 100 females in 2004.

Figure 1 below describes the distribution of the population within the different governorates in Oman. It can be seen that most of the population resides in the governorates of Muscat and Al Batinah. This is markedly different from the 2003 governorates percentages of the total population where most people resided in Al Batinah (31.7%) followed by Muscat (21.4%) [38].

Figure 1: Total Population of Oman by Governorate:



Note: Data obtained from 2010 National Census, National Centre for Statistics.

Oman has been ruled by Sultan Qaboos bin Said Al Said since 23 July 1970; His Majesty also heads the Defence Council, the Financial Affairs and Energy Resources Council and the Supreme Judicial Council [39].

1.6.1. Health care in Oman

There has been a major change in health care provision in Oman in the past four decades. Prior to the establishment of the current government in 1970, the main health care providers were the British Embassy Hospital and a few missionary hospitals in Muscat with no existing national health care system [40]. Providing free health care which is available to the whole population was the main objective for the new government that came into power in 1970 under his Majesty Sultan Qaboos (Sultan of Oman). This government made major investments in improving the health care system which resulted in Oman being the first in the world in regard to the WHO Health System Attainment and Performance Estimates [40]. The Ministry of Health provides free health care to all Omani citizens through multiple

institutions situated throughout the country. These health institutions are divided into extended (primary) health care centres which are situated in villages and small local communities, secondary care hospitals which are located in cities and, finally, tertiary care hospitals mainly in the capital Muscat, but there are a few in major cities within each region (e.g. Sohar). In addition, alongside the Ministry of Health, many government organisations and private institutions provide medical care to their employees.

1.6.2. Emergency care in Oman

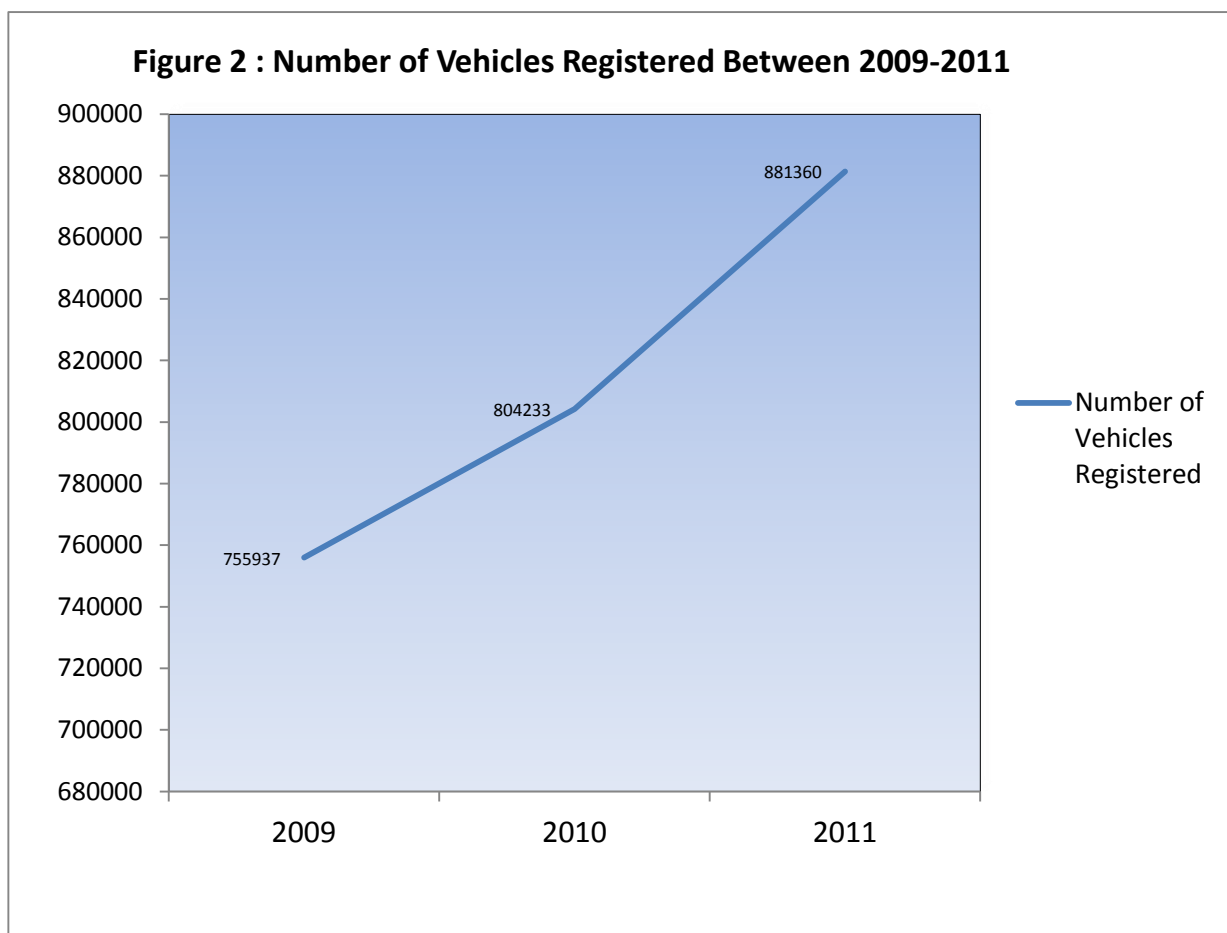
There is a relatively new system of emergency care which follows the Anglo-American system of Emergency Medicine Services (EMS). It is only a land based system and does not include aeromedical services [40]. During 2012, a plan was set in place by the Royal Oman Police for the EMS services to cover the whole country and to incorporate aeromedical services. The EMS currently does not cover all cities and responds mainly to trauma cases with limited coverage of other emergency cases. Under a joint provision from the ROP and the Ministry of Health committee for the development of a modern EMS system, It officially started to provide its services in April 2004, covering approximately 70% of the population with 23 permanent ambulance units. Over a period of four years, the service attended to 5,501 cases of which 83% were trauma cases and the rest were medical emergencies (17%) [40].

1.7. The descriptive epidemiology of road traffic crashes in Oman: a preliminary analysis:

This section is drawn from the traffic statistics report (1971-2009). This was also combined with the online data published by the General Directorate of Traffic in Oman for the following years till 2011. These are the only available sources that collect descriptive data regarding road traffic crashes, injuries and deaths in the country. It summarises the information available on the history of motorization in Oman. It then describes the statistics related to RTCs in Oman up until 2011.

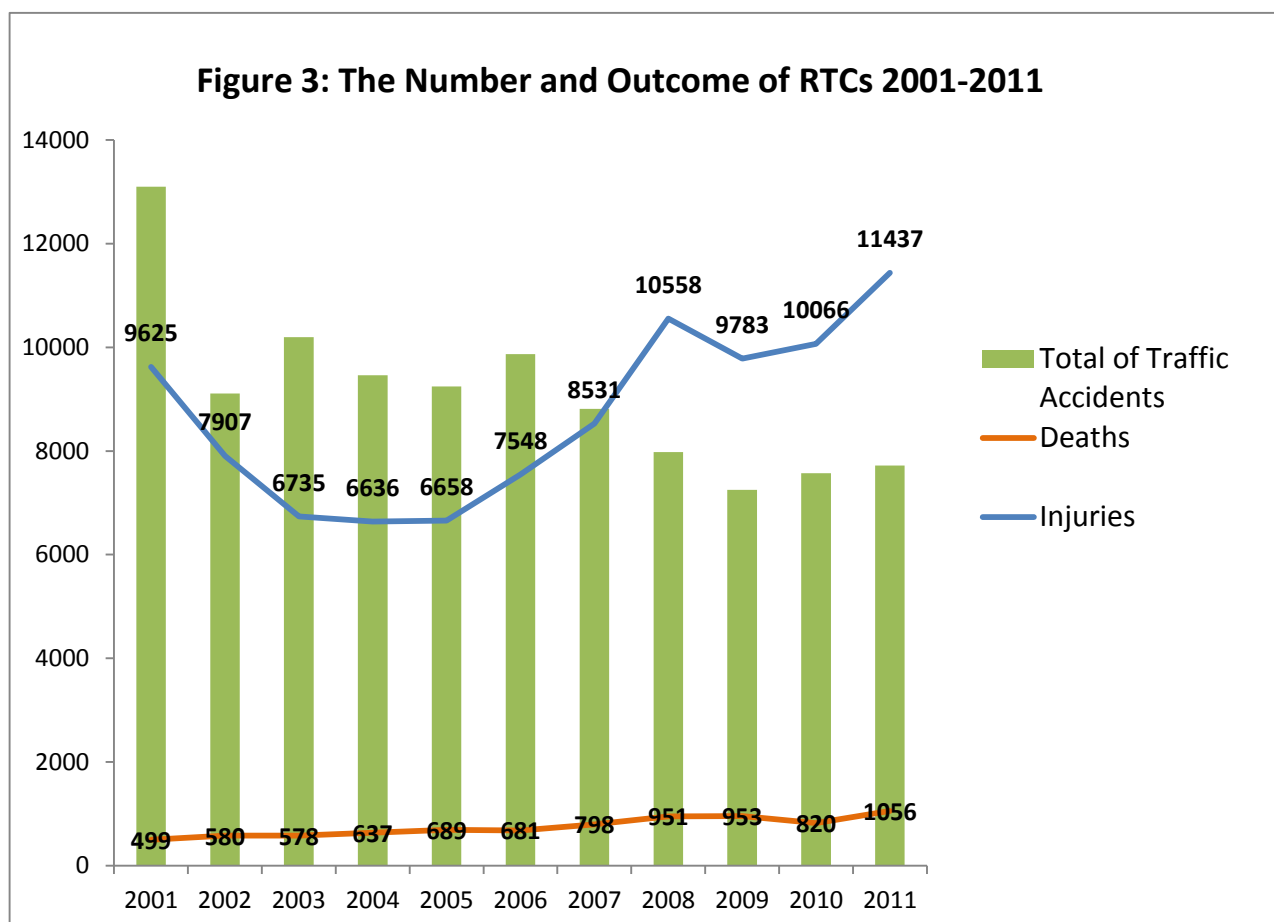
The country's economic, social and international status was substantially improved after 1970. The government started using the main revenue (oil and natural gas) for development, with the first development plan targeting basic needs such as education, health, transportation and telecommunication.

As part of these development plans, the government has invested in the infrastructure of the country including building paved roads and highways. From only 3 km of paved roads in the year 1970, Oman now has more than 30,460 km of paved roads across the entire country [41]. This transformation in road networks, infrastructure and economy has led to an increase in motorization.



Note: Data obtained from the General Directorate of Traffic Department, Oman.

Figure 2 shows the evolution in the number of vehicles registered in the Sultanate of Oman over the past three years. Records indicate that the number of vehicles in 1970 amounted to 1,016 vehicle excluding military or police vehicles [41]. The number of vehicles registered after 40 years, was approximately 804,233 according to the records of the General Department of Traffic in 2010. This number showed a 10% increase in 2011 making the total number of registered vehicles rise to 881,360 [41].

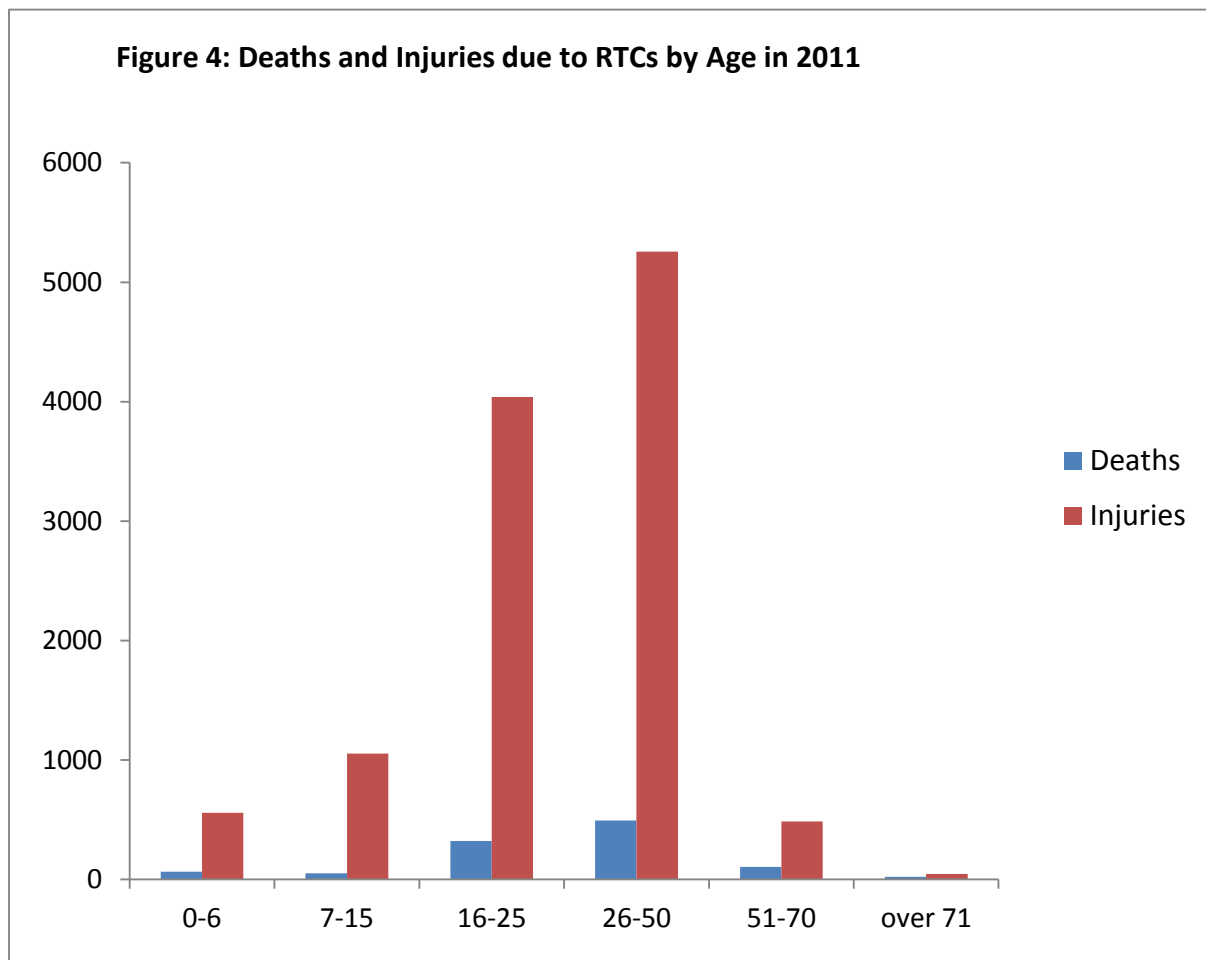


Note: Data obtained from the Directorate of Traffic Department, Oman.

Road traffic crashes are a major community health threat to Oman have attracted political and public attention. Injuries from RTCs have become a burden on the health sector in Oman as it is considered the main external cause of morbidity especially among adults.

[41]. In 2011, more than 7,700 RTCs were reported. There were 1,056 deaths and around 11,000 injuries [41]. Road traffic mortality in Oman was 28 per 100,000 population [41] which is far higher than the global average of 19 per 100,000 [41]. Despite the fact that the overall number of RTCs has declined since 2001, the resulting casualties and fatalities have continued to increase as can be seen from the number of injuries and deaths. Figure 3 shows an increase in RTC deaths and injuries since 2011. Official figures for 'Total Traffic Accidents' show a contradictory flat or decreasing trend over this same period. There are a number of possible explanations for this, including increasing severity of crashes, resulting in more severe injuries. However, it is more likely that this is due to changes in reporting of

traffic crashes, either a reduction in reporting by the public or a service delivery effect from change in the practices of the ROP. No explanation was uncovered.



Note: Data obtained from the Directorate of Traffic Department, Oman.

The main victims of road traffic crashes in Oman are males and they account for approximately 84% of all road deaths. According to ROP 2009 statistics, males represent about 75% of all non-fatal injuries due to RTCs. The distribution of injuries and deaths by age shows that young and middle aged adults are the main groups affected by road traffic injuries in Oman.

Approximately 13% of fatalities and 9.6% of injuries are accounted for by children under 15 years of age. Adults between the ages of 26 and 50 years account for 46.5% and 49.6% of fatalities and injuries respectively [41].

