ANALYSING FACTORS THAT DETERMINE THE OCCURRENCE OF ROAD TRAFFIC ACCIDENTS IN CHILE

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A thesis submitted in partial fulfilment of the requirement for the degree of Master in International Health

by

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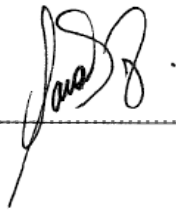
Signature:……  ……

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ABBREVIATIONS

3CV	Centre of Control and Certification of Vehicles
ATC	Australian Transport Council
ASEP	Automated Speed Enforcement Program
AUGE	Universal access with specific guarantees
BAC	Blood alcohol concentration
BCN	Library of National Congress
Cati	Automatized Centre for Infractions
CAT scan	Computerized axial tomography scan
CISR	Inter-ministerial Road Safety Committee (France)
COHA	Council on Hemispheric Affairs
CONASET	National Committee for Traffic Safety
DPSEEA	Driving forces, pressure, state, exposure, effect, actions
DRL	Day-time running lights
DT	Direction of work
FONASA	National Health Fund
INE	National Statistics Institute
ISAPRE	Previsional Health Institutions
GDL	Graduated Driving Licensing
LA	Latin-America
M2-W	Motorized 2-wheel vehicle
M4-W	Motorized 4-wheel vehicle
MDGs	Millennium development goals
MINEDUC	Ministry of Education
MINSAL/Msal	Ministry of Health
MOT	Periodic vehicle inspection
MRI	Magnetic Resonance Imaging
Mtt	Ministry of Transport and Telecommunications
NCDs	Non-communicable Diseases
OECD	Organization for Economic Cooperation and Development
PD	Police Department
RTAs	Road traffic accidents
SES	Socio-economic status
SDGs	Sustainable Development goals
SENDA	National service for prevention and rehab of drugs and alcohol
VRU	Vulnerable Road Users
WHO	World health organization
GIS	Geographic Information System
SEVILE	Injury Surveillance System
SWOV	Foundation for Road Safety Research
UN	United Nations
UNECE	United Nations Economic Commission for Europe
FMVSS	Federal Motor Vehicle Safety Standards

ABSTRACT

In spite of the economic crisis, Chile has had a steady economic growth over the last decade. This has lead to an increase in the motorization rate and also increases in the number of road traffic accidents (RTAs). This study aims to improve the understanding of the occurrence of RTAs in the Chilean context and perceive them as a current health problem with direct impact on mortality, physical-psychological damage and a high economic burden to families and to the country.

This study was done based on the analysis on the DPSEEA framework, adapted to RTAs, for understanding of the factors that have an impact on occurrence. Literature review of peered reviewed articles and grey literature was done, as well as secondary analysis of the traffic accidents database.

In Chile the main individual causes of RTAs are; recklessness of drivers/pedestrians, loss of vehicle control and alcohol. There is basic legislation in the country that covers; speed limits, seatbelt usage, child restraints, helmets. The distribution of the victims show that the most affected are men, mainly between 15-29 years old, drivers in the first place and secondly pedestrians. Insufficient enforcement measures, incomplete data collection system and a deficient health system are some of the issues discussed.

The country data collection system has to improve, in order to create a national strategy that is comprehensive to this context. Road planning and traffic calming measures to protect vulnerable users, increase enforcement and awareness of the population against traffic violations is needed.

KEY WORDS: Traffic, accidents, determinants, Chile, interventions.

Word Count: 13.109

INTRODUCTION

During the past 20 years, the causes of worldwide concern, in terms of health, have change considerably. The health of the population has become a point of international concern. What happened for example with the Millennium Development Goals (MDGs), that helped focus efforts and resources to areas that were needed the most (benefiting mainly the poor, women and children). Unfortunately they didn't represent those dying from Non-communicable Diseases (NCDs), violence and road traffic accidents (RTAs)(Buse & Hawkes, 2015). Even though the MDGs help tackle very important issues, there is still concern in the RTA matter. RTAs are a major cause of death worldwide. Around 1.24 million people die every year because of traffic injuries and an estimate of 1.9 million are going to die each year in the 2020. About a 90% of the RTA in the world occur in low-middle income countries(WHO, 2011).

Latin-American (LA) countries have a characteristically high socioeconomic inequality among their population. These structural inequalities determine that a health system has different needs, resources and abilities (de Andrade et al., 2015). There are certain groups that are more at risk of having a RTA and dying from it. One third of RTA occur among men particularly between 15-44 years old (WHO, 2013). This is the second cause of death between the 5-29 years old group. The majority are vulnerable road users (VRU), which include pedestrians, cyclists and motorcyclists(Peden et al., 2004).

Unsafe public transport has detrimental effects both on public health and global development. Brings considerable economic costs; hospitalization, recovery, reduced productivity and emotional scaring. It is estimated that the worldwide cost of RTA is $518 USD billions and that represents around 1% of the Gross domestic product (GDP) in Latin America and the Caribbean(Peden et al., 2004).

In Chile, the most affected are men between 15-29 years old, occupants of motorized 4-wheel light vehicles and pedestrians. Most frequent individual causes of death are recklessness of driver/pedestrian, loss control of the vehicle and alcohol. Accidents occur more often at night and holidays, which is when people get out of work and have more time to go out(CONASET, 2014a). RTAs contribute to the mortality, morbidity and high inequalities of the population. These deaths and injuries are considered preventable and highly predictable, therefore they have a good response to interventions(Peden et al., 2004)
In 2012, I started working as a medical advisor for the National service for prevention and rehab of drugs and alcohol (SENDA), they had just launched the new modification of the drinking and driving law "Zero Tolerance". During that year, I worked with the police in the alcohol checkpoints, taking samples for the blood alcohol concentration (BAC). I

realized how big of a problem traffic accidents were for the country and that much of the population did not comply with the traffic regulations. Almost at the end of the first year, I noticed that much less people required a blood extraction and that public behaviour towards drinking and driving was more conscious. This was what inspired the subject of this thesis.

The aim of this thesis is to improve the understanding of RTAs, in the Chilean context, as a current health problem, through analysing the factors that have an impact on their occurrence. This information will help in the creation or future modification of comprehensive policies that adapt to the Chilean population and to reduce the burden of this health problem.

CHAPTER 1: BACKGROUND INFORMATION ABOUT CHILE.

1.1. Population

Total population is approximately 17,6 million(CONASET, 2014f). Life expectancy is 79 years. There has been an important demographic transition, with a shift in the causes of death from communicable to non-communicable diseases, attributed to changes in health, sanitation, socio-economic and educational indicators. The decrease in child mortality and prolonged life expectancy have shifted the population from a juvenile structure to a middle-aged one(Vasquez, Paraje, & Estay, 2013).

According to the 2002 census, 86,6% of the population lives in urban areas and the 13,4% lives in rural areas. Population growth rate for the years 2000-2014 is 0,97%(INE, 2002).

A project of law can only be presented by either the president or a member of the national congress (chamber of deputies and senate). The project is handed out from one chamber to the other for revision. The document goes back and forth from both chambers until they both agree on the terms of the policy and then this is given to the president for final approval. The policy becomes official when its published in the National Newspaper(MINEDUC, n.d.).

1.2. Geographic Location and Climate

Has an area of 2,006,096 km^2, its length north-south, is around 8,000km and its width 445km to 90km in its thinner area. Borders with Peru, Argentina and Bolivia, the South Pole and the Pacific Ocean. The surface has 2 mountain ranges (Cordillera de los Andes and Cordillera de la Costa)(INE, 2012).

The country is divided into 13 regions, from north to south. Each region has at least one capital city. The capital of the country (Santiago) belongs to the XIII region.

The country has a wide range of climates, from north to south: dessert, mediterranean, rainforest, rainy, tundra and polar. After Japan, Chile is the second country most seismically active in the world. Situated in the "Ring of Fire"(CSN, n.d.). It has two of the most active volcanoes in South America; Villarrica and Llaima. Because of this the country has suffered a number of natural disasters that have an impact on the subject of this thesis.
List of late Disasters(Gobierno de Chile, 2015):
2010: Earthquake (8.8 Richter scale) and tsunami
2014: Earthquake (8.2 Richter scale)

2015: Valparaiso fire, inundations in Atacama and Antofagasta, eruption of Calbuco volcano, earthquake (8.3 Richter) and tsunami

1.3. Socio-economic status

Chile is an high-income country(World Bank, 2015). Even though there has been a steady economic growth over the past 30 years, the level of inequality in the distribution of capital is currently the worst in LA. The richest quintile holds 50% of the total income, while the poorest quintile only the 6%(Vasquez et al., 2013). The level of poverty and indigence have declined since the 1990s from 39% and 13% to 13,7% and 3,2% respectively in the year 2006(Vasquez et al., 2013).

1.4. Health system

The Chilean health system is a mixed system, were public and private entities co-exist and share the provision of services as well as the financial structure. In 2005 there was a health reform "Plan AUGE". Initially for a number of prioritized conditions with further plans on expanding. The universal access was regardless of the ability to pay(Vasquez et al., 2013).

The public health insurance is provided by the National Health Fund (FONASA), were compulsory contributions (7% of gross income), plus national governments health budget (15,8%), co-payments and others finance the system(Comision Nacional de Salud de la Nueva Mayoria, 2014).

The private health insurance is provided by Previsional Health Institutions (ISAPRES), like the previous one, this is mainly financed by the 7% compulsory contribution, and depending on the benefits provided, this could be higher.

The distribution of the population in the public and private sectors is 81% and 19% respectively. The public sector currently covers more than 88% of the population older than 65 years (Vasquez et al., 2013). While the private sector holds the 45% richest quintile of the population.

CHAPTER 2: PROBLEM STATEMENT, JUSTIFICATION, OBJECTIVES AND METHODOLOGY OF THIS THESIS.

2.1. Problem analysis and justification

Mortality and disability due to RTA are a growing concern worldwide. If no action is taken, road traffic injuries could become the 7th cause of death worldwide by the year 2030(WHO, 2015). The premature mortality and morbidity caused by RTAs is highly preventable and represents a serious health problem. Even though this problem kills less than HIV/AIDS and Malaria in the developing world, it is still a major issue that together with NCDs were not included in the MDGs. The new adopted SDGs will include this in "Target 6: reduce by 50% the amount of deaths and injuries due to RTA by 2020"(Buse & Hawkes, 2015)

Accidents and injuries do not distribute randomly among the population, poor people and minorities are the most affected. Wealthy people usually live closer to work; they travel shorter distances and have safer cars. Poor people have to travel further, usually on foot and without protection. Even after an accident has occurred, poor people have worse outcomes because of the difference in treatments that they can access(Tapia Granados, 1998).

The country has a population of around 17.8 million people, 4,6 million motorized vehicles and a motorization rate of 201 vehicles per 100.000 population(CONASET, 2014f). In spite of the economic crisis, the motorization rate kept growing. This was thanks to the steady economic growth of the country.

Among all causes of mortality in the country, injuries represent around the 8% of the total(DEIS, 2012). In 2014, there were 78.445 crashes, 57.885 injured (7.457 severely injured) and 1.630 died due to RTAs. From the total of injured and deaths, men are overrepresented in 60% of injuries and 76% of deaths cases(CONASET, 2014d). The most affected age group is between 15-29 years old (321 cases). The 71% of the cases are between 15-59 years of age(CONASET, 2014a). According to the road user categories, the majority of the deaths occurred in motorized 4-wheel vehicles (47%) and secondly pedestrians (38%).

The major individual cause of **accidents** is due to recklessness of the driver (48.9%)(Annex 1). Individual causes of **death** is due to recklessness of the driver (23.4%), recklessness of pedestrian (23.5%) and lost control of the vehicle (22.9%)(CONASET, 2014a).

RTAs are a health problem for several reasons; the direct high mortality and morbidity, the physical and psychological damage and the high

economic burden to the families of the victim and the country. The country looses USD$ 500 millions every year due to RTAs(MINSAL, 2011).

There are several safety measures that have been introduced; Speed limits, drinking laws, helmet law, seatbelt law, child restrain law and usage of mobile phone while driving(WHO, 2015). Even though these safety measures are implemented in the system, levels of enforcement are low and they appear not to be enough to prevent accidents. Since the year 2005, when measures started being implemented, the number of accidents has actually risen.

This thesis aims to describe the current effects of RTAs in the country, as well as identify factors influencing their occurrence and actions currently in place, in order to recommend effective strategies for lowering the number of victims.

2.2 General Objective

The objective of this thesis is to describe the current situation of the country and identify influencing factors that determine the occurrence of RTAs for improving the understanding of the Chilean case in order to make recommendations for better comprehensive policies, research and analysis.

2.3 Specific Objectives

1. Describe current incidence of the event and effects; accidents, mortality and morbidity due to RTAs in the year 2014 in Chile.
2. Describe and identify factors that contribute to RTAs in Chile.
3. Describe actions currently in place in the country and identify best practices done in other countries; for improvement of the effectiveness of the actions against RTAs in Chile.
4. Provide cost effective recommendations in order to improve performance of the actions that are in place, as well as possible options that could be implemented.