Table 4: RTC mortality by age and sex (1995-2009):

Year	0-6 years		7-15 years		16-25 years		26-50 years		51-70 years		71+ years	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1995	13.4	10.3	16.0	2.5	55.1	7.4	36.1	15.4	50.4	19.0	20.9	13.7
1996	21.5	11.5	10.4	5.4	52.8	8.6	38.8	14.6	50.3	20.0	43.1	21.0
1997	23.1	12.0	14.1	4.9	51.8	12.6	34.8	20.5	47.4	50.6	43.4	0.0
1998	15.3	10.5	17.2	7.3	57.8	8.4	40.6	20.4	57.5	24.9	79.6	7.0
1999	16.4	7.9	13.7	8.9	56.8	9.8	43.8	12.1	50.6	19.3	56.5	13.8
2000	11.0	9.8	7.1	5.3	42.1	9.8	34.1	13.0	43.2	17.5	30.0	6.4
2001	13.8	7.7	12.2	2.5	41.7	4.3	35.4	10.6	37.2	6.1	64.1	0.0
2002	10.9	5.5	9.5	4.4	38.7	9.8	47.3	15.4	28.9	18.9	35.3	12.1
2003	14.1	9.4	12.6	3.7	51.5	9.8	45.1	17.5	45.9	15.7	20.6	5.4
2004	20.6	6.9	13.5	6.8	40.5	5.3	54.8	16.8	45.4	25.9	53.6	8.9
2005	19.8	15.9	17.9	5.4	46.5	10.1	46.4	16.0	48.0	23.5	68.9	0.0
2006	17.6	8.8	10.3	8.9	52.8	9.8	43.6	14.4	49.5	20.6	49.8	17.2
2007	11.8	9.7	11.9	3.8	59.7	10.3	49.5	16.9	47.2	23.0	46.6	8.1
2008	14.0	9.4	12.8	4.7	74.2	12.0	56.7	12.7	43.5	33.9	98.1	15.6
2009	15.8	14.9	11.5	3.6	57.6	13.1	42.7	13.7	51.5	29.8	97.2	7.8
Average change per year	-0.16	0.076	-0.107	-0.007	0.504	0.185	1.065	-0.140	-0.217	0.153	2.86	0.064
P value	0.497	0.664	0.556	0.957	0.381	0.210	0.005	0.428	0.605	0.807	0.043	0.873

Table source: [42]

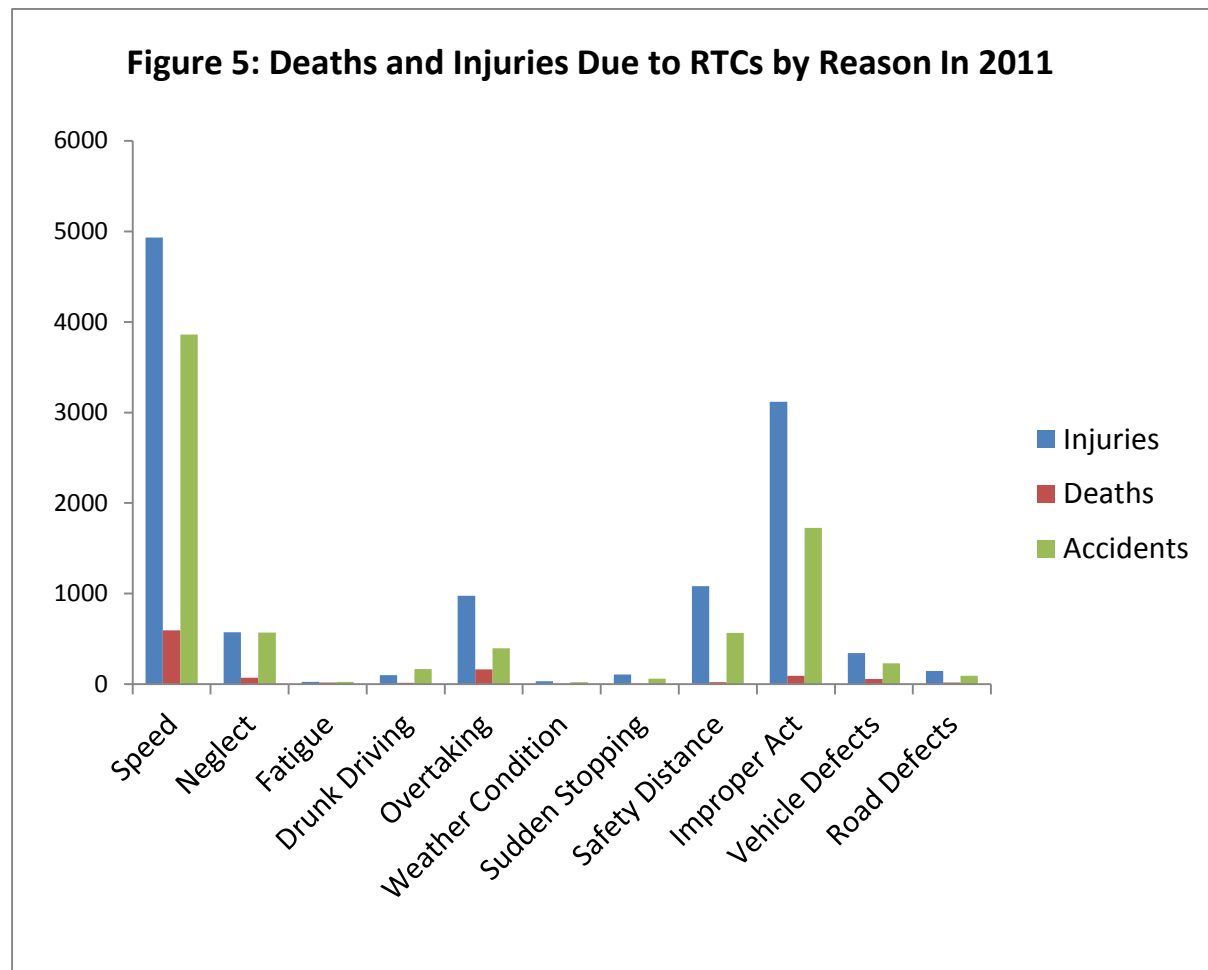
The above table demonstrates the death rate per 100,000 by age and sex from road traffic crashes in Oman, 1995-2009. Rates are much higher among men than women and consistently high among young men.

Information on contributing factors for RTCs is collected by the police at the time of the crash and the main reason for the crash is usually a subjective assessment by the police officer at the crash scene.

Speeding and improper acts¹ were the main contributors to RTCs in Oman according to ROP 2011 statistics. They accounted for 51.6% and 22.6% of all reasons respectively. The total

¹ There is no official definition of this term however I was told by a police officer that it is usually when a driver mistakenly jumps in front of another vehicle and causes the crash

number of crashes caused by speeding was 3,744 crashes, which resulted in 499 deaths and 4,074 injuries. Lack of control resulted in 121 deaths and 2,925 injuries. Other reported reasons for RTCs include negligence (8.5%), fatigue (0.2%), drink-driving (2.4%), overtaking (5.2), weather (1.8%), sudden stop (1.2%), unsafe distance (3.3%), vehicles (2.5%) and road (0.8%) defects [41].



Note: Data obtained from the Directorate of Traffic Department, Oman.

1.8. Risk factors for road traffic crash injuries

A detailed review of the extensive literature on risk factors for RTCs is beyond the scope of this thesis. This section summarises findings from the published literature directly relevant to this research.

Road traffic crashes result from a combination of different factors. The understanding of factors that contribute to RTCs and their consequences could be facilitated by using the Haddon matrix model. It is one of the most frequently used paradigms in injury

prevention. It defines the epidemiological triad of humans, vehicles and environment which interact during the three phases of the time sequence of a crash event i.e. pre-crash, crash and post-crash [11,2].

Table 5: Example of factors contributing to RTC using Haddon Matrix:

Phase		Factors		
		Human	Vehicles and Equipment	Environment
Pre-crash	Crash prevention	Information Attitudes Impairment Police Enforcement	Roadworthiness Lighting Braking Handling Speed Management	Road design Road layout Speed Limits Pedestrian Facilities
Crash	Injury prevention during the crash	Use of restraints Impairment	Occupant restraints Other safety devices Crash-protective design	Forgiving roadside
Post-crash	Life sustaining	First-aid skill Access to medics	Ease of access Fire risk	Rescue facilities Congestion

Note: information obtained from The World Report on Road Traffic Injury Prevention. Road Safety Training Manual.

The Haddon matrix framework aids in understanding the behavioural, road-related and vehicle-related factors that may have an impact on the number and severity of RTCs [11].

Table 5 illustrates some examples of factors that may lead to an RTC categorised by the Haddon matrix.

Road traffic crashes result from the interaction of a variety of factors, some of which some may not appear to be directly related. However, there is no doubt that a major contribution is made by human factors.

According to the WHO Road Safety Manual, the top three risk factors for crashes were as follows: inappropriate or excessive speed, presence of alcohol or medicinal/recreational drugs and fatigue. Restraint use is an important determinant of injury risk and severity when a crash does occur, therefore, a risk factor for road traffic injury. Each risk factor will be further explored from published literature.

1.8.1. Driving speed

Excessive speed is one of the major road safety problems in many countries. It influences both crash risk and crash consequence. Studies from many different countries have shown the role of speed in road crashes. It has been shown that up to third of all crashes involve an element of excessive speed [43]. In addition, it has been suggested that an increase of 1 km/h on average traffic speed may result in a 3% increase in the incidence of an injury and an increase of 4–5% of death [44]. This relationship between speed and involvement in RTCs has been tested by many studies. It is a straightforward relationship; the faster the vehicle is travelling, the greater the kinetic energy absorbed in the collision by both the vehicle and its occupants.

In order to promote road safety and regulate traffic speed, speed limits have been set and reinforced by traffic authorities all over the world [45, 46]. It has been reported that a reduction of 1 km/hour in driving speed will reduce the toll of road traffic crashes by 2-3% [43]. Factors influencing speed, such as setting and then lowering speed limits, the level of police enforcement, the penalties for speeding and the speed choice of other drivers have been studied by many researchers [43]. Ryeng found that those factors are variably significant determinants in an individual's speed reduction. He found that the most influential determinant of speeding is the speed choice of other drivers, suggesting that social pressure is a significant factor in the individual decision of speeding. He also found that a great reduction in speed follows an increase in police enforcement and police activity around the targeted roads while only a slight reduction in speed followed stricter sanctions [47].

1.8.2. Restraints non-use (seatbelts and child restraints)

Seatbelts are one of the most important road safety interventions which have made a major contribution in the reduction of RTC injuries and deaths worldwide [48]. Seatbelts function by restraining the vehicle occupant from hitting other objects or being thrown outside the car. Therefore, they help in reducing the severity of the injuries acquired by vehicle occupants involved in RTCs [48]. According to the WHO, unrestrained drivers and front seat occupants involved in a traffic collision most frequently suffer from injuries to the head followed by chest and abdomen. In addition, unrestrained passengers at the time of the crash constitute the majority of road traffic fatalities globally. Disability and mortality caused by failure to use seatbelts present a huge burden on governments' health resources and economies.

Therefore, wearing a seatbelt is one of the most important measures that could be taken by a vehicle occupant in order to prevent injury and/or death from a traffic crash.

Moreover, despite the proven efficiency of child safety seats in preventing child injuries and deaths, RTCs are still one of the leading causes of child mortality around the world and the leading cause of child mortality in the USA [49]. Children travelling without restraints are more common in developing countries than in the developed world. For example, in the USA, it was found that only 2% to 17% of 0-12-year-old passengers did not use any restraint. This issue is considerably worse for developing countries, specifically the GCC countries, as it was found that almost 99% of all child passengers were travelling unrestrained in the UAE [50].

1.8.3. Alcohol

Alcohol consumption by drivers is one of the major contributors to the burden of car crash injuries on public health resources in many countries. It is responsible for approximately one third of all RTCs' deaths [51]. In a case-control study carried out in Auckland, New Zealand, a strong association was found between consuming alcohol in the six hours preceding the crash and the outcome of having a serious injury crash. It was also found that drivers with a blood alcohol level more than 50 mg/mL were at 40 times the risk of being involved in a serious injury crash [52]. Also, a recent meta-analysis clearly states that the risk of an injury crash increases exponentially, even with low levels of alcohol consumption [53]. Legal limits for alcohol levels in blood have been set globally, especially in Europe and the USA, and

have been reinforced by the police and legal authorities [52]. Those limits vary from one country to another, from as low as 20 mg/100 mL in Sweden reaching as high as 100 mg/mL in the United States (current limit in New Zealand is 80 mg/100 mL) [52]. Reports indicate that alcohol intoxicated drivers are more likely to be involved in RTCs and more likely to bear fatal injuries as an outcome [51].

Despite the contribution of alcohol, and other substance abuse in RTCs globally, information and research in this area are limited due to the religious, cultural and sometimes legal restrictions in the GCC countries [54]. Participants in this study were not questioned about drinking alcohol while driving. Drinking alcohol is culturally and religiously prohibited, in addition to being legally prohibited when driving. As well as fearing legal consequences if disclosing drink-driving, we considered that asking about alcohol would make the participants feel intimidated and judged, consequently reducing the chance that they would complete the survey. While the ROP do determine whether alcohol has been involved in RTCs, the prevalence is extremely low (see later, Figures 14 and 15).

1.8.4. Fatigue

Fatigue decreases alertness, concentration and reaction time which are all critical elements in avoiding RTCs [55]. According to the European Transport Safety Council, driver fatigue is responsible for 20% of commercial road traffic crashes in the member states of the council² [56], and a systematic review of studies conducted in high income countries found driver sleepiness to be a major contributor to car crashes in the general population (also approx 20%) [57].

Driver sleepiness can be due to sleep disorders (such as obstructive sleep apnea) or to drug and/or alcohol use, but is mostly commonly due to “lifestyle” factors such as acute or chronic inadequate sleep, and to driving at times of the day when alertness is impaired by circadian rhythm (i.e. early morning and mid-afternoon). Long work hours and shift work can also contribute to inadequate sleep [58].

Another important risk factor is driver inattention which includes being distracted by outside persons, objects or events. These distractions may also include using a mobile

² Many European countries and international Road Safety Associations

phone, adjusting radio, cassette or CD, a moving object in vehicle, eating or drinking and smoking cigarettes [59]. It has been reported that approximately 25% of all RTCs in the United States involved drivers' inattention [60].

1.9. Importance of this research

In order to develop effective intervention programs for road safety, one first needs to describe the problem and the potentially effective interventions on a population level. This research is a first step in describing prevalence of known risk factors contributing to the high documented road toll, and considering which interventions used elsewhere in the world might be high priority for Oman.

Carrying out both descriptive and analytical epidemiological studies in the field of RTC is of national interest. Design of effective interventions requires epidemiological and social diagnosis of the problem. The present thesis represents an attempt to describe the epidemiology of RTC in Oman with a focus on the Northern Region of Batinah, specifically, Sohar. The evaluation of road traffic crash trends and characteristics in Oman has many worthwhile and anticipated outcomes which include:

1. The study may raise awareness among individuals, community and decision makers about RTCs.
2. Results from this study will be useful in planning future prevention programs to reduce RTCs.
3. It may also help in the understanding of potential risk factors affecting drivers which will, eventually, help in identifying populations at high risk to be targeted by prevention programs.
4. The study may also raise new empirical questions that, in turn, would be the basis for further investigation.

1.10. Context of this study

There are a number of facts which may help the reader to understand the context of this study. Firstly, the organisation of the week in Oman is different from that in New Zealand and other western countries. The Islamic religion presents Friday as a public worshipping day; therefore, in countries where Islam is the predominant religion, the work week either starts on Saturday and runs till Wednesday (as in Oman) or starts on Sunday and runs till Thursday (as in United Arab Emirates) [61].

There are a few general requirements to get a new driving licence in Oman. Firstly, an applicant must be 18 years old to get a light vehicle driving license and 21 years old to get a heavy vehicle driving license. A vehicle must be insured then registered by its owner to the closest Royal Omani Police Station [62]. In order to get a driver's license in Oman, an individual has to pass four tests conducted by the ROP. The tests are as follows:

Test one: Traffic signals:

This is usually conducted jointly with an eye vision test. An applicant will be required to correctly identify a number of traffic signs.

Test two: Drum test:

After passing the eye vision and the traffic sign tests, practical driving tests include checking the applicant's ability to reverse between two rows of drums without touching any of them. The applicant is usually alone in the vehicle for the test, with the instructor and the police officer observing from a distance. The applicant will automatically fail if they change gear or go forward once the test has started, but they are allowed to apply brakes during the test.

Test three: Slope test:

The slope test involves driving up a slope while observed by a police officer. There will be a traffic light signal in the middle of the slope which will alternate between red and green. The applicant is instructed to move when the light is green and stand still without moving backwards when the light is red. The applicants will automatically fail if they start without the permission of the police officer and if their vehicles move backwards or forwards on the slope when the light is red.

Test four: Road test:

In this test, the applicants must drive in traffic accompanied by a police officer. The test is targeting the applicants' behaviours in specific circumstances such as: changing lanes, taking right/left turns, stopping at intersections, taking roundabouts and driving in regular traffic and sometimes motorways [\[63\]](#).

1.11. Traffic rules in Oman

The traffic code in Oman was first developed in 1936. This was followed by the safety belt laws in 1990 and the mobile phone laws in 2000. In 2004, radars were fixed around the country roads and the first Road Safety College was founded. The first Ambulance EMS Service unit in Oman also started in 2004 [19]. The first governmental survey regarding the burden of road traffic crashes in Oman was launched in 1993 by the National Programme for Prevention and Control of Road Traffic Accidents. This survey found that there is a need for an urgent focus shift from treatment policies to prevention policies on road safety [19].

Listed below are articles related to the studied risk factors in this thesis as issued by the Royal Decree 28/93 and published by the Royal Oman Police, Legal Affairs Department [63].

Article 35:

"It shall be prohibited to drive a vehicle on the road without care or drive it at a high speed or under the influence of alcohol or drugs or in a manner which form a risk or expose the life of others or their properties to the hazards. The driving license shall be withdrawn in case of the violation of the rule of the previous paragraph without prejudice to the imposed penalty."

Article 38:

"If the driver of the vehicle commits an accident, which results in injuries or damages to the public or private properties he shall stop and report the accident to the nearest police station or ambulance immediately. It shall be prohibited for any person or workshop to repair any vehicle exposed to a traffic accident without obtaining a permit from the Directorate or the police station or the authorities determined by a decision from the Inspector General according to the control measures indicated by the Executive Regulations."

Article 130:

"(1) The driver of a vehicle may be apprehended in any one of the following cases:

(a) Driving the vehicle under the influence of alcohol or drugs or any other mentally affecting substances.

(b) Causing a traffic accident which result in fatality or serious injuries or considerable damages to the properties of the others.

(c) Failure to report to the police any accident he commits or fleeing from the site of the accident or the police station.

(d) Driving the vehicle with high speed and rashness, which constitute a hazard to the road users.

(e) Driving the vehicle without obtaining a driving license or refusal Jan-2005 88 to present it to the policemen on request.

(f) Passing the red light signal.

(g) Exceeding the maximum speed limit by more than 75 km per hour.

(h) Arrangement of races on the road without obtaining a permit in advance."

Annex No.3:**Table 6:** Speed limit violations:

Violation	Category	Points
Exceeding the maximum speed limit by more than 80 km per hour	First	3
Exceeding the maximum speed limit by more than 50 to 80 km per hour	Second	2
Exceeding the maximum speed limit by more than 35 to 50 km per hour	Third	Zero
Exceeding the maximum speed limit by more than 15 to 35 km per hour	Fourth	Zero
Failure to reduce the speed near the schools or hospitals or markets or crowded areas with passers by or work locations, which are determined by a permit.	Third	1
Driving at low speed on the left lane of a road of several lanes.	Fourth	Zero
Driving slowly in a form, which cripples the traffic movement.	Fourth	Zero
Failure to reduce the speed on encountering animals.	Fourth	Zero
Failure to reduce the speed on approaching the turning points and roundabouts and junctions.	-	-

Note: as stated by article (133) from the traffic rules. A driver's licence will be withdrawn if he/she reaches 12 points within 2 years of the first violation.