2.4 Methodology

This study was done with literature review and secondary data analysis of the current database of the "National Committee for Traffic Safety" (CONASET) and police department (PD). Data was extracted from public records of the 2014 country report. Information of previous years was also used when relevant. These records were taken routinely. The records of deaths and degree of the injuries are only taken into account during the first 24hrs from the accident itself. This means that there is an underestimation of the numbers of deaths or seriousness of the injuries.

The National Statistics Institute (INE) collects information through the Ministry of health, which collects the information through hospitals about

major causes of death among the population. These also include deaths after 24hrs; because of this there is a difference in numbers of death between INE and CONASET. INE shows 2.129 deaths due to RTAs and CONASET only 1.630. INE does not have a detailed description of individual causes on their last report (injuries due to RTAs). This is why the information provided by CONASET will be used to provide the results on Chapter 3. The underestimation between these 2 sources of information will be discussed further in Chapter 4.

Search was done with the combination of key words; social determinants, health, RTAs, public health, prevention, policies, injuries, measures, legislation, speed, transportation; in Google Scholar, PubMed, Sciencedirect, Cochrane library and Scielo. Review of online information from national websites; CONASET, SENDA, MINSAL and PD. Grey Literature was extracted from; Google and local news-papers (El Mercurio, La Tercera, La Nación). Only articles in Spanish and English were used. Dates of the articles range from 1982-2015.

2.5 Conceptual Framework: DPSEEA for linkage between health environment and development.

The Linkage-based model, DPSEEA framework (driving forces, pressure, state, exposure, effect and action) was created in order to understand the linkage between health, environment and development. This model uses the "causality" or "cause-effect" concept into account and creates a chain of events to explain a health problem and benefits with high flexibility and adaptability. Previous version Pressure-State-Response (PSR) was a more limiting model, less adaptable to other health situations(Corvalan CF, Briggs D, 2000)(Waheed, Khan, & Veitch, 2009).

Rather than a unidirectional chain, this model is more a network (multiple effects can de the cause of one driving force and viseversa), therefor has been adapted to fit other important factors(Corvalan CF, Briggs D, 2000). The model used in this thesis better adapts the current issue of "road traffic accidents" and because there are many factors involved in an accident, two additional steps have been added (primary/secondary risk factors and the event) (see Figure 1). This model better adapts the topic under research because it recognizes that the exposure (driving) alone does not lead to the effect (mortality), but the addition of risk factors and event (accident, crash) create a better understanding of the causality(Farchi et al., 2006).

Other used model "The Safe-systems approach" by the Organization for Economic Cooperation and Development (OECD) and Australian Transport Council (ATC) fail into including the "accident" and "effects" into their model, which are important factors when implementing better post-crash care and rehabilitation services.

Possible limitations of this model are that the higher up chains are the most important and missing information can lead to causality errors. Also can oversimplify the inter-linkages between factors and interaction, which can lead to bad informed management decisions.

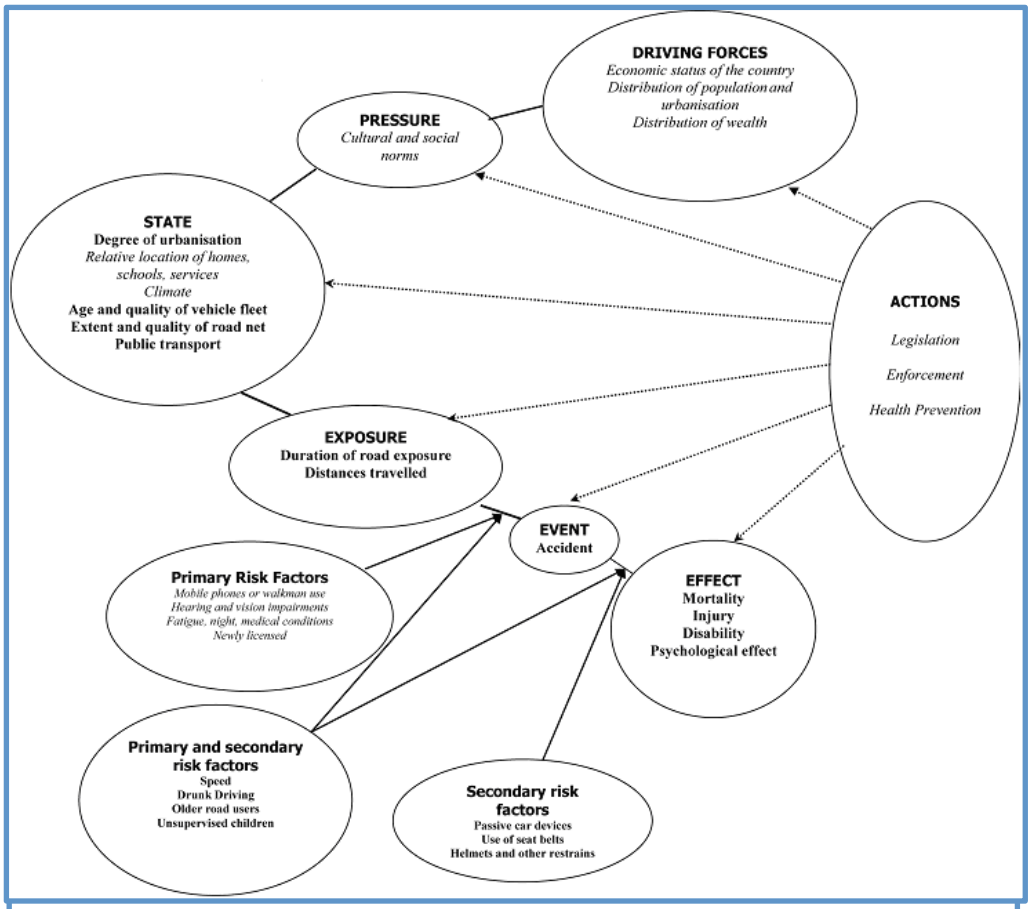


Figure 1: Adapted version of DPSEEA framework(Farchi et al., 2006)

In order to contextualize the framework to the current health problem, a bottom-up strategy will be used. This means that the description of the model will start with "event and effect" and finish with "driving forces and pressure".

Chapter 3 will describe the results obtained from the analysis of the factors found in the framework. Chapter 4 will discuss results from the previous chapter, describe current actions undertaken in the country at different levels, along with evidence from best practices in other countries. Chapter 5 will provide a final discussion, conclusion and recommendations.