Chapter Two: Aims and Methods

2.1. Aims

There were two aims for this thesis:

- 1- To describe the distribution of road traffic crashes in Oman by time, person and place using the data collected by the ROP and specifically focusing on the data collected in 2010 to compare it later with Sohar Hospital data.
- 2- To estimate the prevalence of known risk factors in Oman, focusing specifically on Sohar. This involved describing the characteristics of RTCs, including detailed information about the drivers involved and the circumstances of the crashes.

Having reliable descriptive information will identify the groups most at risk of road traffic injury and help identify which potential risk factors for crashes present an opportunity for prevention and where further research would be warranted. This research could be extended to research to assess the relative importance of modifiable risk factors in Oman and prioritisation of preventive interventions.

2.2. Part I: Retrospective data from national Royal Oman Police

2.2.1. Study design and period

All of the traffic crash data from the ROP database was used in this retrospective case series study. The study period was from 1985 to 2009 for general patterns of RTCs and their morbidity and mortality. Additional data for the year of 2010 were extracted and made available for further analysis and comparison with the Sohar prospective study.

2.2.2. Data sources

The source of the historical and 2010 RTC data for this part of the study was The Directorate General of Traffic which is responsible for vehicle's inspection licensing, investigations of RTCs and ensuring safety on the roads. The concept of a police force is relatively new to Oman. The official start of the current Oman Police was after the widespread administrative changes in the country in 1970. It was named The Royal Oman Police in 1974 by his Majesty. The duties of the Royal Oman Police are divided between protecting people's lives and properties and maintaining the law in Oman. It is divided into 11 Regional Police Headquarters, one in each Governorate, and each of the Headquarters supervises a number of police stations within each Governorate. It is also organised into multiple Directorates Generals in which some are responsible for serving the public and some are restricted to serve the ROP only [64].

2.2.3. Analysis

Analysis of this part of the study was mainly descriptive, focusing on time trends for morbidity and mortality, describing the involvement of each type and gender of road users and reasons for all RTCs during the period of 1985 to 2009 and also the year of 2010. The police definition of fatality, injury and reasons for RTCs was used in the analysis which was done using the statistical package STATA.

2.3. Part II: prospective case series of injured drivers admitted to Sohar Hospital Emergency Department

2.3.1 Place of study

This descriptive study was conducted at Sohar Hospital, a 363 bed referral tertiary care hospital for the population of North Al-Batinah. It is a multispecialty hospital which was established in 1997 and is a teaching hospital for students of Oman Medical College (the second medical college in the Sultanate of Oman) [65].

According to the 2010 census, Sohar is the fifth most populous city in Oman with a population of 140,006 (2:1 male to female ratio) which constitutes approximately 5% of the total population. Sohar is connected to Muscat, the capital of Oman, by a 375 kilometre (233 miles) two-lane motorway network which represents the only connection between the GCC countries' citizens coming from the North to Muscat. It also represents the only way for citizens of Oman living north of Sohar to get to the capital city, Muscat [38].

2.3.2. Study design

This part of the research was a case series study that aimed to describe the characteristics of drivers of cars involved in crashes which have resulted in the driver or a passenger attending the Emergency Department in the city of Sohar as well as investigating potential risk factors that might be associated with their crash. The candidate carried out questionnaire-based interviews with injured drivers as they came into the Emergency Department of Sohar Hospital. The plan was to include as many consecutive cases as possible in one month so that the study was representative of the whole catchment population of the hospital. The interviews were conducted directly between the main investigator (myself) and the injured driver. I was present in the ED from 4pm to 2am daily starting on 20 February and finishing on 20 March 2012. Drivers in injury crashes occurring outside this period were recruited by the in-charge nurse. During that period, 250 interviews were completed.

2.3.3. Inclusion and exclusion criteria

All drivers involved in an RTC who attended the Accident and Emergency department, were interviewed to obtain the circumstances leading to their accident. On the other hand, drivers were excluded from this study in two conditions; firstly, if they did not consent to take part in the study and secondly, if they were severely injured or had a medium to severe head injury.

2.3.4. Case definition

For the purpose of this study, an RTC was defined as a crash that occurred on a road and involved at least one moving vehicle. The participants in the interviews were the injured drivers of those vehicles, who were attending the Emergency Department of Sohar Hospital.

2.3.5. Data collection

This prospective study was carried out using questionnaire-based interviews. The questionnaire was developed from questions that have been used in The Auckland Car Crash Injury Study, a case-control study of determinants of car crash injuries conducted in Auckland, New Zealand in 1998-9 [52]. It involved questions regarding the demographic and socioeconomic information of the injured driver and about the circumstances of the crash and injured car occupants. In addition, questions about known risk factors such as speeding, cell phone usage and wearing seatbelts were included.

After this study questionnaire was finalised (see Appendix), it was tested over one week in the emergency department in order to assess the clarity and ability of its questions to collect the required information. The pilot study resulted in the modification of some questions and the addition of two characteristics of the vehicles that were not included before (brake system and condition of tyres). It also served as an opportunity for the candidate to examine the dataset in terms of participants' responses to the questions before commencing data collection.

2.3.6. Data analysis

After the questionnaire-based interviews were completed within the given period, the data were entered into Microsoft Excel, after which they were exported to the statistical package STATA for the statistical analysis.

Data were summarised to illustrate frequency and percentages of socio-demographic characteristics of drivers in RTCs in Sohar, the prevalence of studied risk factors and the usual, and at the crash time, behaviour of the injured drivers in Sohar Hospital. The results were presented in tables and graphs.

2.3.7. Ethics

Before commencing any interview, the injured driver was provided with a brief description about the aims of this study. Moreover, respondents were informed that the obtained data would be only used for the purpose of scientific research. Confidentiality and privacy of information were ensured as the questionnaires were anonymous, so that no direct personal information such as names and/or ID numbers were required. Respondents were informed that their submission to be interviewed implied their full consent to participate in the study. Ethical approval was obtained from the Medical Research and Ethics Committee at Ministry of Health, Oman (see Appendix).

Chapter Three: Results

3.1. Part I: Retrospective data from national Royal Oman Police

3.1.1. Road traffic crashes (1985-2009)

Figure 6: Total RTC Deaths in Oman, 1985-2009 (n):

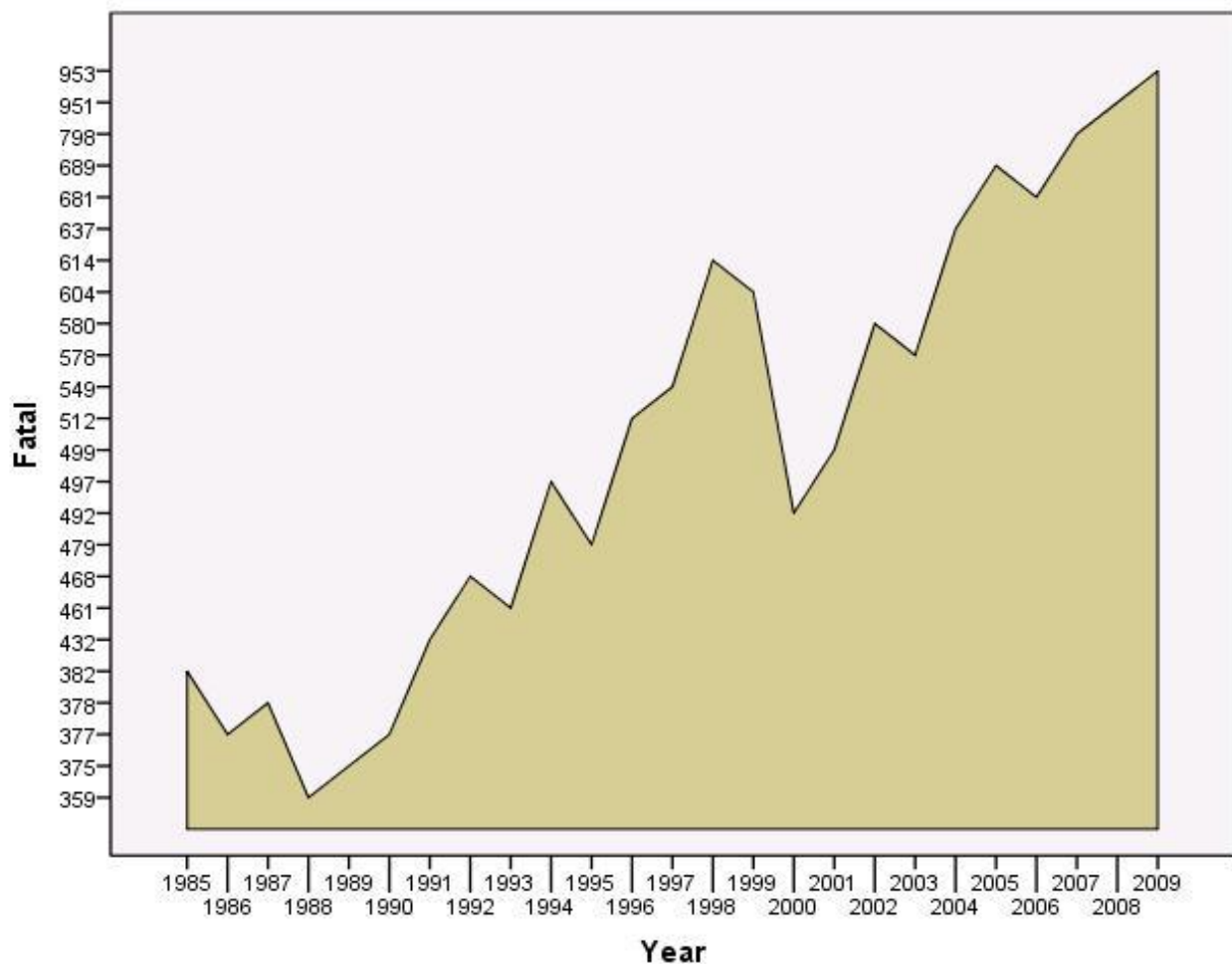


Figure 6 shows the substantial increase in the number of road traffic crash fatalities in Oman between 1985 and 2009. In comparison, there has only been a small increase in the population during that period, rising from 2,340,815 in 2003 to 2,773,479 in 2010. However, there has been a vast increase in motorization during this period. According to the Directorate General of Traffic database, the total length of roads increased by almost 200% from 2002 (32,800 km) to 2011 (59,363 km). In addition, the total number of registered

vehicles has risen dramatically during that period as well, climbing from 113,370 vehicles in 2002 to reach 881,360 vehicles in 2011. In 2000, the death rate in Oman was 23.2 per 100,000 population compared to 19.9 and 14.7 in neighbouring UAE and Qatar, respectively, 15.1 in the USA and 5.7 in the UK. By 2010, the rate in Oman had reached 30.6 deaths per 100,000 population.

Table 7: Mortality and injury rates 1985-2011(per 100,000 population):

Year	Deaths (n)	Mortality (per 100,000 population)	Mortality (per 100,000 vehicles)	Injuries (n)	Injury rate (per 100,000 population)	Injury rate (per 100,000 vehicles)
2011	1056	37.1	120	11420	401.2	1295
2010	820	29.5	102	9709	349.0	1207
2009	953	35.1	-	9783	360.7	-
2008	951	36.0	-	10558	400.3	-
2007	798	31.1	-	8531	333.1	-
2006	681	27.3	-	7548	303.0	-
2005	689	28.3	-	6658	274.0	-
2004	637	26.7	-	6636	273.0	-
2003	578	24.7	-	6735	288.3	-
2002	580	25.1	-	7907	343.3	-
2001	499	21.9	-	9625	422.3	-
2000	492	21.7	-	9323	411.7	-
1999	604	26.7	-	8183	362.2	-
1998	614	27.1	-	7913	349.6	-
1997	549	24.2	-	7278	321.1	-
1996	512	22.6	-	6654	294.5	-
1995	479	21.4	-	6685	299.5	-
1994	497	22.7	-	5954	272.7	-
1993	461	21.8	-	6203	293.8	-
1992	468	23.0	-	5876	289.3	-
1991	432	22.1	-	5481	281.5	-
1990	377	20.1	-	4771	255.4	-
1989	375	20.8	-	4389	244.2	-
1988	359	20.7	-	4072	235.2	-
1987	378	22.6	-	3318	198.8	-
1986	377	23.4	-	2693	167.7	-
1985	382	24.8	-	2981	193.7	-

Figure 7: Mortality and injury rates (per 100,000 population) 1985-2011:

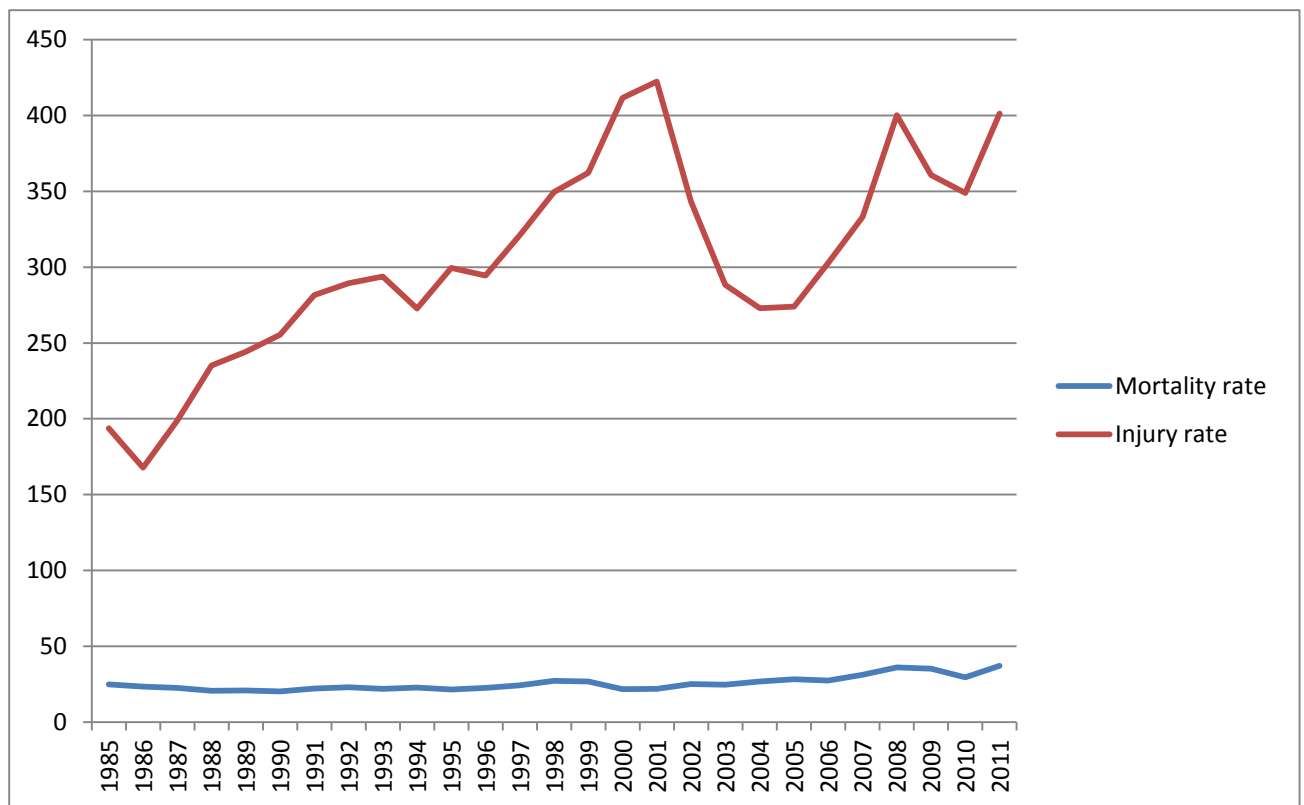


Figure 8: Total RTC injuries in Oman, 1985-2009 (n):

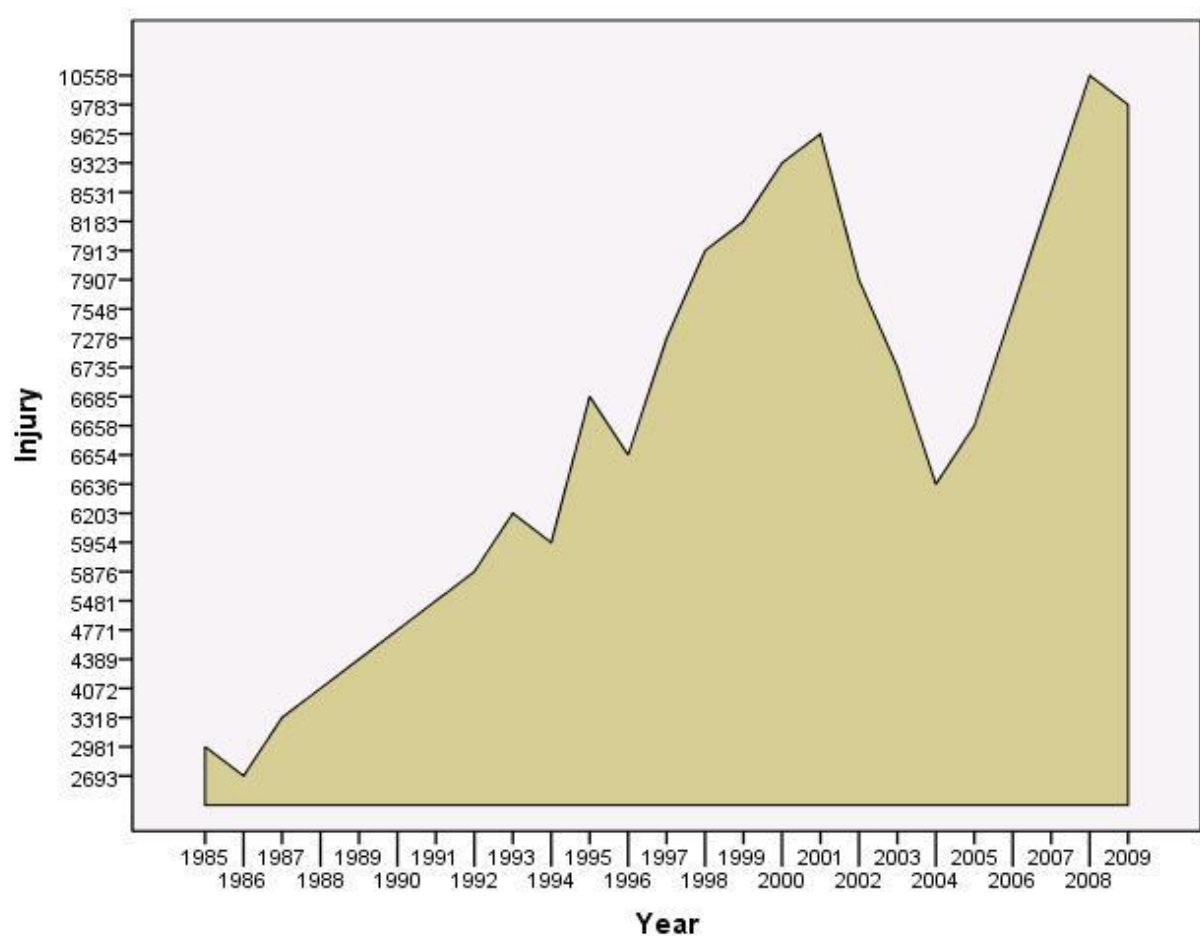
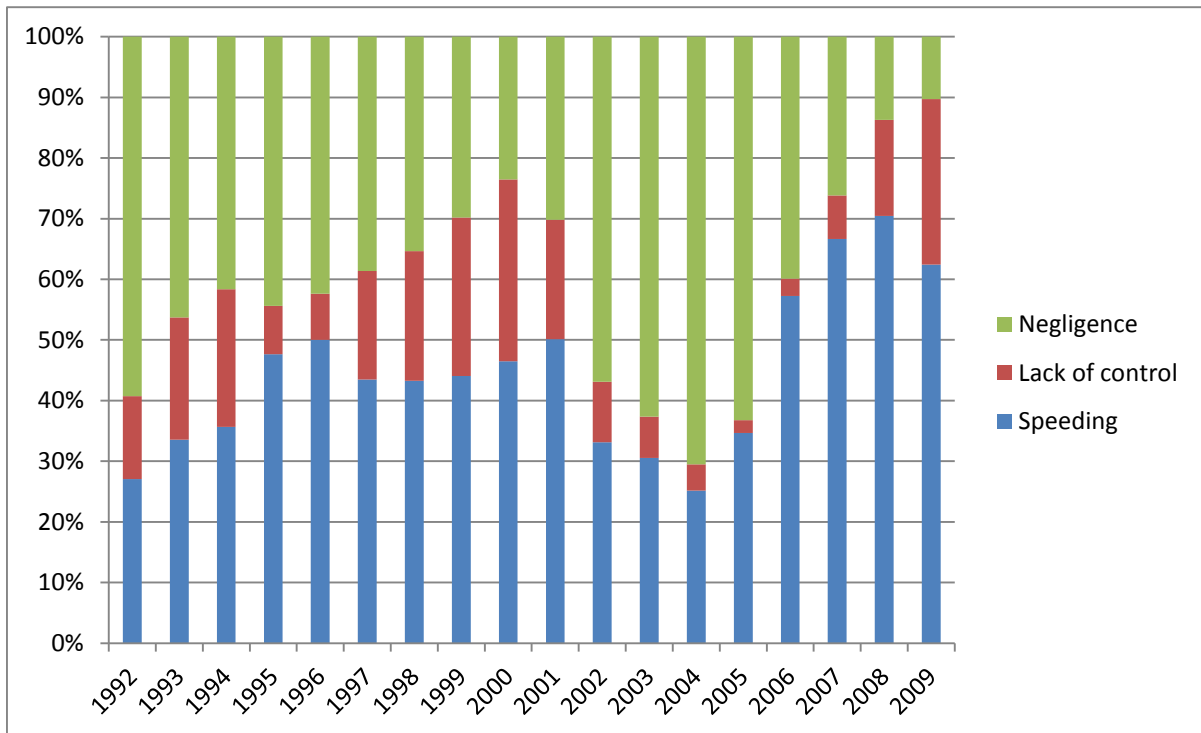


Figure 7 shows the increase in the number of injuries caused by road traffic crashes between 1985 and 2009. It can be seen that there is a similarity between the pattern of increase in death and injury numbers during that period. In 2000, the injury rate in Oman was 287.3 per 100,000 population compared with 195.3 in Qatar. Although the year 2004 marked the release of the the world report on road traffic injury prevention which is not a plausible explanation of the trend, no other explanation was determined. it seems more likely to be a reporting effect or a reflection of some real underlying change.

Figure 9: Top three reasons for RTCs attributed by Royal Oman Police, 1992-2009:



According to the Royal Oman Police, speeding is the top reason for RTCs in Oman followed by lack of control and then negligence. The above graph shows that over 15 years there has been a dramatic change in these reasons. Speeding was the attributed cause of 25-30% of all crashes in 1992, but over 60% of 2009 crashes. In addition, negligence, which caused over 50% of the crashes in 1992, is reported for only 10% in 2009. It is unknown whether these are changes in how the ROP attributes specific cause to the crashes, or real changes in the distribution of causes over time.

Figure 10: Total RTC injuries, by road user type in Oman, 1985-2009:

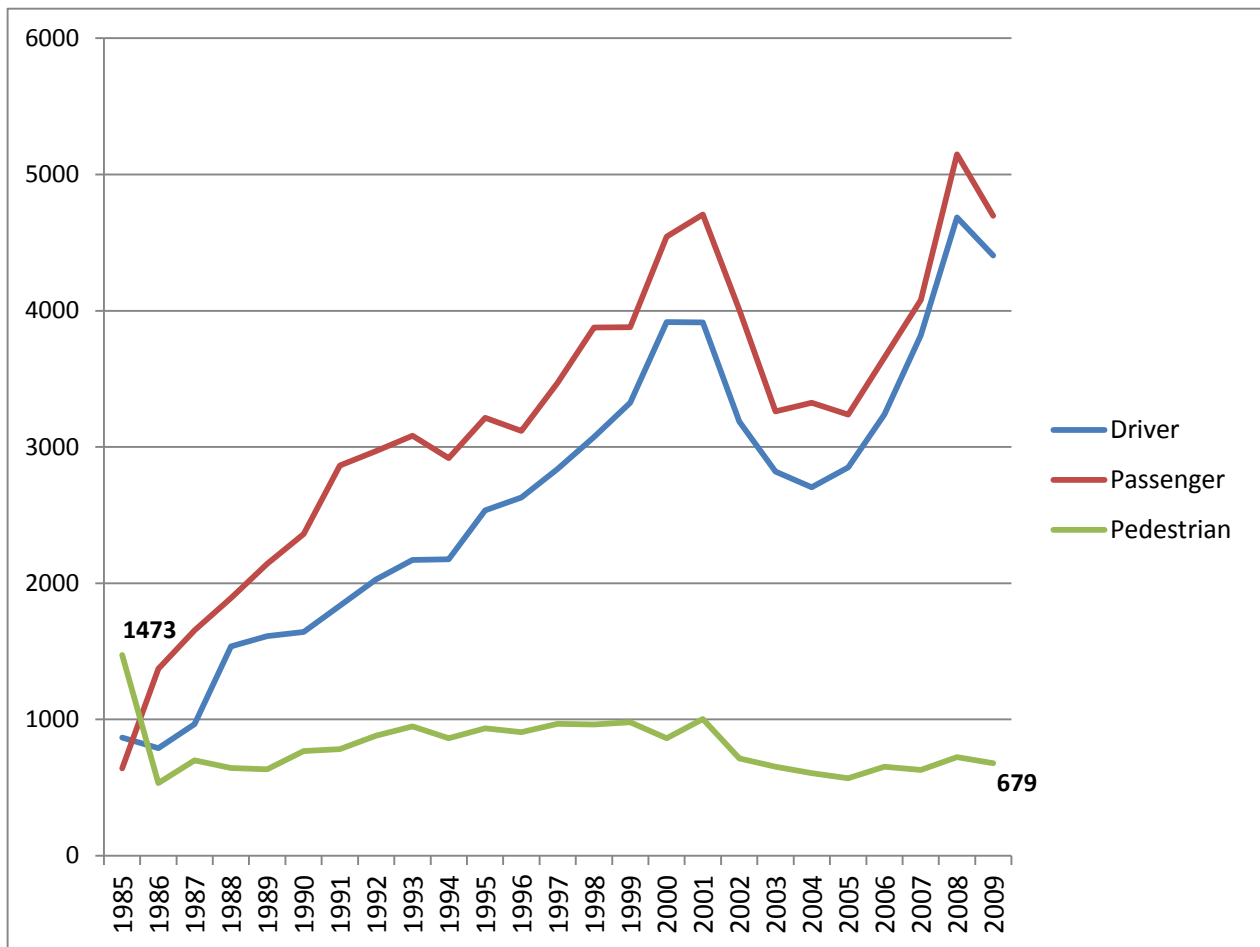
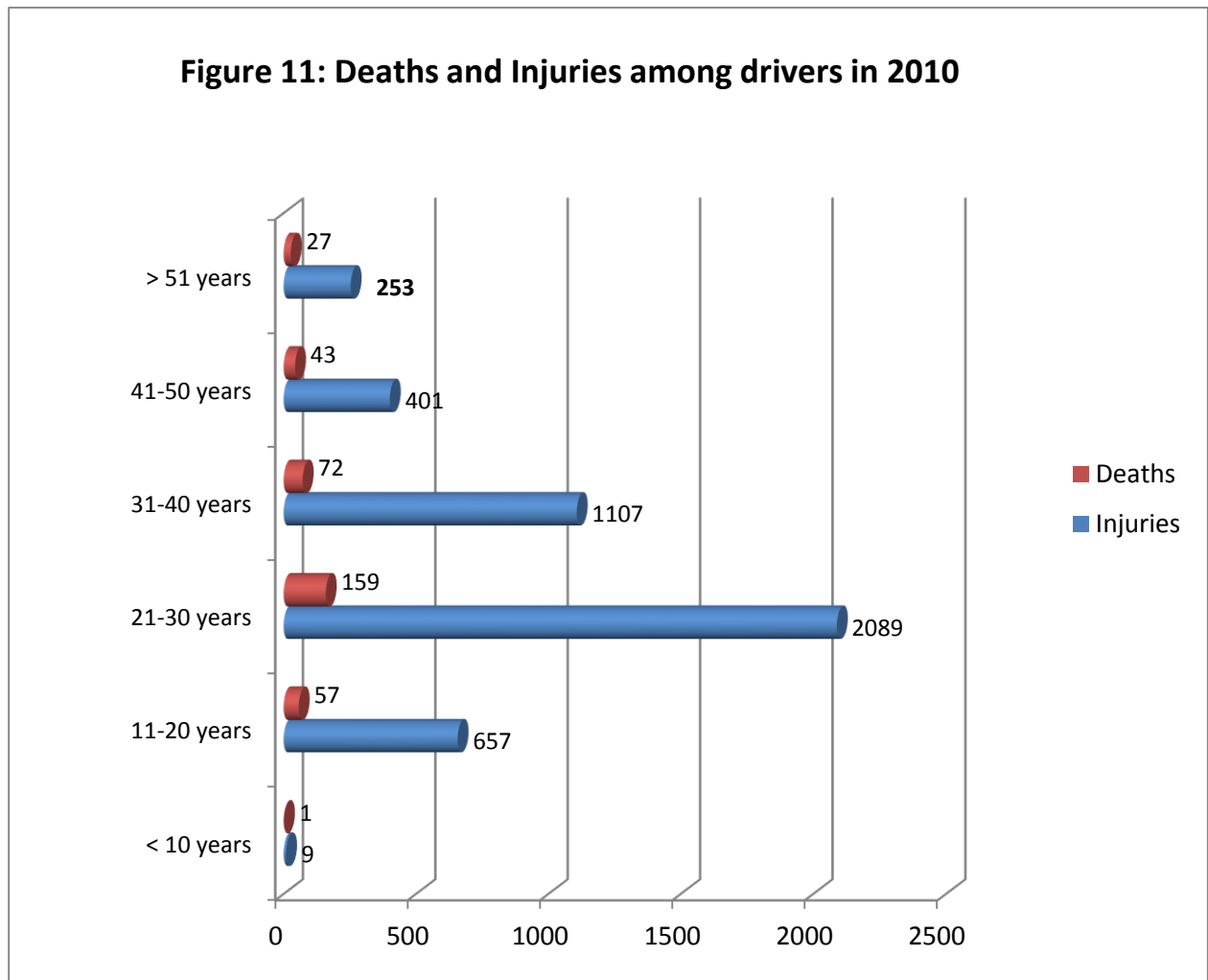


Figure 9 shows the changes in who is injured as a result of RTCs between 1985 and 2009. It can be seen that in 1985 there were more injured pedestrians than drivers and passengers, but this number suddenly dropped and continued to be the least injured road users. In addition, an incredible increase in the involvement of drivers and passengers could be seen from the graph which has a drop of approximately 2000 RTC injuries between 2003 and 2005, but which continues to rise after that. This is likely to be due to a reporting artefact.

3.1.2. Road traffic crashes 2010³

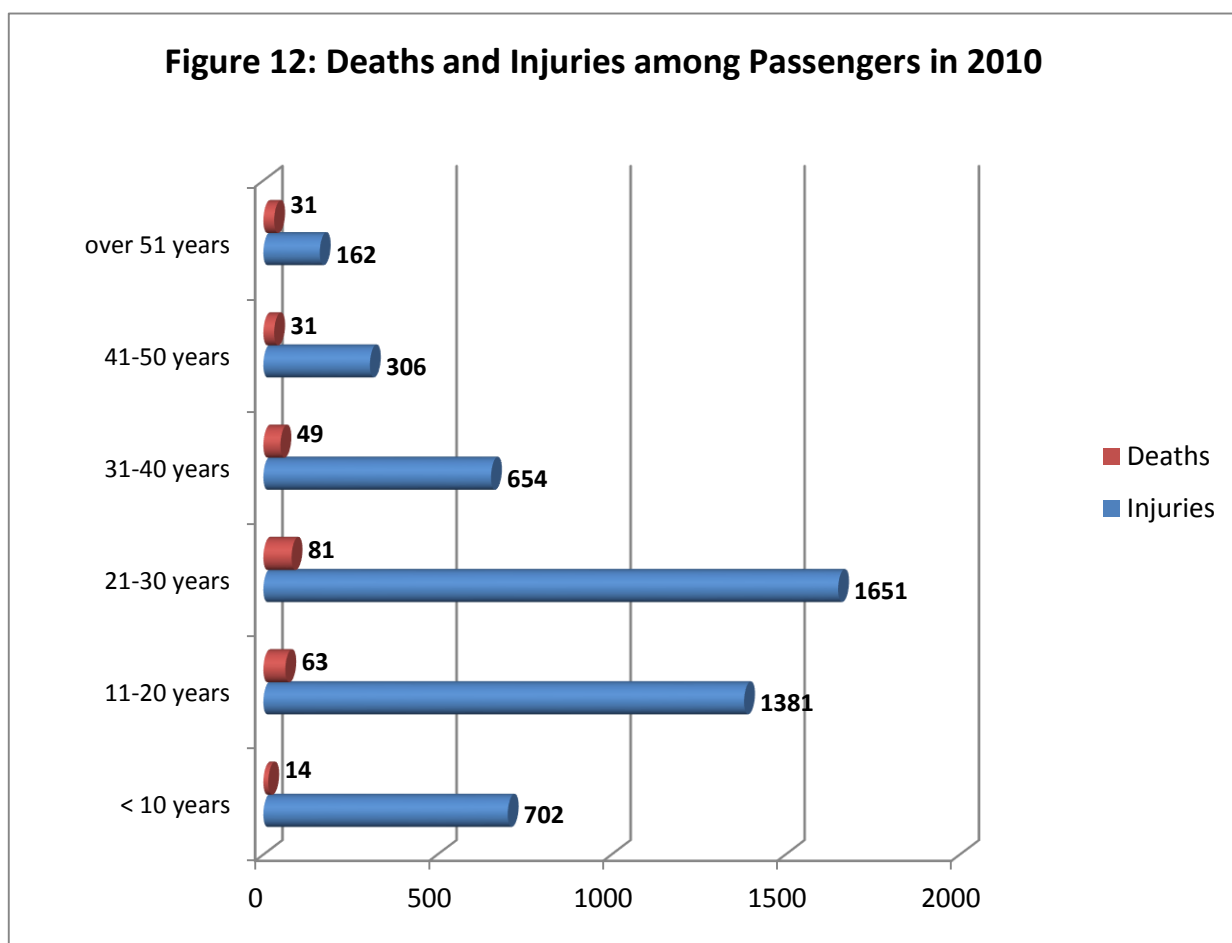
Drivers' injuries and deaths by age groups:



It can be seen from Figure 10 that most injured and killed drivers are in the age groups of 21-30 and 31-40. Almost half of the total number of injured and killed drivers were from the young age group, 21-30.