The effects and event will be described as current incidence of RTAs and mortality and morbidity due to RTA. This will be separated into different groups (sex, ages, individual causes, road users, vehicles).

Primary risk factors influence the occurrence of the Event and secondary risk factors are those that influence the degree of damage after the "Event" has occurred. Some factors can belong to both categories but they will be analysed under the same headline. This will include; different sources of distraction, medical conditions, fatigue, newly licensed, children supervision, drink and driving, speed, and safety devices (helmets, seatbelts)(Farchi et al., 2006).

A person has to have contact with traffic in order to participate in an accidents, this is called "Exposure". The amount (duration and distance) is also a factor that determines the occurrence of the event. This alone doesn't guarantee the occurrence of the event, but when combined with "Risk factors" the chances of having an accident are higher.

"State" is several factors that determine hazardousness of the environment. Traffic calming measure can influence how road users interact with traffic, for example; mixing VRU with highways. Age/quality of vehicles can be more/less dangerous to drivers and VRU. A non-comprehensive public transport can cause that disabled people have to walk or use wheel chair on the road. House settlements or business areas with no separation from highways can create a dangerous environment for workers or people living in those areas (children).

"Pressures" are the cultural and social norms, this can be expressed through human occupation and how they exploit their environment(Corvalan CF, Briggs D, 2000), but also determined by social policies from higher up.

"Driving forces" are the factors that push and motive the all processes of this framework. Indicators like; economic status of the country, distribution of population and wealth, urbanization and health system. These are factors that create a need to travel in the country.

The following section will describe the results obtained from the analysis of the framework

CHAPTER 3: CURRENT INCIDENCE OF "EVENT" AND "EFFECTS " OF RTA AND DESCRIPTION OF FACTORS INFLUENCING THEIR OCURRENCE.

This chapter will answer the first and second objectives of this thesis. The Event and Effects section (3.1) will answer specific objective Nº1. The occurrence of an event and its effects are determined by multiple factors that interact in a complex network. As mentioned before just the exposure does not necessarily generate an effect. Therefor the factors involved in the occurrence will be described in sections 3.2 to 3.5, answering specific objective Nº2.

3.1 Event and Effects on population

Traffic accidents are a major health problem, because of the impact that they have not only on the direct victims but also on their families. Due to the rapid country motorization, it is estimated that the problem will worsen. To have a better understanding of the scale of the problem; number of accidents, death and injuries will be used to describe the current effects of RTAs in the country. The "causes" described in this section represent individual causes rather than factors influencing the occurrence of RTA, which will be described later in the chapter.

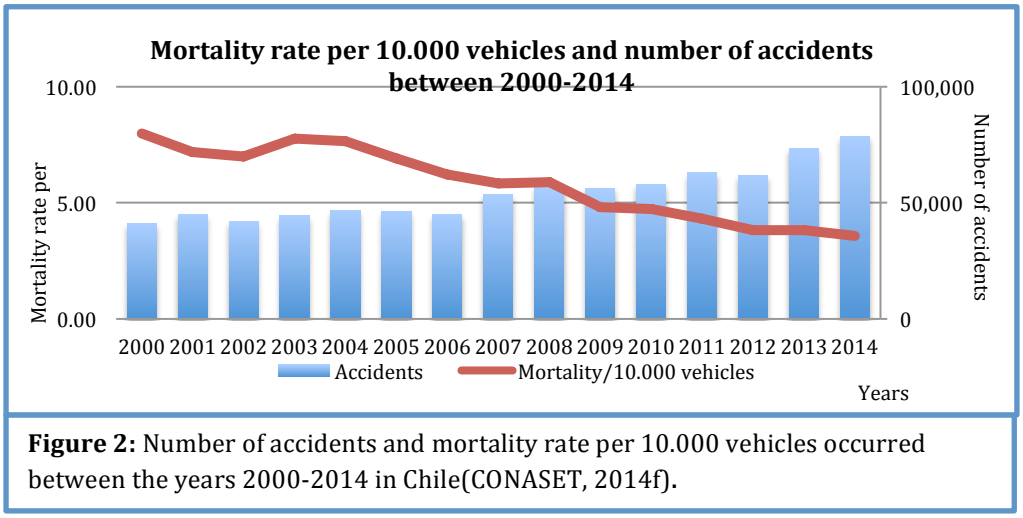


Figure 2: Number of accidents and mortality rate per 10.000 vehicles occurred between the years 2000-2014 in Chile(CONASET, 2014f).

In 2014, there were 114.398 accidents, 1.630 deaths and 57.885 injured. According to the Global safety report on road safety, Chile has the lowest mortality rate (12,3) per 100.000 population in LA(WHO, 2013a). Figure 2 shows that the number of accidents has increased in the country, while the mortality rate has decreased between 2000-2014(CONASET, 2014f).

3.1.1 Individual causes of accidents, deaths and injuries registered

In this case CONASET receives the information from the PD and groups it into different databases according to topics. For example: Individual causes of accidents; the category "recklessness of the driver" contains others like; not respecting pedestrian right of way, driving distracted, overtaking when not allowed, etc (See Annex 1).

Table 1 shows that the main **causes of accidents** in 2014 were, recklessness of the driver (49%), sign disobedience (9,2%), loss of vehicle control (7,3%) and alcohol (7,2%). Main **causes of death** were, recklessness of the driver (26%), recklessness of the pedestrian (23,6%), loss of vehicle control (21%) and alcohol (11,8%). Main **causes of injuries** were, recklessness of the driver (41,2%), sign disobedience (11,6%), loss of vehicle control (11,2%) and alcohol (8,9%)(CONASET, 2014a). Non-determined and other causes were not taken into account in this case.

In all three categories (accidents, deaths, injuries) the most important causes are:

- Recklessness of driver/pedestrian,
- Sign disobedience,
- Loss of vehicle control,
- Alcohol

Table 1: Causes of accidents, deaths and injuries and percentages (%) in Chile in 2014(CONASET, 2014a).

Cause	Accidents	Deaths	Injuries			Total Injuries
			Severe	Moderate	Mild	
Alcohol in driver	5.255 (6,7%)	142 (8,7%)	793	405	3.583	4.781 (8,3%)
Alcohol passenger	20 (0%)	0	5	2	16	23 (0%)
Alcohol pedestrian	379 (0,5%)	51 (3,1%)	119	38	181	338 (0,6%)
Non-determined	8.083 (10,3%)	31 (1,9%)	771	322	3.604	4.697 (8,1%)
Road Deficiencies	880 (1,1%)	6 (0,4%)	75	38	442	555 (1%)
Sign disobedience	7.233 (9,2%)	67 (4,1%)	553	333	5.849	6.735 (11,6%)
Drugs a/o Fatigue on driver	597 (0,8%)	24 (1,5%)	104	66	642	812 (1,4%)
Mechanical flaws	1.255 (1,6%)	14 (0,9%)	139	83	1.178	1.400 (2,4%)
Recklessness of driver	38.298 (48,8%)	423 (26%)	2.380	1.494	19.955	23.829 (41,2%)
Recklessness of passenger	303 (0,4%)	3 (0,2%)	33	23	224	280 (0,5%)
Recklessness of pedestrian	2.809 (3,6%)	384 (23,6%)	703	250	1.631	2.584 (4,5%)
Loss of vehicle control	5.760 (7,3%)	343 (21%)	1.027	598	4.883	6.508 (11,2%)
Reckless speed	1.181 (1,5%)	92 (5,6%)	224	122	1.094	1.440 (2,5%)
Other Causes	6.392 (8,1%)	50 (3,1%)	531	238	3.134	3.903 (6,7%)
Total	78.445	1.630	7.457	4.012	46.416	57.885

3.1.2 Type of road users affected

Motorized 4-wheel (M4-W) light vehicles were the most involved in RTAs(68%). The group most fatally affected was VRU (53%). In this group, pedestrians are killed the most (38%). The majority of people injured are M4-W light vehicles occupants (59%) (See Table 2)(CONASET, 2014e). No distinction is made whether the occupants are drivers or passengers.

In the countries' database two different terms were used, type of road user and quality of the participants. The later separating road users into pedestrians, drivers and passengers. No further detail is given over the type of vehicle they drove (2-wheeler versus 4-wheeler) and it is not clear into which category cyclist were included. For this reason data contained in "quality of participants section" was not included here.

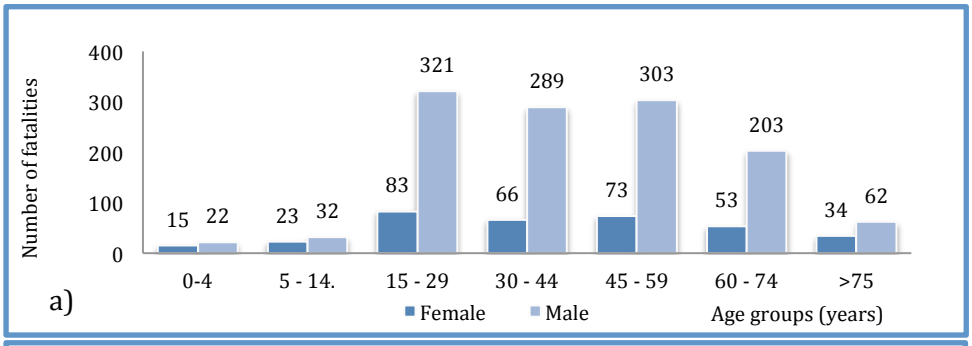
Table 2: Number of accidents, deaths and injuries by type of road user in 2014 in Chile(CONASET, 2014e)

Type of User	Accidents	Deaths	Injuries			Total injuries
			Severe	Medium	Mild	
Pedestrians	11.491 (10%)	615 (38%)	1.978	780	6.061	8.819 (15%)
Cyclists	3.957 (3%)	109 (7%)	600	277	2.536	3.413 (6%)
M 2-wheelers	5.878 (5%)	123 (8%)	1.291	437	3.245	4.973 (9%)
M 4-W light	77.300 (68%)	650 (40%)	2.907	2.046	28.921	33.874 (59%)
M 4-W heavy	13.508 (12%)	117 (7%)	600	391	4.946	5.937 (10%)
Others	2.264 (2%)	16 (1%)	81	81	707	869 (2%)
Total	114.398	1.630	7.457	4.012	46.416	57.885

3.1.3 Gender and age groups

In 2014, 76% of fatal cases were male and 24% female. Figure 3a and 3b shows that most deaths and injuries occurred between 15-59 years old, being the age group between 15-29 years old the one with the most number of deaths/injuries. In 2014, 71% of the deaths occur between 15-59 years old, and 48% occur between 15-44 years old. After 60 years of age the number of fatal victims start to decline (see Figure 3a). From the total of **deaths** among people older than 60 years (352 fatalities), the majority were pedestrians (53%), followed by drivers (30%) and passengers (17%). The **injured** (5.662) in this group (>60 years) were 41% drivers, 32% passengers and 27% pedestrians(CONASET, 2014c).

Figure 3b shows the number of injured people in 2014 by age group and gender. The age group between 15-29 years old had the highest amount of injuries (11.601 male, 6.934 female). In both cases, deaths and injuries, males are the most affected; this is consistent with the literature.



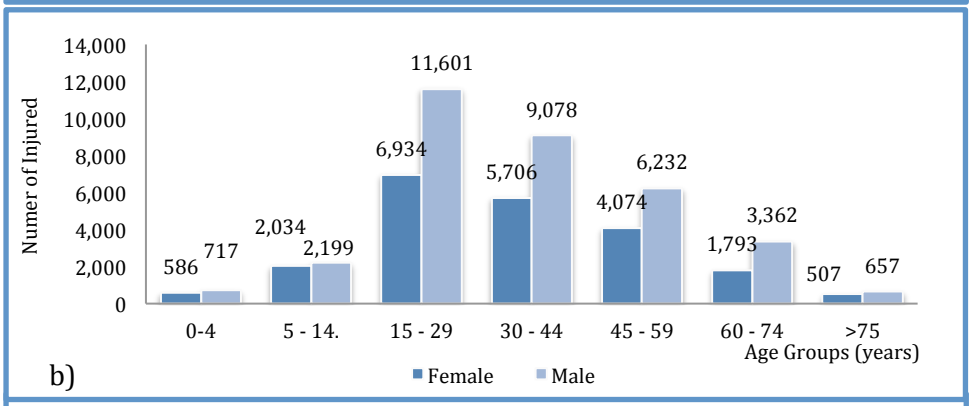


Figure 3a: Number of fatalities in 2014 by age groups and sex(CONASET, 2014d). **Figure 3b:** Number of injured people in 2014 by age group and sex(CONASET, 2014d).

3.1.4 Area

Most accidents occur in urban areas (84%) and only 16% in rural areas. The percentage of deaths that occur in rural and urban areas is; 60% and 40% respectively. In terms of injuries; these occur more in urban than in rural areas (63% and 37% respectively). There is no information in CONASET about type of road (with or without pavement) or intersections.