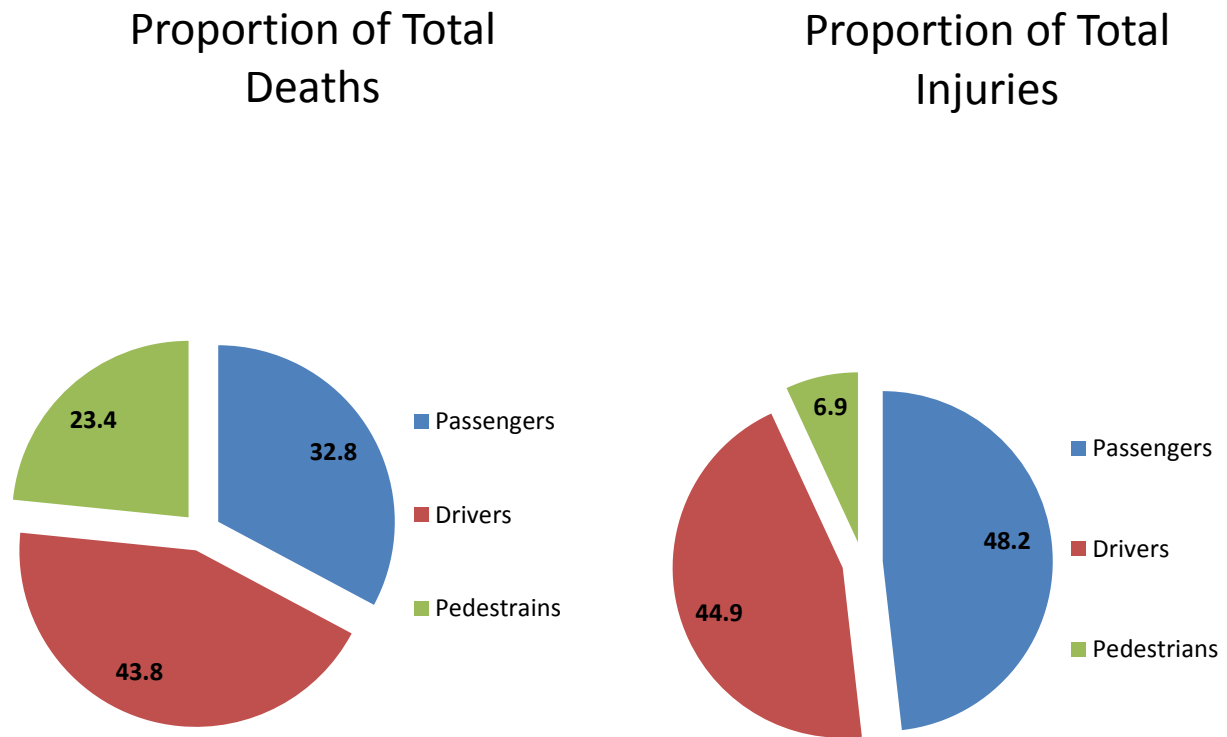
³ 2010 Police data was the latest available detailed road traffic crash data at the time of analysis

Passengers' injuries and deaths by age groups:



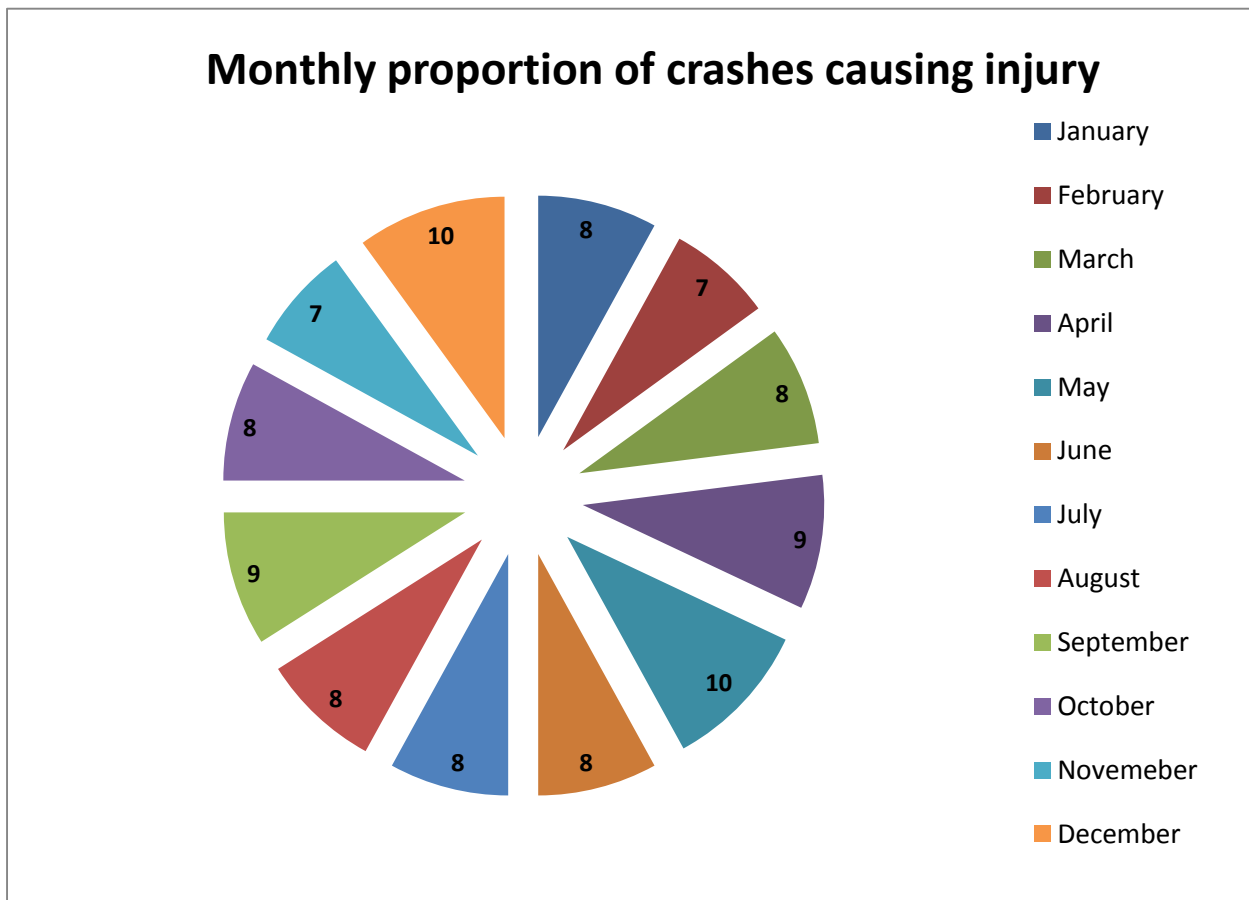
It can be seen that the passengers' age groups of those injured and killed in RTCs are different from those seen in the previous graph of drivers' age groups. Many child passengers were injured in 2010 with approximately 15% of all injured passengers in that year below the age of 10.

Figure 13: Total deaths and injuries by type of road user in Oman, 2010 (%):



The two pie charts show the proportions that each road user occupied of the total RTCs' deaths and injuries in 2010. It can be seen that drivers were the most-killed type of road users and passengers were most-injured road user type. Moreover, a higher proportion of pedestrians, 23.4%, were killed compared with only 6.9% who were injured. The larger case fatality reflects their greater vulnerability when involved in RTCs.

Figure 14: Total RTC injuries by month in Oman, 2010:



In Figure 13, it can be seen that most crashes occur in May, which is the month of mid-semester break from schools and universities, and December which is the middle of the end of year holidays for schools and universities and the start of annual holidays for government.

Figure 15: Total RTC deaths, by reasons according to ROP, 2010 (%):

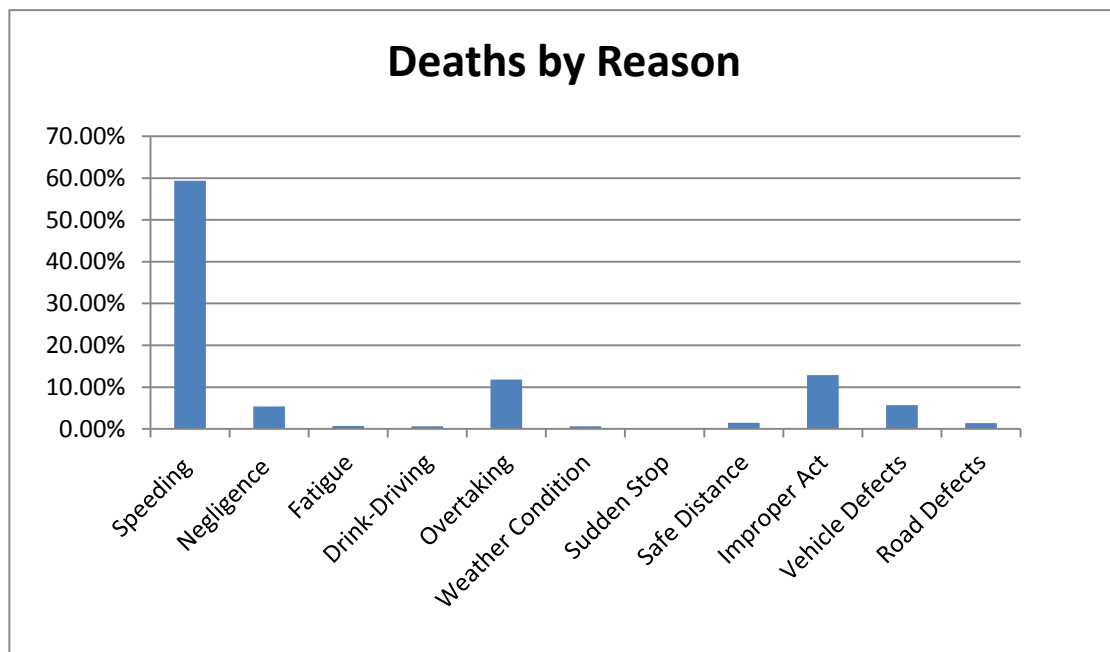
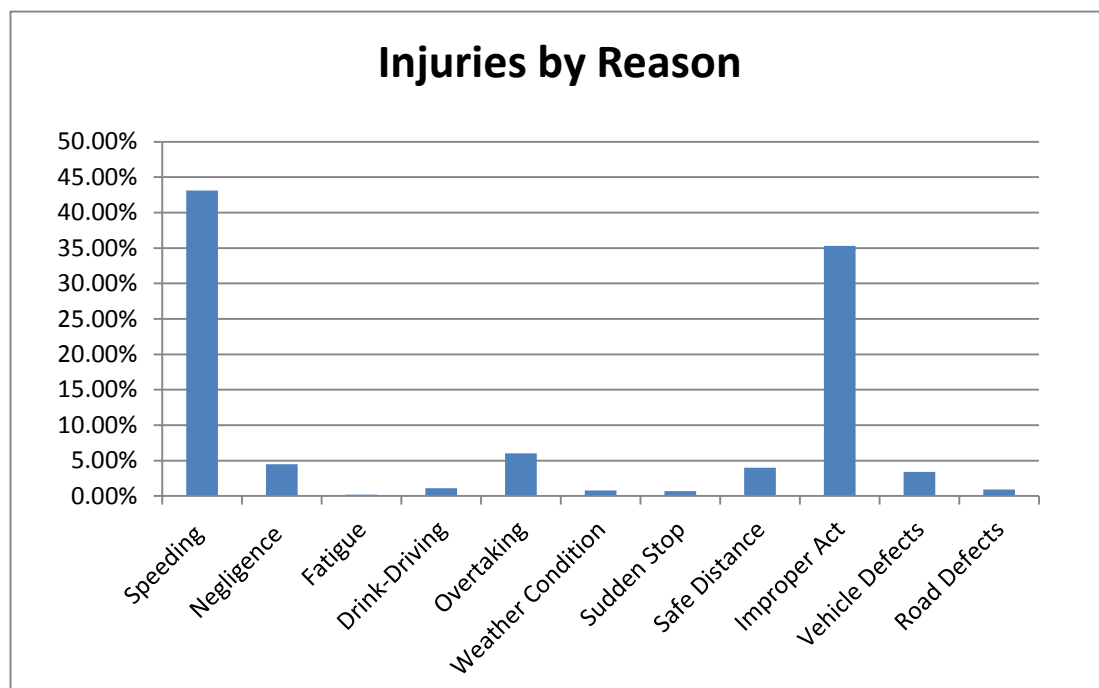


Figure 16: Total RTC injuries, by reasons according to ROP, 2010 (%):



It can be seen in Figures 14 and 15 that most deaths and injuries were attributed to speeding (more than half of deaths and almost half of the injuries). The second top reason for both deaths and injuries was improper acts including any reason that would cause the driver to jump front of another vehicle and cause a crash.

3.2. Part II: Prospective case series of injured drivers admitted to Sohar Hospital Emergency Department

3.2.1. Study population

In the study period from 20 February to 20 March 2012, 250 injured drivers attending the ED at Sohar Hospital were recruited to the study. They were consecutive attendees with the exception of 5 drivers who attended during the hours of 3:00 to 15:00. The most seriously injured drivers, who had to be taken by ambulance to the capital city Muscat for further investigation and those who died of their injuries, were not included. There were no eligible participants who declined to take part in the study. The data collection period was constrained for practical reasons. It was expected that 300 participants would be recruited, based on information supplied about numbers of ED attendances for RTC. The number of drivers who died or were transferred to Muscat was not known as data about that was not obtained. This was due to the fact that some do not report death to the authorities. In addition, some transferred cases are done by individuals involved rather than hospital services.

Table 8 summarises the characteristics of the study population for men and women separately. Of the 250 interviewed injured drivers, 75.2% were males and 24.8% were females. The highest percentage of RTCs occurred in the age group 25-35 years (58%), followed by 18-25 years (38%), but there were marked gender differences. Almost all of the women in the study were 25-35 years old, but half of the men were younger (18-25 years). Slightly more than half of the study population were full time workers (57.4% in males and 56.5% in females), and most owned their own car, with no gender difference seen in these characteristics.

In an average week, approximately half of the interviewed male drivers (46.3%) drove 100-300 kms and 61.7% of them spent 21-30 hours driving. Similarly, slightly more than half (54.8%) of the interviewed female drivers drove 100-300 kms weekly and a similar proportion (53.2%) spent 21-30 hours driving during the same period. More than half of the interviewed drivers (68.6% of males and 72.6% of females) had no history of past RTCs. However, there was a marked gender difference in the number of reported traffic violations over the past 5 years; the majority of male drivers (83%) reported at least three

traffic violations whereas approximately half of the female drivers reported one (30.6%) or no (19.4%) traffic violations.

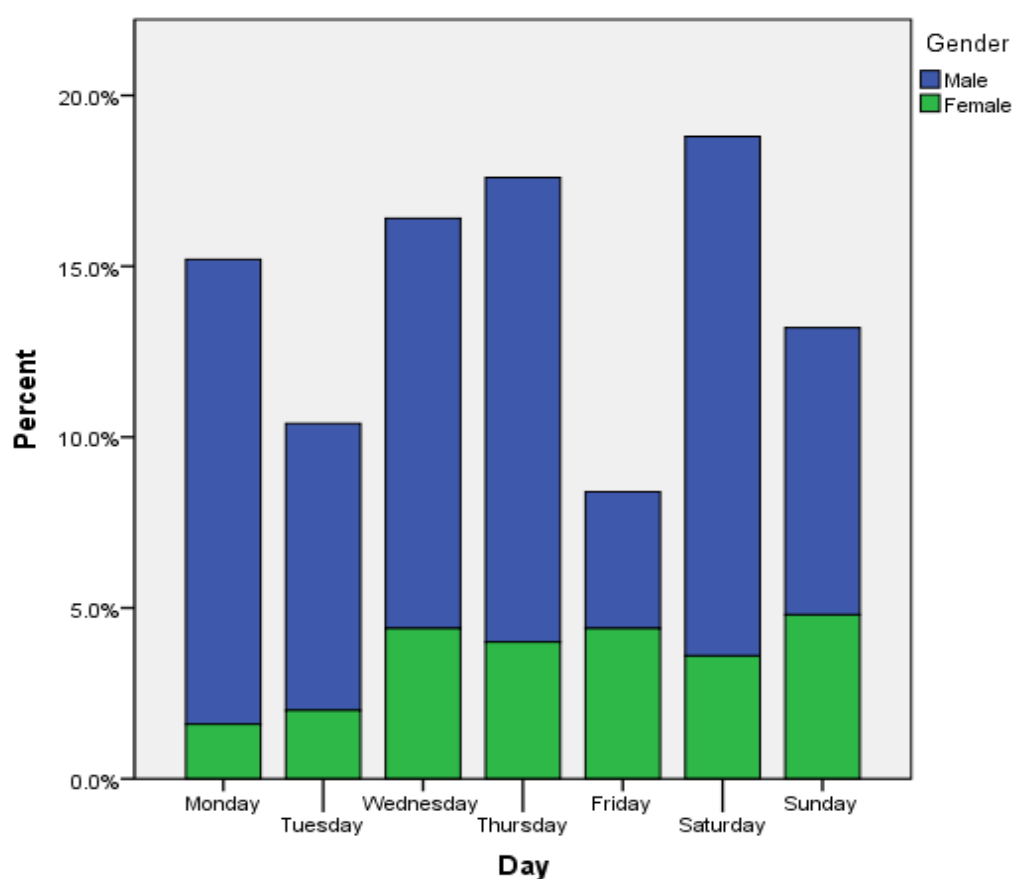
Table 8: Description of study population:

		Male		Female	
		n	%	n	%
All Study Participants		188	75.2	62	24.8
Age Groups					
	18-25	93	49.5	2	3.2
	25-35	86	45.7	59	95.2
	35-45	9	4.8	1	1.6
Employment					
	Full time work for pay	108	57.4	35	56.5
	Part time work for pay	15	8.0	6	9.5
	Student	48	25.5	13	21.0
	Unemployed	17	9.1	8	13.0
Car Ownership					
	Owner	154	82.0	52	83.9
	Not Owner	34	18.0	10	16.1
Distance Spent Driving in an Average Week (km)					
	10-100 kms	2	1.1	2	3.2
	100-300 kms	87	46.3	34	54.8
	300-500 kms	56	29.8	16	25.8
	More than 500 kms	43	22.8	10	16.2
Time Spent Driving in an Average Week (hours)					
	5 hours or less	0	0.0	1	1.6
	6-10 hours	16	8.5	9	14.5
	11-20 hours	24	12.8	10	16.1
	21-30 hours	116	61.7	33	53.2
	More than 30 hours	31	16.5	9	14.6
	Don't Know	1	0.5	0	0.0
Traffic violations over 5 years					
	0	17	9.0	12	19.4
	1	4	2.1	19	30.6
	2	11	5.9	17	27.4
	3	81	43.0	10	16
	4	36	19.0	2	3.3
	5	39	21.0	2	3.3
Past Crashes					
	0	129	68.6	45	72.6
	1	43	22.9	10	16.1
	2	14	7.5	7	11.3
	3	2	1.0	0	0.0

3.2.2. Circumstances of crashes

Table 9 describes the circumstances at the time of crashes according to time and location. Most of crashes occurred on the first working weekday; Saturday (18.8%) followed by Thursday (17.6%) which is the first day of the weekend. It can be seen from Figure 16 that there are some gender differences in the pattern of crashes across the week. There is more variability in crashes with male drivers with the highest prevalence on Saturday and markedly lower prevalence on Friday. Amongst women, there is less variation, but lower prevalence on Monday and Tuesday.