3.1.5 Disability in Chile

The last disability report showed that, 12,9% people live with a disability. Among direct causes; chronic diseases (62,9%), degenerative problems (15,3%) and accidents (7,7%). Preventable causes amount to 80% of the cases(Disability, 2004). No detailed information about the type of accidents (intentional, unintentional) was included in this report.

The report also shows that most disabled are adults between 30-60 years old, majority are women, most common is physical disability, only 30% have paying jobs, 40% live in poor socioeconomic conditions and only 6% had access to rehabilitation services in the past(Disability, 2004).

3.2 Primary and Secondary risk factors

Primary risk factors modify the probability of an accident to occur and secondary risk factors modify the damage caused by the accident, both of them could increase or decrease the chances and some of the factors can even act at both levels. In this section factors are going to de described together, for references on which act as primary or secondary see Figure1.

3.2.1 Distraction in Traffic

In Chile, very little information is available on this matter. Unfortunately, there are no records on the types of distractions that might have caused the accidents; CONASET catalogues all distractions under the same category, recklessness of the driver in this case (see Annex 1). During 2014 there were 22.132 traffic accidents due to inattention, with 102 deaths and 13.587 injured(CONASET, 2014a).

Although it is not detailed in the Chilean statistical data, mobile phone usage while driving is a major concern. According to a survey done by the Pew Research Centre, an estimate of 91% of the Chilean population owns a cell phone, which 39% are smartphone(Wike, R. Oates, 2014).

Insurance companies reported 2.390 traffic accidents caused by mobile phone usage in 2011, this is a 15% increase compared to the year 2010 (2.085). They also reported that 62% were male and the majority from a high socioeconomic income. A survey done by Automobile Club Chile showed that 60% of the drivers uses a mobile phone while they are driving(Vásquez, 2012).

3.2.2 Hearing, vision impairment and medical conditions

A health check-up for the people that apply for a driving's license is included in the general evaluation. This includes visual, psychometric, hearing and blood sample for most common diseases. If necessary they are sent to see a specialist for treatment. Whether any of these conditions are the cause of traffic accidents, is not presently notified in the reports from the CONASET.

3.2.3 Fatigue and night driving

In 2014, fatigue caused 23 deaths and 775 injured (see Table 1). A 67% of the fatal cases occurred in the rural area(CONASET, 2014a). No information on whether these were professional drivers or private cars.
In 2006, the Labour Inspection supervised a number of companies, they found that most of them had no control over the amount of hours worked by their drivers or the amount of hours they rested(Diario la estrella de

Iquique, 2006). A survey done in 2012 showed that 36% of the workers use a register for time worked and that 29% work more than 5 hours in a row without resting. The reasons they gave were, "to finish quickly", "to have a better salary", "to meet the companies working schedules"(DT, 2012).

3.2.4 Newly Licensed (Young Novice Drivers)

In Chile, legal driving age begins at 18 years old. There are exceptions for some 17 year olds to get their license earlier by completing a driving course at a certified driving school plus a signed permit from their parents. There are no restrictions for these drivers in Chile like; driving alone, driving at night, Blood Alcohol Concentration (BAC) <0,2g/L or number of passengers allowed in the car)(BCN, 2012).

In 2014, 105 young drivers between 17-24 years old died and 5.267 were injured in different severities(CONASET, 2014c). Unfortunately data does not show the male/female drivers proportion, the type of vehicle they were driving, if they had a valid drivers license, amount of accidents caused or individual causes of accident.

3.2.5 Speed

In 2014, there were 1.181 traffic accidents due to reckless speed, 92 fatalities and 1.440 injured (see Table 1). Reckless speed means speed higher/lower than the allowed or that the driver misjudges the appropriate speed to drive. For example driving at the maximum speed in a 120km/hr highway when the pavement is slippery and wet from rain (CONASET, 2014a).

There are discrepancies in the information about deaths due to high speed. According to the Ministry of Transport and Telecommunications (Mtt), 40% of the accidents in the country have high speed as a contributing factor, but according to the PD and CONASET this is much lower(CONASET, 2014a; Mery, 2015; Mtt, n.d.-b).

3.2.6 Drinking and driving

In 2014, there were 5.654 accidents, 193 fatalities and 5.142 injured. Accidents due to alcohol consumption were around 8% of all the causes, but around 12% among the fatal cases(see Table 1). The majority occurred between 21:00-23:59hrs and 03:00-5:59hrs during the weekends, which are the times when bars open and close. Males between 19-33 years old had the highest mortality rates(CONASET, 2014g). According to direct causality of the accidents, drunk drivers had the highest involvement (52%), followed by drunken pedestrians (26%) (CONASET, 2014g).

In 2012, the alcohol law was modified, lowering BAC levels allowed while driving to <0,3g/L. The amount of accidents increased after the campaign started (2%). There is almost 30% decrease in the amount of deaths and 10% decrease in injuries between 2011 and 2014 (before and after the alcohol law) (see Table 3).

Table 3: Trend in the number of accidents, deaths and injuries due to alcohol use from 2011 to 2014. In red; introduction of alcohol law(CONASET, 2014a)

Years	2011	2012	2013	2014	Trend (%)
Accidents	5540	4162	5171	5654	+2.1
Deaths	272	216	231	193	-29
Injuries	5694	4220	5086	5142	-9.7

3.2.7 Older road users

Figure 4, shows the amount of elderly that was involved in a RTA. In 2014, there were 96 fatalities and 1.164 people injured in the group of elderly (>75 years old). In the three user categories, pedestrians were the most affected.

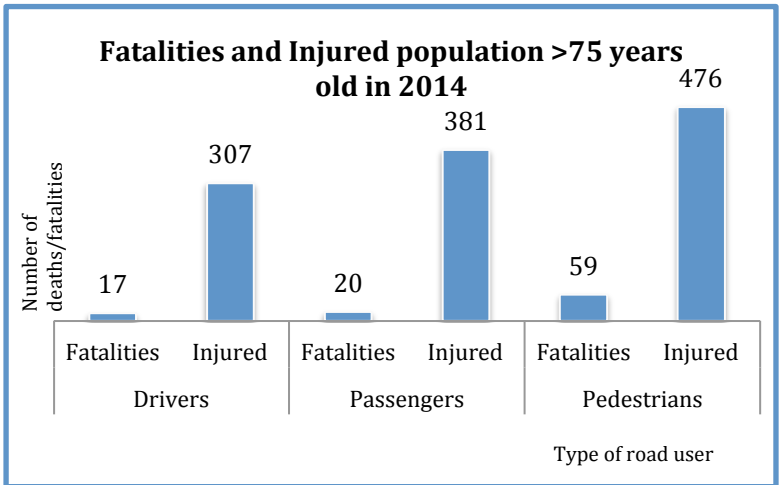


Figure 4: Number of fatalities and injured in the group of people older than 75 years by type of user in 2014 (CONASET, 2014c)

3.2.8 Unsupervised children

Motorized vehicle accidents and violence are the first cause of death in children from 1 to 14 years in the country. In 2014, 92 children died and 5.633 were injured between 0-14 years old. Number of deaths between 4-14 years old were; 47 pedestrians, 41 passengers and 4 drivers. The

majority of injured children occurred in the group of passengers with 4.015 injured, followed by pedestrians and drivers with 1.286 and 332 cases respectively(CONASET, 2014c).