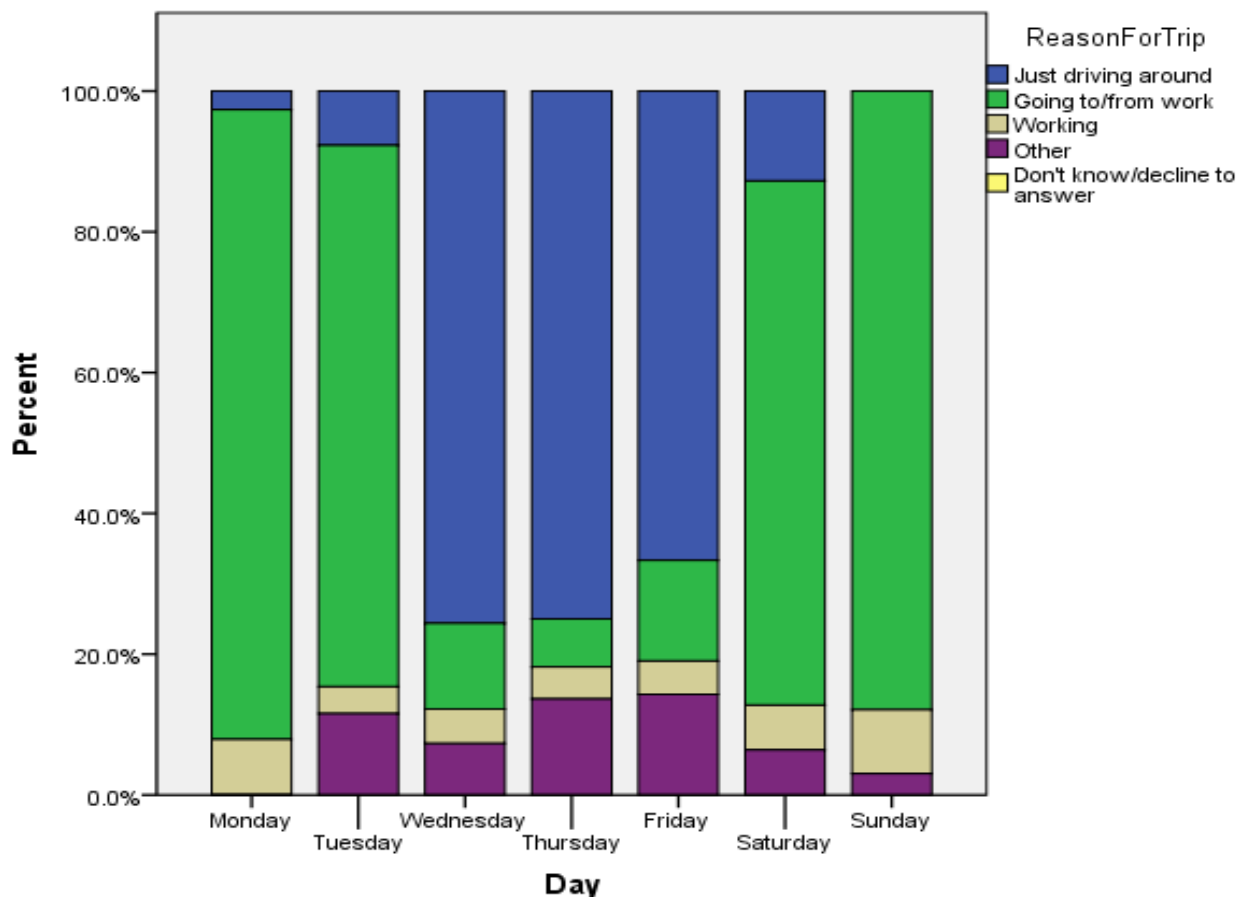
Figure 17: The Pattern of crashes over a week, by gender (%):



Most of these crashes were located in the city of Sohar with no noticeable gender difference. However, there was a marked gender difference in the main reason for the drivers' trip on the day of the crash. More than half of all interviewed male drivers (51.8%) reported that the main reason for their trip was to go to or from work compared with 45.2% of all interviewed female drivers who were just driving around before their crashes. It can

be seen from Figure 17 that almost all (90%) of the interviewed drivers who reported just driving around as the main reason for their trip crashed during the weekend, including Wednesday. On the other hand, the majority (76.7%) of those interviewed drivers who reported going to or from work as the main reason for their trip crashed during a weekday.

Figure 18: The Pattern of crashes over a week, by Reason for Trip (%):



The majority of both genders stated that they were either familiar or very familiar with the roads they crashed on. In addition, there was a gender difference in the number of cars involved in the crash; more than half of the males' crashes (58%) involved two cars compared with 69.4% of the females' crashes involving only one car. Most of the crashes occurred during a sunny day and on a dry road surface with 18.6% of males and 11.3% of females reporting a head on glare from the sun while driving on the day of the crash. As can be seen from Figure 18, most of the cars involved in the crashes had no passengers at the time of the crash, however, most of the cars with passengers crashed on Thursday (the weekend).

Figure 19: The pattern of crashes over a week, by number of passengers in vehicle (n)

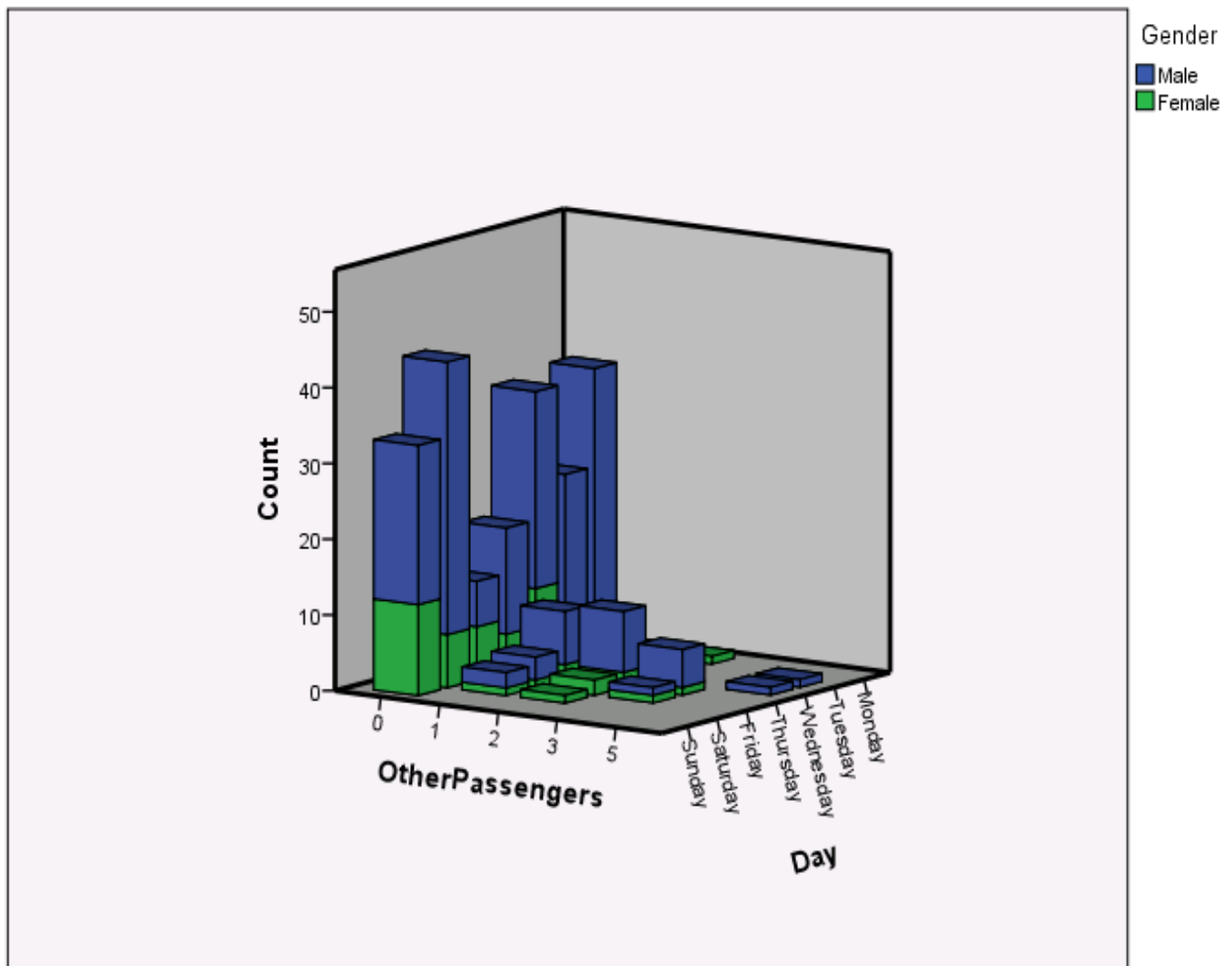


Table 9: Circumstances at the Time of the Crash:

		Male		Female	
		n	%	n	%
Day of the Week					
	Monday	34	18.1	4	6.5
	Tuesday	21	11.1	5	8.1
	Wednesday	30	16.0	11	17.7
	Thursday	34	18.1	10	16.1
	Friday	10	5.3	11	17.7
	Saturday	38	20.2	9	14.5
	Sunday	21	11.2	12	19.4
Location					
	Al-Khaboura	0	0.0	1	1.6
	Barka	0	0.0	1	1.6
	Liwa	26	13.8	12	19.4
	Al-Rustaq	0	0.0	1	1.6
	Saham	32	17.0	7	11.3
	Shinas	27	14.4	10	16.1
	Sohar	103	54.8	30	48.4
Reason for the Trip					
	Just driving around	59	31.4	28	45.2
	Going to/from work	103	51.8	26	41.9
	Working	13	8.4	2	3.2
	Other	13	8.4	6	9.7
Familiarity with the road					
	Unfamiliar	44	23.4	11	17.7
	Familiar	59	31.4	32	51.6
	Very familiar	83	44.1	17	27.4
	Don't know	1	1.1	2	3.3
Number of Vehicles involved in the Crash					
	One	69	36.7	43	69.4
	Two	109	58.0	19	30.6
	Three or more	9	4.8	0	0.0
	Don't Know	1	0.5	0	0.0
Number of passengers					
	0	156	83.0	49	79.0
	1	15	8.0	4	6.5
	2	9	4.8	7	11.3
	3	6	3.2	2	3.2
	5	2	1.0	0	0.0
Darkness					
	No	117	62.2	38	61.3
	Yes	71	37.8	24	38.7

Raining					
	No	187	99.5	62	100.0
	Yes	1	0.5	0	0.0
Road Wetness					
	No	187	99.5	62	100.0
	Yes	1	0.5	0	0.0
Head-On-Glare from the Sun					
	No	152	80.9	55	88.7
	Yes	35	18.6	7	11.3
	Don't Know	1	0.5	0	0.0

3.2.3. Driver behaviours at time of crash

Table 10 shows the behaviour of all interviewed male drivers at the time of the crash according to age groups. The majority (90%) of all interviewed male drivers reported not wearing their seatbelts at the time of the crash. In addition, the majority of all age groups were wearing jandals, clogs or scuffs at the time of the crash.

The majority of 18-25 and 25-35 age groups (62.3% and 72.1% respectively) were travelling at a speed of 100-140 km/hour and a significant proportion estimated that they were driving at 140-180 km/hour (18.3%, 17.4%). Most injured drivers reported that they had been driving for 15-60 minutes before the crash with the youngest age group (18-25) reporting a larger proportion of trips over 30 minutes before their crashes.

A substantial proportion of all age groups reported using a cell phone at the time of the crash (38.7% of the 18-25 group, 23.3% of the 25-35 group and 33.3% of the 35-45 group). In addition, 11.8% of the 18-25 years, 22.1% of the 25-35 years and 44.4% of the 35-45 years said that they were smoking a cigarette at the time of the crash. 24.7% of the 18-25 age group, 17.4% of the 25-35 age group and 22.3% of the 35-45 age group reported they had been involved in using the CD and/or radio at the time of the crash. In addition, only 19 of 188 interviewed male drivers reported that they were engaged in adjusting the air conditioner or the windows at the time of the crash.

Only 15 of the 188 injured male drivers had passengers in their cars at the time of the crash, with most of them being in the 18-25 group. When asked about the number of nights they had a 7-hour sleep during the week prior to their crash, almost all of the interviewed drivers had either 3 or 4 nights at maximum. Five drivers reported they had fallen asleep prior to the crash and 10 others thought it was possible that they had.

Table 10: Behaviours at the Time of the Crash (Male Distribution by age groups):

Age Groups		18-25	25-35	35-45
All Male Participants		(n=93)	(n=86)	(n=9)
		N (%)	N (%)	N (%)
Wearing Seatbelt				
	No	83 (89.2)	79 (91.9)	7 (77.8)
	Yes	9 (9.7)	7 (8.1)	2 (22.2)
	Don't know	1 (1.1)	0 (0.0)	0 (0.0)
Footwear				
	Nothing	14 (15.1)	10 (11.6)	1 (11.1)
	Jandals/Clogs/Scuffs	72 (77.4)	73 (84.9)	5 (55.6)
	High Heels	0 (0.0)	0 (0.0)	0 (0.0)
	Gumboots/Work boots	7 (7.5)	3 (3.5)	3 (33.3)
	Other	0 (0.0)	0 (0.0)	0 (0.0)
	Don't Know	0 (0.0)	0 (0.0)	0 (0.0)
Speed (km/hr)				
	20-60	2 (2.2)	0 (0.0)	1 (11.1)
	60-100	16 (17.2)	9 (10.5)	2 (22.3)
	100-140	58 (62.3)	62 (72.1)	3 (33.3)
	140-180	17 (18.3)	15 (17.4)	3 (33.3)
Time Driven Before the Crash				
	< 15 mins	8 (8.6)	6 (7.0)	2 (22.3)
	15 mins-30 mins	34 (36.6)	44 (51.2)	3 (33.3)
	30 mins-1 hour	39 (41.9)	29 (15.4)	2 (22.2)
	> 1 hour	12 (12.9)	7 (8.1)	2 (22.2)
Using a Cell Phone				
	No	56 (60.2)	62 (72.0)	5 (55.6)
	Yes	36 (38.7)	20 (23.3)	3 (33.3)
	Don't Know	1 (1.1)	4 (4.7)	1 (11.1)
Smoking a Cigarette				
	No	78 (83.9)	66 (76.7)	5 (55.6)
	Yes	11 (11.8)	19 (22.1)	4 (44.4)
	Don't Know	4 (4.3)	1 (1.2)	0 (0.0)
Using CD/Radio				
	No	69 (74.2)	69 (80.3)	7 (77.7)
	Yes	23 (24.7)	15 (17.4)	2 (22.3)
	Don't Know	1 (1.1)	2 (2.3)	0 (0.0)
Car Occupants				
	No	83 (89.2)	83 (96.5)	7 (77.7)
	Yes	10 (10.8)	3 (3.5)	2 (22.3)
	Don't Know	0 (0.0)	0 (0.0)	0 (0.0)
Adjusting Windows/AC				
	No	83 (89.2)	77 (89.5)	9 (100.0)
	Yes	10 (10.8)	9 (10.5)	0 (0.0)
	Don't Know	0 (0.0)	0 (0.0)	0 (0.0)

Nights of 7 hours Sleep in the Week prior to the Crash

2	7 (7.5)	7 (8.1)	1 (11.1)
3	32 (34.4)	28 (32.6)	1 (11.1)
4	45 (48.4)	44 (51.2)	6 (66.7)
5	6 (6.5)	7 (8.1)	1 (11.1)
6	1 (1.1)	0 (0.0)	0 (0.0)
7	2 (2.1)	0 (0.0)	0 (0.0)

Fallen Asleep Immediately before the Crash

No	82 (88.2)	76 (88.4)	7 (77.8)
Yes	2 (2.1)	3 (3.5)	0 (0.0)
Possibly	4 (4.3)	5 (5.8)	1 (11.1)
Don't Know	5 (5.4)	2 (2.3)	1 (11.1)

Table 11 shows the behaviour of all interviewed female drivers at the time of the crash according to age groups. The 25-35 years age group will be the main focus here as it constituted almost all (95.2%) of the female drivers. 43.5% (27 out of 62 drivers) of this age group reported not wearing their seatbelts at the time of the crash compared with 90% of the male drivers. As with the male drivers, almost this entire group stated that they were wearing jandals, clogs or scuffs at the time of the crash. More than half (59.3%) reported travelling at a speed of 100-140 km/hour immediately before the crash, but, unlike the men, few (n=4) reported driving faster than this (140-180 km/hour). Most of the interviewed female drivers (72.6%) reported to have been driving for 15-60 minutes with only six drivers reporting trips over one hour.

A high proportion (15 of 62 drivers) of this age group (25-35) stated that they were using a cell phone at the time of the crash. In addition, only 10 drivers reported they were smoking a cigarette at the time of the crash. Regarding use of the CD player or radio and adjustment of the air conditioner or windows at the time of the crash, similar proportions of the interviewed females in this group stated that they were using the CD player or radio (11.9%) or they were adjusting windows or air conditioner (10.2%) at that time. Only 8.5% of this group had passengers in their cars at the time of the crash.

In the week prior to the crash, 18 of the 62 interviewed female drivers reported having less than 4 nights of 7 hours sleep. Moreover, only one driver reported to have fallen asleep immediately before the crash, but six others thought it was possible that they had.