3.2.9 Passive car devices

Passive devices, also called secondary safety systems, are those that protect the driver and passengers of serious injuries once a car crash has occurred.

Airbags are required by law on the 2 front seats of new vehicles, since 2014. No information was found on the amount of vehicles that currently have them installed. According to a local observational study in 2013, drivers and front passengers use seatbelts 82% and 67% respectively and only 14% in rear seats(CONASET, 2013c). The country profile mention that the usage can be as low as 50% in front seats and 10% in rear seats(WHO, 2013a). A local newspaper mentioned that Chile has one of the lowest seatbelt usages in LA(Tercera, 2012). There is a clear difference in ciphers and further research could be done on this matter.

CONASET and Automobile Club Chile did a qualitative study about the usage and safety perception of child restraints. Some of the results are; Families with more than 3 children cannot accommodate 4 children with the respective restraints in a normal 2 row car; Some children find the chair excessively uncomfortable and therefore parents prefer not to use it; Most people perceive it is a necessity when they have a car, but prices are high and most people cannot afford them or don't have access to a good quality product; Some people referred to it as "a luxurious accessory"; Some children perceive the usage of the seatbelt as embarrassing(Automóvil club de chile, 2008). This study shows the economic, educational and cultural barriers that must be addressed.

3.2.10 Helmets, other restraints

In 2014, there were 5.878 motorcycle accidents (123 died; 4.973 injured) and 3.957 bicycle accidents (109 deaths; 3.413 injured) (CONASET, 2013a). According to a qualitative study done by CONASET, 99% of the drivers and passengers of motorcycles, used helmet (CONASET, 2013b). In Chile the usage of helmets appears to be an important priority. Other protective devices like cloths and boots appropriate for motorcycles is less popular, due to their prices and uncomfortable during summer. There is no cross-reference data about the accidents and rate of usage in the statistics website.

3.3 Exposure to Risk

The exposure to the risk is important in order to calculate the risk that a person has of being involved in a RTA. This is a way of determining how many people participate in traffic. The more and longer people travel, the risk of having an accidents gets higher(SWOV, 2013b). There are several ways of analysing exposure. In this section I will show data found about the country motorization, demographic factors, transport/land-use and need to travel.

In 2014, there was a 15% increase in the number of vehicles compared with 2012 (see Table 5). At the moment there are 4.568.664 vehicles registered, 40,9% of them are in the Metropolitan region. The major growth was in M2-W vehicles with a 26% increase, followed by light M4-W vehicles (15%) and heavy M4-W vehicles (7%)(INE, 2014). The vehicle fleet in the country is dominated by M4-W vehicles(88%). The rate of motorization between the years 2008 and 2012 increased a 21,2% (from 158,6 cars per 1000 population to 201,2). In an interview with the expert Louis de Grange (PhD in Transport) said that the growth of the vehicle fleet is a symptom of the economic growth of the country, generating a bigger demand and longer trips. There have been measures to try and mitigate the growth of the vehicle fleet and their quality. For example, an increase in taxes for those vehicles that use diesel(Mercurio, 2014).

Table 5: Trend in growth of vehicle fleet registered between the years 2012-2014 in Chile(INE, 2014) (% of the total)

Type of Vehicles	Total in 2012	Total in 2014	Number of vehicle increase	Trend (%)
M 2-W	133.640 (3%)	167.876 (4%)	34.236	+ 26%
M 4-W light weight	3.500.224 (88%)	4.029.883 (88%)	529.659	+ 15%
M 4-W heavy trucks	234.748 (6%)	251.295 (5%)	16.547	+ 7%
Others	105.301 (3%)	119.610 (3%)	14.309	+ 14%
Total	4.505.413	4.573.693	594.751	+ 15%

M 2-W: motorized two-wheel vehicle (motorcycle), M 4-W: motorized four wheel vehicle,

Mobility data is very hard to find in the country. There is one mobility survey done in the metropolitan area that determined that people travel 2,78 times per day. The majority of those trips were done in motorized vehicles (61,5%) and 38,5% walking or cycling. Public transport was the most used (29%), followed by private transport (28%). In addition, most of the trips generated were "to go to work" (29,4%), "study/school" (17,7%) and "shopping/supermarket" (16,9%)(SECTRA, 2012).

The exposure risk will be different in certain groups, according to results exposed above; males between 15-29 years have the highest chance to be involved in a RTA. Women are more likely to be injured than of being involved in fatal accidents (see Figure 3). A behavioural study showed that women had a safer behaviour when compared to men, in all age

groups. Also that at older ages the risky behaviour decreased compared to younger ages(Mtt, 2011). A study on Chilean pedestrian behaviour showed that young males commit more violations of traffic laws, than women and adults. Also commented on the importance of taking into account that pedestrian might be the cause of accidents even if they don't get injured(Moyano-díaz, 2014).

According to the 2013 registry of drivers licenses there were 1.225.540 approved; 76% where for men and 24% for women; 74% renewed licenses and 26% new; 64% between 30-59 years old, 24% 17-29 years old and 11% older than 60 years(DEIS, 2013).

Unfortunately, there is no data on the amount of kms travelled annually per person in Chile, neither of the amount of time that people spend participating in traffic.

3.4 State of the environment

3.4.1 Housing

During the 1990s there was a 25,7% of increase in the amount of houses in the country, which was much higher than the population increase (13,3%) during that same period of time(Sanhueza & Larrañaga, 2008). There was a new policy to reduce the housing shortage, this restricted residential areas to some sectors in Santiago, sometimes contributing to the segregation of the poorer population. For example; 58,6% of household in the Vitacura sector have a high income, whereas only 0,5% have high income in the La Pintana sector (63,8% are poor)(Sanhueza & Larrañaga, 2008). The richer areas (suburbs), like Vitacura, are often further away of the working areas, had less public transport and were only accessible to those with private transportation.