Table 11: Behaviours at the Time of the Crash (Female Distribution by age groups):

Age Groups	18-25	25-35	35-45
All Female Participants	(n=2)	(n=59)	(n=1)
	N (%)	N (%)	N (%)
Wearing Seatbelt			
No	1 (50.0)	26 (44.1)	0 (0.0)
Yes	1 (50.0)	33 (55.9)	1 (100.0)
Don't know	0 (0.0)	0 (0.0)	0 (0.0)
Footwear			
Nothing	0 (0.0)	1 (1.7)	0 (0.0)
Jandals/Clogs/Scuffs	1 (50.0)	55 (93.2)	0 (0.0)
High Heels	1 (50.0)	2 (3.4)	0 (0.0)
Gumboots/Work boots	0 (0.0)	1 (1.7)	1 (100.0)
Other	0 (0.0)	0 (0.0)	0 (0.0)
Don't Know	0 (0.0)	0 (0.0)	0 (0.0)
Speed (km/hr)			
20-60	0 (0.0)	1 (1.7)	0 (0.0)
60-100	1 (50.0)	19 (32.2)	1 (100.0)
100-140	1 (50.0)	35 (59.3)	0 (0.0)
140-180	0 (0.0)	4 (6.8)	0 (0.0)
Time Driven Before the Crash			
< 15 mins	0 (0.0)	8 (13.6)	0 (0.0)
15 mins-30 mins	1 (50.0)	31 (52.5)	1 (100.0)
30 mins-1 hour	1 (50.0)	14 (23.7)	0 (0.0)
> 1 hour	0 (0.0)	6 (10.2)	0 (0.0)
Using a Cell Phone			
No	2 (100.0)	42 (71.2)	1 (100.0)
Yes	0 (0.0)	15 (25.4)	0 (0.0)
Don't Know	0 (0.0)	2 (3.4)	0 (0.0)
Smoking a Cigarette			
No	2 (100.0)	47 (79.7)	1 (100.0)
Yes	0 (0.0)	10 (16.9)	0 (0.0)
Don't Know	0 (0.0)	2 (3.4)	0 (0.0)
Using the CD/Radio			
No	1 (50.0)	52 (88.1)	1 (100.0)
Yes	1 (50.0)	7 (11.9)	0 (0.0)
Don't Know	0 (0.0)	0 (0.0)	0 (0.0)
Car Occupants			
No	2 (100.0)	54 (91.5)	1 (100.0)
Yes	0 (0.0)	5 (8.5)	0 (0.0)
Don't Know	0 (0.0)	0 (0.0)	0 (0.0)
Adjusting Windows/AC			
No	2 (100.0)	53 (89.8)	1 (100.0)
Yes	0 (0.0)	6 (10.2)	0 (0.0)
Don't Know	0 (0.0)	0 (0.0)	0 (0.0)

Nights of 7 hours Sleep in the Week prior to the Crash

2	1 (50.0)	1 (1.7)	0 (0.0)
3	0 (0.0)	16 (27.1)	0 (0.0)
4	0 (0.0)	22 (37.3)	0 (0.0)
5	1 (50.0)	8 (13.6)	1 (100.0)
6	0 (0.0)	12 (20.3)	0 (0.0)
7	0 (0.0)	0 (0.0)	0 (0.0)

Fallen Asleep Immediately before the Crash

No	1 (50.0)	52 (88.1)	1 (100.0)
Yes	0 (0.0)	1 (1.7)	0 (0.0)
Possibly	1 (50.0)	5 (8.5)	0 (0.0)
Don't Know	0 (0.0)	1 (1.7)	0 (0.0)

3.2.4. Usual driving behaviours

Table 12 demonstrates the usual driving-related behaviours for all interviewed drivers according to gender. The majority of the interviewed drivers reported that they never or almost never wore seatbelts, with no marked gender difference. However, a slight gender difference was noted in that the majority (76.6%) of male drivers reported that they often drove post the speed limit whereas the majority (69.4%) of female drivers stated that they sometimes drive post speed limit. In addition, 10.6% of male drivers stated that they had raced once or twice during the past 12 months compared with only 3.2% for female drivers. Moreover, 20% of male drivers and 8% of female drivers had less than 7 hours of sleep each day.

There was a slight gender difference when asked if the cars they crashed had had a professional service in the past year; 24.2% of all interviewed female drivers reported that their cars had not had a professional service in the past year compared with only 15.4% of interviewed male drivers. Almost all of the cars involved in this study were not modified (95.2% in male group and 96.8% in female group). Moreover, 40.4% of males and 30.6% of females had their tires for 1-4 years and few of either gender had had them for over 4 years (6.9% for males and 6.5% for females). There was a gender difference when asked about the last time the brake system was checked; in the male group, 30.3% answered with more than one year compared with 38.7% in the female group. In addition, in approximately all the included cars, seatbelts were fitted in both the front and rear of the cars (97.9% of male group and 100% of female group).

Table 12: Usual Driving Related Behaviours:

	Male		Female	
	N	%	N	%
Wearing seatbelt				
Never or almost never	105	55.9	27	43.5
sometimes	59	31.4	23	37.1
often	23	12.2	12	19.4
Always or nearly always	1	0.5	0	0
Don't know	0	0	0	0
Driving Post-Speed Limit				
Always or nearly always	36	19.1	3	4.8
Often	144	76.6	16	25.8
Sometimes	5	2.7	43	69.4
Never or almost never	3	1.6	0	0
Hours slept each 24 hours				
5	13	6.9	1	1.5
6	26	13.8	4	6.5
7	140	74.5	37	59.7
8	8	4.3	20	32.3
9	1	0.5	0	0
Racing during the past 12 months				
Several times	2	1.1	0	0
Once or twice	20	10.6	2	3.2
Never	166	88.3	60	96.8
Professional Service in the past 12 months				
No	29	15.4	15	24.2
Yes	155	82.5	47	75.8
Don't Know	4	2.1	0	0
Car Modification				
No	179	95.2	59	96.8
Yes	9	4.8	2	3.2
Tires Age				
< 1 year	99	52.7	39	62.9
1-4 years	76	40.4	19	30.6
> 4 years	13	6.9	4	6.5
Seatbelts in the vehicle				
Front and rear	184	97.9	62	100
Front only	3	1.6	0	0
No seatbelts	1	0.5	0	0
Last time brake system checked				
< 6 months	53	28.2	21	33.9
1 year	78	41.5	17	27.4
2-3 years	44	23.4	19	30.6
> 3 years	13	6.9	5	8.1

3.3. Summary of main findings

- A substantial increase in traffic crash deaths and injuries occurred in Oman from 1985 to 2009.
- According to ROP, from 1985 to 2009:
 - Speeding has been the number one contributing factor for all RTCs.
 - Passengers have been the most commonly injured road user type.
- According to ROP, in 2010:
 - Age group 21-30 years was most affected by road deaths and injuries.
 - Drivers were the road user type most commonly killed and passengers most commonly injured.
- More younger male drivers were involved in injury crashes than female drivers.
- 49.4% of male drivers were in the 18-25 age group compared to 95.2% of female drivers in the 25-35 age group.
- Generally, drivers were found to spend long periods on the roads and drive for long distances.
- More crashes occur on Saturday and Thursday than any other days of the week.
- Most male drivers crashed on the way going to or from their work places while most female drivers were just driving around when they crashed.
- Female drivers were found to be more compliant with wearing seatbelts than male drivers.
 - 89.9% of male drivers were not wearing seatbelts at the time of the crash compared to only 43.5 % female drivers.
- 84.0% of male drivers were driving at a speed in excess of 100 km/hr compared with only 64.5% of female drivers.
- More male drivers reported specific risk factors or behaviours at the time of the crash:
 - 31.4% of male drivers were using their cell phones compared to only 24% of female drivers.
 - 18% of male drivers were smoking a cigarette compared to 16.1% of female drivers.

- 21.3% of male drivers were using the CD or radio compared to only 13.0% of female drivers.
- 40% of male drivers had less than 4 nights of 7 hours sleep/night in the week before the crash compared to 30% of female drivers.
- Evidence that the group of injured Omani drivers included in the Sohar study routinely ignored the traffic laws:
 - Most injured drivers never or almost never wore seatbelts when they were driving.
 - 76.6% of male drivers often drove over the posted speed limit and 69.4% of female drivers sometimes drove past the posted speed limit.
 - It is not known how this compares with usual driving practice in Oman as this study did not include a control group.
- No obvious deficiencies in the cars being used were detected:
 - Most cars in the Sohar study have had professional maintenance in the year prior to the crash.
 - Almost all of the cars have seatbelts fitted in the front and rear seats.
 - 69.7% of males and 61.3% of females had their cars' brake systems checked professionally in the year prior to their crashes.
 - Most of the cars were not modified.

Chapter Four:

Discussion

4.1. Main findings

Morbidity and mortality due to traffic crashes is a serious public health issue in most parts of the world, including the GCC countries of the Eastern Mediterranean Region of WHO [66]. There has been little attention paid to this issue in Oman to date. This study is a first step in describing the problem and assessing potential for prevention. The first part described the magnitude and trends in road traffic crash numbers in Oman, as recorded by the Royal Oman Police (ROP), from 1985 to 2009, and in more detail in 2010. The second part was a comprehensive case series study of road traffic crashes and their potential risk factors in the city of Sohar, to identify potential prevention opportunities.

According to ROP statistics, the last 25 years have seen road traffic injuries and fatalities increase by almost 300% in concert with a substantial increase in the number of registered vehicles, while the population increased only slightly in the same period. Since 1992, speed has been consistently cited as the top reason for RTCs, lack of control and negligence have been the next common but both have seen a decrease by almost 50% since then. In 1985, pedestrians were the most commonly injured road user group, but by 2009 they were the least injured group. According to the ROP, in 2009, drivers were the most injured road users' type, with passengers following the same increasing pattern as drivers over that period.

In 2010, ROP statistics indicated that most drivers and passengers injured and killed in traffic crashes were in the 12-30 years old category. Moreover, the road users' group most often injured was passengers and the most often killed were drivers. Speeding was the main cause reported for most crashes in 2010 and the peak months for crashes were May and December.

In the Sohar study, all injured drivers attending Sohar (regional) hospital were interviewed over a one month period. Three quarters (75.2%) of injured drivers were males and 24.8% were females, and more than half of both sexes were full-time workers. Almost half of the males were 18-25 years old and the majority of the females were 25-35 years old. The injured drivers generally drove a lot. On an average week, the majority of the study population estimated they spent 21-30 hours driving and covered 100-300 kms. Generally, male drivers had more traffic violations than female drivers with 83% of males reporting at least 3 traffic violations over the past five years whereas almost half of the females reported one or no traffic violations over the same period.

Saturday and Thursday had the highest frequency of crashes (18.8% and 17.6% respectively) and most of the crashes occurred in the city of Sohar rather than outlying areas of the hospital catchment. However, the most common reason for male drivers' trips on the day of their crash was "going to/from work", reported by about half (51.8%). In addition, the most common reason for female drivers' trips on the day of their crash was "just driving around", reported by approximately 45%. In addition, the majority of the study population were either familiar or very familiar with the roads they crashed on. Generally, crashes with male drivers involved more cars than crashes with female drivers, with 58% of male drivers' crashes involving two cars and 69.4% of female drivers' crashes involving only one car. The majority of crashes did not involve passengers but crashes with passengers were more likely on Thursdays.

Very few male drivers who presented with injuries were wearing their seatbelts at the time of the crash (less than 10%). In addition, the majority of male drivers were travelling at a speed of 100-140 km/hour and almost 42% of those aged 18-25 had been driving for 30 minutes to one hour before their crash. A high proportion of young drivers reported known risk factors for being involved in an injury crash. For instance, 31.4% of injured male drivers were using their cell phones at the time of their crash. Almost all of the interviewed male drivers had had only 3 or 4 nights of 7 hours sleep/night at maximum during the week prior to the crash. About 8% thought they may have fallen asleep immediately before the crash.

In contrast to male drivers, 56% of the female population were wearing their seatbelts at the time of the crash and a similar proportion were travelling at a speed of 100-140 km/hour at the time of the crash. At the time of the crash, 24% of female drivers reported that they were using their cell phones when they crashed. Unlike the men, the majority of females reported having more than 4 nights of 7 hours sleep/night in the week prior to their crash.

When describing their usual driving behaviours, the majority of all injured drivers interviewed reported that they never or almost never wore their seatbelts while driving. The majority of male drivers reported that they "often" drove past the speed limit whereas females were more likely to report that they "sometimes" drove past the speed limit.

4.2. Critique of the methods

4.2.1. Weaknesses

Several limitations should be considered when interpreting our findings. With regard to the ROP data, underreporting bias is a known limiting factor in studies involving official road traffic crash statistics [67]. While this has not been examined in Oman, it is well-known that a number of road traffic crashes do not get reported to the police for several reasons such as not having insurance, not holding a current valid driving licence or escaping police fines. Biases of this sort vary by context but have been demonstrated to be present in official road traffic statistics of other countries [68]. A second limitation is the inability to calculate the incidence of RTCs as there are no appropriate denominator data available for most years (example of a denominator: vehicle kilometres travelled (VKT) [69].

Little is known about the way the ROP assign "reasons" for crashes to their reports. These have been interpreted as being an impression formed by the police at the time of factors that may have contributed to the crash.

The Sohar study has produced a wealth of descriptive data but is limited by its case series design. Without a control group, a comparison of the prevalence of risk factors in the injured drivers with those same characteristics in the rest of the population of drivers could not be carried out and so causal inferences could be made. The size of the study population in Sohar hospital was modest which limited the power of the study to find differences between groups. Also only one regional hospital, Sohar Hospital, was involved due to the limitations of time and the manpower provided in the study.

It is not known how reliable the collected information was as findings might be biased by the exclusion of some daytime cases which are likely to differ from night time crashes. In addition, the most seriously injured drivers were not included in the study, either because they had died or had been transferred elsewhere for treatment. We were unable to ascertain the number of cases in these categories. The sample is therefore representative of less severely injured drivers attending hospital rather than all injured drivers.

4.2.2. Strengths

To the best of my knowledge, this is the first descriptive study of its kind in Oman, and in the city of Sohar. The ROP provides the traffic data annually but it has not been analysed in the context of the available literature. This study is the first to describe the prevalence of road traffic crash characteristics, drivers' behaviour and potential risk factors in Oman through interviewing the drivers themselves. Furthermore, the prospective study in Sohar Hospital had a high response rate which was almost 100% (only 5 cases were missed out of 250).

This study can draw on the extensive international literature of epidemiological studies to draw inferences about the likely contribution of the measured risk factors to car crash injuries, and therefore effective strategies for reducing such injuries.

4.3. Implications of findings

The findings of this study are relevant to policy makers in Oman. From the study that was conducted in Sohar Hospital and the national police data, a number of recommendations can be made to reduce injury from traffic crashes in Oman and to improve the national road safety status.

4.3.1. Reducing speed-related crashes

According to the WHO, countries such as USA, UK, New Zealand and Finland which reduced the speeds limits or introduced new laws regarding speed limits witnessed an 8% to 40% reduction in all road crashes [70]. It was also found that drivers usually choose to drive over the posted speed limits if they did not perceive a high level of enforcement or a high risk of being caught by the responsible authorities i.e. Police force. Installation of speed cameras has been found to be effective in reinforcing speed laws and limits. For instance, France started installing speed cameras at a national level in 2003 and by 2007 there was a 40 - 65% reduction in fatal and injury crashes. Finally, more public compliance could be expected after the implementation of widespread enforcement measures and the increase in the severity of sanctions against speed [70].

Proposed strategy in Oman:

According to the Royal Oman Police, speed has been a top reason for RTCs in Oman since 1985 and in our study in Sohar Hospital most injured drivers were travelling at speeds of more than 100 km/hour.

- Regulations:

The following interventions have been tested internationally and proven effective in reducing speed-related crashes. To begin with, speed limits could be set around the country and this step has been taken by the authorities in Oman. However, many studies have shown that setting speed limits without supporting actions such as police enforcement would have a minimum effect on the public [71, 72]. Therefore, one of the important interventions that could reduce the number of drivers exceeding posted speed limits is

lowering the speed limits nationwide and raising the penalties for exceeding them [73].

Another regulation that could be implemented in Oman is a driving licence points system in the ROP. This system involves deducting points from the driving license with each traffic law violation which could eventually lead, with increased violations, to the suspension of the individual's driving license [74]. Currently, this system is being studied by the authorities and is planned to be implemented by the beginning of next year. This new system would be an opportunity to show the public that the authorities are serious about reducing road traffic injuries. This new system would include all sorts of violations, not only exceeding speed limits.

- Enforcement:

Enforcement by the police increases compliance and therefore the effectiveness of active interventions. Police enforcement could be carried out in a number of ways, one of which is by implementing speed detection devices such as speed cameras and radars (mobile and fixed) [75]. Another enforcement method is for the police to be present at times of higher than usual risk for speed-related crashes, e.g. on roads during busy traffic hours such as Wednesdays (the last working day of the week) and Fridays (the end of the weekend). During these two days, police should be present particularly on all motorways linking Muscat, the capital, to other major cities such as Sohar and handing out speeding tickets to drivers who deserve to be penalised. The two methods mentioned above provide a deterrent, and serve to convince and remind other drivers on the roads that the police could be anywhere at any time and that they could be caught and penalised [70, 76].

- Publicity:

In addition to legislation and enforcement, it has been found that media campaigns and advertising increase the awareness of the drivers about the likelihood of being caught by the police for speeding and being fined for it. For instance, simple highway signs that display a driver being passed a speeding ticket by a police officer are considered effective in raising the population's awareness of the activity of police patrols on the roads [77].

- Environmental interventions:

Passive environmental interventions can reduce the risk of speed related crashes without having to actively change drivers' behaviour. For example, physical speed-reducing interventions such as roundabouts, speed humps and rumble strips have been widely used to reduce driving speed in high income countries. These measures were effective, predominantly where police enforcement may be lacking for various reasons [78]. Finally, road design could be made safer, especially in high-risk locations such as intersections into a highway, and results in reducing speed levels. This design could involve separating high-speed road users (light vehicles) and low-speed road users (trucks) or preventing specific vehicles from entering areas with vulnerable road users [70]. The aforementioned environmental interventions could be used to reduce the severity of the outcome for many other crashes caused for any reason.

4.3.2. Seatbelt interventions

The mechanism by which seatbelt usage reduces the severity of injuries is by preventing the occupant from hitting the interior of the vehicle or from being ejected through its windows [48]. There are some injuries related to seatbelt usage (example: seatbelt sign injury on chest and abdomen), however, these are very minor in comparison with major injuries related to not wearing a seatbelt. Although seatbelts have substantially reduced injuries and fatalities in many countries, they are still underused, especially in the developing world [79]. In a study comparing the Gulf Cooperation Council countries with high-income countries, it was found that seatbelt non-use in GCC countries is significantly higher than that in high-income countries ($P < .0001$) [80].

The use of seatbelts has been considered to be a crucial factor in road safety in research conducted in Iran [79]. Two influential factors have been identified to increase seatbelt use compliance; firstly, implementation of mandatory laws regarding seatbelt use and secondly, public education to increase their awareness of the importance of seatbelts. Both the aforementioned factors have been shown to increase compliance to seatbelt use and to decrease the total number of traffic injuries and their severity [81, 82].

Proposed strategy in Oman:

Over half (54%) of the injured drivers in the Sohar study stated that they never or almost never wore seatbelts whenever they are driving, and only about 15% reported wearing them often.

- Regulations:

Mandatory laws and regulations regarding wearing seatbelts and fitting them in all passenger vehicles should be increased and sustained. In order to be effective in increasing compliance to wearing seatbelts, these laws and regulations need to meet the internationally approved standards [83]. For instance, the authorities need to check that seatbelts are fitted in the front and rear seats of all cars. In addition, individuals who have to wear seatbelts should be defined in the law. For instance, the Australian law of seatbelts, rule 265, states that "a passenger in or on a motor vehicle that is moving, or is stationary

but not parked, must comply with wearing seatbelts if the passenger is 16 years old, or older" [84].

Moreover, penalties for non-compliance with seatbelts laws should be serious enough to discourage drivers from breaking the laws. In addition, seatbelt violations should be linked with other traffic violations and a penalty points system should be implemented, as mentioned previously, so that with more traffic violations a person runs the risk of losing their licence as more points are being taken from it.

- Enforcement:

Enforcement of the use of seatbelts should begin from government agencies and police departments by making it compulsory for their staff to wear them to and from their work places in order to lead the population by example [85]. In addition, Police officers should be visible to drivers, monitor them and be able to penalise them when seatbelt laws are being violated. This could be done through random, repeated and strict checkpoints which vary in location and time of the day or night. Moreover, police checkpoints should not be located on highways and where they could be anticipated by drivers [86]. It was found in the United States that without high-visibility police enforcement of seatbelt laws, compliance with seatbelt use decreases dramatically [87].

- Publicity:

Media campaigns can increase awareness of new regulations, and the intention to enforce them, and therefore increase compliance with the new laws. Hence, in order to achieve maximum driver compliance with seatbelt laws, public campaigns led by the government and national media (television, newspaper, radio) should be carried out [88]. In addition, benefits of wearing seatbelts, consequences of not wearing them and education on existing seatbelt laws and penalties over non-compliance should be included in the schools' curriculum. By doing so, an opportunity for changing parents' non-compliance to seatbelts through their children's behaviour will be created. Finally, it has been observed that public support for seatbelt laws has usually increased once legislation and enforcement has increased the level of compliance [88].

4.3.3. Child restraints interventions

For children aged 1-4 years in the USA, a 69% reduction in the need for hospitalisation was observed after committing to the use of child safety seats. In addition, the risk of death was reduced by almost 70% for infants, and 47%-54% for toddlers aged 1-4 years old [89]. Moreover, it was found that if all vehicle occupants younger than 4 years were to be restrained, that would save 162 lives and prevent 20,000 injuries annually [89].

Proposed strategy in Oman:

The conventional seatbelts are not designed to be used by children aged 12 years and younger; these require a special child restraint system that is appropriate to their varying sizes and weights. Child restraints are designed to protect children during sudden braking or collision by keeping them firmly in their seats [83]. There is no clear legislation regarding the use of child restraints in Oman.

- Regulations:

A law regarding the use of child restraints and elaborating on specifics regarding their design has to be implemented by the government and enforced by the ROP. In addition, exemptions from the law and penalties for non-compliance should be specified by the police. Royal Oman Police should also identify individuals who are legally responsible for making sure children are properly restrained in child seats [83].

- Enforcement:

For a new law such as child restraints in Oman, the transition from law introduction to law enforcement could take a lengthy period of time. Therefore, police enforcement should be carried out in phases; for example police can start by issuing warnings and explaining the new laws to offenders. After that, Police could move on to issuing fines for those not complying with the new law and they could increase the severity of the penalty as time passes

[83]. Another type of enforcement is to provide child restraints at an affordable cost for the public. An example of that is New Zealand which has a loan scheme for restraints which are expensive and only needed for a short period [90].

- Publicity:

As with seatbelt laws, after the child restraints law is passed, the enforcement process by the police should be visible to the majority of drivers for maximum impact. It is also crucial to educate the public on the advantages of using child restraints and the consequences of not using them. This could be done through mass media campaigns and community-based activities to promote the use of child seats [77].

4.3.4. Reducing alcohol-related crashes

Breath testing is an efficient way to detect alcohol level in drivers due to its low cost, quick reading and non-invasiveness. The first testing devices for drivers' breath were developed around the 1940s, but the first modern breathalyzer as we know it today was designed by Dr. Robert Borkenstein in 1954 in Indiana, USA [91]. Roadside testing for alcohol level, especially when conducted randomly, has reduced alcohol-related road traffic crashes in many countries [92].

Proposed strategy in Oman:

As mentioned in the first chapter of this thesis, driving under the influence of alcohol is completely intolerable by the ROP in Oman with a legal blood alcohol concentration of 0.0 mg/mL. However, the magnitude of the drinking and driving problem is not yet well-explored in Oman due to religious and cultural reasons. In addition, there is low public awareness of the problem and inadequate testing. Blood alcohol concentration (BAC) for drivers involved in RTCs is often not measured at Emergency departments nor is it routinely monitored by the police.

- Regulations:

Although the issue of alcohol-related crashes may be minor compared to other risk factors such as speeding and seatbelt use, it should be kept under routine surveillance by the authorities in order to monitor its status in the future. A regulation that required all Emergency Departments in the country to record blood alcohol concentrations for those involved in RTCs would make assessment of the burden of drink driving simple. In addition, the existing laws regarding drink driving need to be reviewed and a better definition of what is "drunk" should be established. In line with most other countries, legal blood alcohol concentration could be set and publicised and drivers who exceed that limit should be penalised. The police force should be enrolled in training courses related to the proper use of alcohol breathalysers. Serious sanctions on drivers caught with BAC over the legal limit could be set. These sanctions could start with a fine for a first drinking and driving

offence and could increase to a night in custody and perhaps points deducted from the licence for a second time offence [93].

- Enforcement:

Like the seatbelt and speeding laws, enforcement of laws regarding drinking and driving should be persistent and visible to the public. The police force's objective should not be to apprehend those found to be drinking and driving; their main objective should be to reduce the risk of this problem and reduce the number of RTCs caused by it. The Royal Oman Police force should start with compulsory breath tests at crash scenes and Emergency Departments should start with compulsory blood samples to check BAC at hospitals and should penalise drivers with BAC over the legal limit. Furthermore, a police enforcement programme should start by investigating about venues where alcohol could be available to the public (hotels and tourist entertainment venues) and focus on the roads closer to these venues. This programme could, later, be expanded to cover more road networks and have random drivers' screening tests which will help in reducing the incidence of drinking and driving and will also help in collecting more data on this problem for research purposes [92, 93].

- Publicity:

Since the drink driving issue is relatively new in Oman, public awareness and education on the problem is extremely important. One of the best and most effective ways to raise public awareness and educate them about the risks of drinking and driving is mass media campaigns. Another possible way to raise public awareness is short messages on road signs, police cars and public transportation vehicles (e.g.: buses). In addition, interviews with important figures and opinion leaders in the country such as Police officers, celebrities and religious figures should be an effective measure to educate the public and note the importance of this problem. Finally, in order to have long-term effective prevention of drink-driving, its consequences, and road safety in general, this needs to be implemented in the schools' curriculum to positively change children's attitude and behaviour towards road safety. All the interventions mentioned in this section will not have maximum impact unless visible regulations and enforcement are being carried out [92, 93].

4.4. Future research

This thesis has identified a number of areas where lack of data hampers the developing and monitoring of interventions to reduce harm for car crash injuries.

4.4.1. National Trauma database

For better definition of the magnitude and burden of Road Traffic Crashes in Oman, more adequate data collection systems are required. A linked trauma database between tertiary care hospitals in major cities would enable the gathering of accurate information on RTIs and evaluate the prevalence of their risk factors. In addition, this database could be linked, through the national identity number, with the police database in order to cross check the data and to be able to monitor the efficiency of national RTC prevention campaigns. Furthermore, the availability of a linked database between hospitals and police will make it feasible to conduct research on a national level rather than regional as for this research.

4.4.2. Case-control study on risk factors for injuries

In this research, many of the internationally proven risk factors of RTCs were found to be prevalent in the study population. To identify the relative importance of various modifiable risk factors in causing car crash injuries in this particular population a case-control study on risk factors is the most appropriate research design. In this proposed case-control study, the control group would be a sample of normal drivers, randomly stopped on the side of the road during normal traffic and asked about the known risk factors. The comparison of potential risk factors in the injured cases and the usual driving population would allow quantification of the contribution of the various risk factors to car crash injuries, and suggest priorities for prevention.

4.4.3. Work-related fatigue and sleepiness research

There are a number of published reports on work-related sleepiness and fatigue as risk factors for RTCs. However, no epidemiological studies on this topic were carried out in Oman and specifically in the city of Sohar which has a host of many industrial areas. Fatigue

and sleepiness were found to be among the most common contributing risk factors to work-related crashes [94].

From our study, we found that around 50% of those drivers involved in traffic crashes were either going to or from work. Thus, it would be critical to investigate the contribution of work-related fatigue and sleepiness on the drivers and their consequent involvement in a road traffic crash.

4.4.4. Pre-hospitalisation trauma care research

A significant number of trauma deaths occur outside the hospital environment. Pre-hospital trauma systems have been shown to be beneficial in reducing mortality, specifically in middle-income countries [95].

Pre-hospital trauma care focuses specifically on the management of injuries at the scene and en route to the hospital or health institution. Trauma management of the pre-hospital environment could be life-saving for road traffic crash victims. A set of questions regarding pre-hospital trauma care have not been investigated yet in Oman. The first question is whether pre-hospital trauma care in Oman provides an acceptable coverage to the whole population or not. The second question is whether an efficient level of trauma management is being provided in the pre-hospital scene. These questions need to be thoroughly investigated through controlled research guided and funded by policy makers in Oman. This research should evaluate the current status of trauma care existing in Oman and, where necessary, improve and restructure the system and organisations involved.

4.4.5. Conclusion

This thesis characterised Oman as a country where motoring is increasing rapidly with a high incidence of road traffic injuries. Well-recognised risk factors for injuries are prevalent among injured drivers. Reduction in road traffic injuries will require further developments in areas of policy and legislation, police enforcement activity and public awareness. There is considerable international experience that could be drawn upon to achieve this.

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Appendix

The Sohar study questionnaire:

Questionnaire No. : Date:

Socio-demographic information:

1. Date:
2. Day:
 1. Monday
 2. Tuesday
 3. Wednesday
 4. Thursday
 5. Friday
 6. Saturday
 7. Sunday
3. Gender: Male Female
4. Age:
5. Where did the crash happen?
6. How many vehicles were included in the crash?
 1. One
 2. Two
 3. Three or more
 4. Don't know
7. Which vehicle do you think was at fault?
 1. Your vehicle
 2. Another vehicle
 3. Both vehicles

4. No vehicles fault
 5. Don't know
8. Were you wearing your seatbelt at the time of the crash?
1. No
 2. Yes
 3. Don't know
9. What were you wearing on your feet at the time of the crash?
1. Nothing
 2. Jandals/clogs/scuffs
 3. High heels
 4. Gumboots/work boots
 5. Other
 6. Don't know
10. Had you driven on this road before?
1. No
 2. <5 times
 3. Between 5 and 100 times
 4. >100 times
 5. Don't know
11. What was the main reason for this trip?
1. Just driving around
 2. Going to/from work
 3. Working.
 4. Other please specify-----
 5. Don't know/decline to answer

12. How fast do you think you were travelling immediately before you were aware of the crash?

Kms/hr

13. How long had you been driving before the crash?

Hours mins

14. In the week before the crash, how many nights did you sleep 7 hours or more
Out of 7

15. Which of the following best describes your level of alertness in the 15 minutes prior to the crash:

1. Felt active, wide awake.
2. Was functioning at a high level but not at peak
3. Felt relaxed, awake but not fully alert, responsive
4. Felt a little foggy headed
5. Felt a little foggy headed, had difficulty staying awake, was beginning to lose track
6. Felt sleepy, would have preferred to lie down, woozy
7. Could not stay awake, sleep onset was imminent
8. Don't know

16. How would you describe that on a scale from one to ten, where one is tired and 10 is fresh?

17. Do you think you might have fallen asleep immediately before the crash?

1. No
2. Yes
3. Possibly
4. Don't know

Potential Risk Factors:

Were you doing any of the following at the time of the crash?

18. Using a handheld cell phone

1. No
2. Yes
3. Don't know

19. Smoking or lighting a cigarette

1. No
2. Yes
3. Don't know

20. Adjusting radio or CD/cassette player, or inserting CD/cassette

1. No
2. Yes
3. Don't know

21. Attending to passengers

1. No
2. Yes
3. Don't know

22. Adjusting windows/air conditioners

1. No
2. Yes
3. Don't know

23. Other activity

1. No
2. Yes please specify-----
3. Don't know

24. How many other people were with you in the car?

25. Can you tell the age of each of these people, where they were seated, and whether they were wearing a seatbelt:

Person 1

Person 2

Person 3

Person 4

Person 5

26. At the time of the crash..... Was it dark?

1. No
2. Yes
3. Don't know

27. Was it raining?

1. No
2. Yes
3. Don't know

28. Was there head-on glare from the sun?

1. No
2. Yes
3. Don't know

29. Was the road wet?

1. No
2. Yes
3. Don't know

Personal factors:

30. In general, would you say your health was:

1. Excellent
2. Very good
3. Good
4. Fair
5. Poor

31. How long do you usually sleep each 24 hours?

Hours mins

32. Do you usually awake refreshed?

1. No
2. Yes
3. Don't know

33. Have you ever been told that you regularly snore loudly?

1. No
2. Yes
3. Don't know

Migraine:

34. Has a doctor ever told you that you have migraines?

1. No
2. Yes
3. Don't know

35. In the past year have you experienced recurrent headaches that last for more than 4 hours and less than 3 days, and which stop or decrease your daily activities?

1. No
2. Yes
3. Don't know

Medications:

36. How often do you take sleeping tablets to help you sleep?

1. Never
2. Less than once a month
3. 2-4 times a month
4. 5-15 times a month
5. At least every second day
6. Don't know

37. Had you taken any sleeping tablets during the 24 hours before the crash?

1. No
2. Yes
3. Don't know

38. At the time of the crash, were you taking regular medications for depression or anxiety?

1. No
2. Yes
3. Don't know

39. If yes, did you start the medication in the six weeks before the crash?

1. No
2. Yes
3. Don't know

40. Which of the following are you?

1. Right handed
2. Left handed
3. No preference for left or right
4. Don't know

41. How much do you weigh?

Kg

Driving experience:

42. What type of car licence do you hold a present?

1. Never had a car license
2. Disqualified/suspended
3. Full car licence
4. Don't know

43. During an average week before the crash, how many hours would you spend driving a car or van on the road?

1. 5 hours or less
2. 6-10 hours
3. 11-20 hours
4. 21-30 hours
5. More than 30 hours
6. Don't know

44. During an average week before the crash, how far would you drive a car or a van on the road?

1. 10 kms or less
2. 10-100 kms
3. 100-300 kms
4. 300-500 kms
5. More than 500 kms
6. Don't know

45. Before the crash, how often would you drive above the posted speed limit?

1. Always or nearly always
2. Often
3. Sometimes
4. Never or almost never
5. Don't know

46. Before the crash, how often would you wear a seat belt when you were driving a car?

1. Never or almost never
2. Sometimes
3. Often
4. Always or nearly always
5. Don't know

47. During the last 12 months, how often did you race in a motor vehicle for excitement?

1. Several times
2. Once or twice
3. Never
4. Don't know

48. Over the past 5 years, how many times have you been involved in a crash when you were driving and someone was injured requiring medical attention?

49. In the past 5 years, how many traffic convictions have you had?

Vehicle details:

50. Is the car registered in your name?

1. No
2. Yes
3. Don't know

51. At the time of the crash, was the car insured?

1. No
2. Yes
3. Don't know

52. Has the car been professionally serviced in the past 12 months?

1. No
2. Yes
3. Don't know

53. Are seat belts fitted in the car?

1. Front and rear
2. Front only
3. No seat belts
4. Don't know

54. Has the car been modified? (for example; suspension raised or lowered, wide tyres, loud muffler)

1. No
2. Yes
3. Don't know

55. How old are the tires?

1. < 1 year
2. 1-4 years
3. > 4 years

4. Don't know

56. When was the last time you checked the brake system?

1. < 6 months

2. 1 year

3. 2-3 years

4. > 3 years

5. Never

6. Don't know

Background information:

57. Which of the following best describes your job situation at the time of the crash?

1. Full time work for pay

2. Part time work for pay

3. Student

4. Unemployed

5. Homemaker

6. Retired

7. Other please specify-----

8. Don't know

The ethical approval from the Ministry of Health, Oman:

<i>Sultanate of Oman</i> <i>Ministry of Health</i> <i>Directorate General of Planning</i> <i>Directorate of Research & Studies</i>		سلطنة عُمان وزارة الصحة المديرية العامة للتخطيط المديرية للدراسات والبحوث
Ref : MH/DGP/R&S/PROPOSAL _APPROVED/2/2012		الرقم : _____
Date : 15.2.2012		التاريخ : _____
		الموافق : _____
 To, Ahmed Salim Al-Risi - Principal Investigator, " Characteristics of Road Traffic Accidents and Potential Risk Factors "		
 After compliments. We are pleased to inform you that your research proposal " Characteristics of Road Traffic Accidents and Potential Risk Factors " has been approved by Research and Ethical Review & Approve Committee, MOH.		
 Regards,		
		
Dr. Ahmed Al Qasbi Director General Of Planning, Chairman, Research and Ethical Review & Approve Committee MOH, Muscat, Sultanate of Oman.		
Cc Day file		

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هاتف : ٢٤٦٩٧٥٥١ (٩٦٨) - فاكس : ٢٤٦٩٦٧٠٢ (٩٦٨)