With the new transport reform in the capital, the segregation was even more evident in some areas, with privileged connectivity in terms of transport, but the poorer areas didn't have access to the main lines of transport(Corvalán, 2008).

3.4.2 Quality of the vehicle fleet

In 2012, 12,3% of the cars had less than 1 year of use(Fuentes, 2014). The public transport in other regions of the country are aging and decreasing in numbers. The average age of buses is 9,4 years in regions versus 3,9 years in the metropolitan area. Most vehicles enter the public service with 6 years of use and exit with around 20 years (Mery, Villegas, & Blanco, 2014). Vehicles must pass a technical inspection once a year, to ensure their optimal functioning and they don't represent a risk for health and the environment. Unfortunately there is not much information about

the results of this inspection. According to a local newspaper article, the recent modification in the minimum requirements for the inspection in 2013, may have caused an increase in rejection from 3% to 10% (Mercurio, 2013).

3.4.3 Road Network and Infrastructure

The road network has an impact on crash risk, because it influences how road users interact on a certain environment. Roads and sidewalks are clearly marked. There is no real bicycle culture, so cyclists have to choose which is the lesser "evil" (crash with a car or with a pedestrian). (CONASET, 2011). Cyclists continue to have no space of their own, they are forced to use the same space of pedestrians because other vehicles do not respect their right of way(Otano, 2011). According to the last balance of the Mtt, there are 252 km of bicycle lanes in the capital, which only 80% are according to OECD standards and properly segregated from other road users. Many have no connection to lanes in other sectors of the city(Mtt, 2012).

The state of the road is also important. According to a qualitative study in Chile, people sometimes described the roads as an unsafe place, especially poor areas with high criminality that lack of proper illumination. The road is not designed for motorcycles, pavement doesn't give enough grip and paint causes them to slide, signs not visible enough and containment barriers were described as "guillotines"(CONASET, 2011). The "Master Plan Santiago 2025" stated that one of the greatest problems for improving infrastructure was the lack of space(Mtt, 2012).

3.4.4 Climate

The climate has great variation over the year. Last winter the rain flooded part of the city creating holes on the pavement and power cuts. The holes damage the front part of the cars and drivers cause accidents trying to avoid them(La Tercera, 2015). Transports with high flow of people, like the subway and buses, don't have air conditioner, which in the months of summer during rush hour creates great discomfort for their users.

The last 5 years, the country has been subjected to several natural disasters (see Background information on Climate). These destroy the existing road infrastructure and further isolate rural areas or sectors in urban areas.

3.5 Driving Forces and Pressure

This section examines the context in which the country currently is immersed. The high economic status of the country, with unequal distribution not only of wealth but also evident in the health system, leads for unequal chances of diagnostics, treatment and recovery of victims of RTAs.

3.5.1 Economic Status and Distribution of Wealth

In the early 1980s there was a debt crisis in LA. Most countries spent that decade revising their economic structure and creating policies to overcome the crisis. Quality of institutions with property protection rights, lack of corruption and bureaucracy, better rule of laws helped Chile to continue to grow during and after the crisis at an even higher rate than before (annual growth 1985-97 average 7.3%) (Hernández & Parro, 2008). Chile was the first Latin American country that joined the OECD and the continued economic growth over the years has taken the country to become a high-income country(World Bank, 2015).

According to the OECD, Chile is one the most uneven countries in terms of wealth distribution(COHA, 2011). Chile had an 8,4% growth at the beginning of 2011, but the wealthiest 10% of the country got 75% of that. The consequences of unequal income distribution reflects different degrees of bad exposure to the environment plus a lack of resources due to underinvestment at different levels of the system(ACIP, 2012). Which therefore will determine the final outcome of the victims of RTAs.

3.5.2 Health system

Social inequalities influence health inequalities and the chances of living longer and healthy. The current universal health coverage FONASA, covers the public sector. This is separated in to 4 groups (A,B,C,D) going from lower to higher income. The groups A and B have 100% coverage, while group C has 75% and group D has 50% coverage. The rest of the payment comes out-of-pocket. The country total expenditure in health decreased between the year 2000 and 2010 from 7,7% to 7,4% of the gross domestic product, in spite of the country continuous economic growth(WHO, 2013b).

Distribution of the population between public and private systems in 81% and 19% respectively(Vasquez et al., 2013). Distribution of resources is; public sector has 41 Computerized axial tomography scans (CAT scan) and 12 Magnetic resonance imagining (MRI) and the private sector has 69 CAT scans and 32 MRI. Number of beds available have decreased from 2,7per 100.000 population in 1999 to 2,3 per 100.000 population in 2009(Becerril-Montekio, Reyes, & Manuel, 2011).

3.5.3 Lead Transport Agency

Due to an alarming increase on the number of RTAs, injuries and deaths, with an impact in society and economy of the country, a multisectoral collaboration began; National Committee for Traffic Safety (CONASET)(Mtt, 1994). In charge of the promotion of road safety, drivers licensing, vehicle/road/public transport quality control, enforcement, use of information available, education and communication. They can propose changes and inform, but they don't have the power to execute plans (see background information).

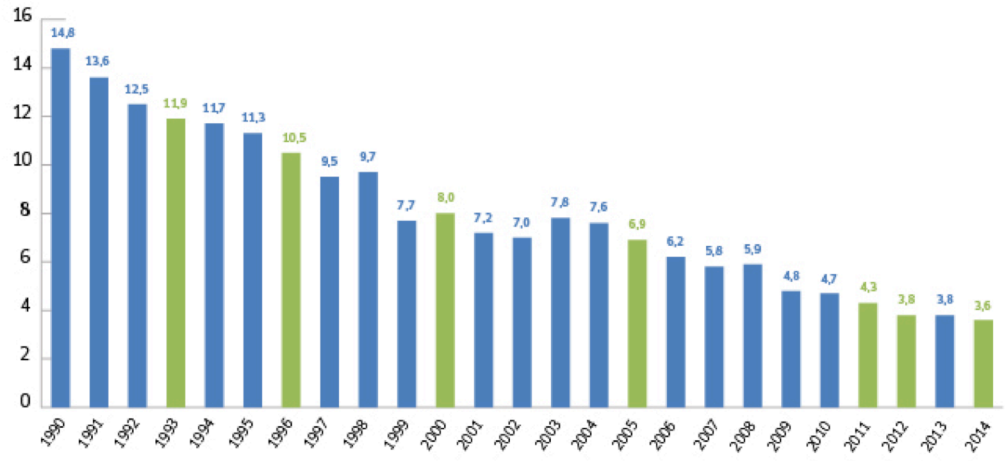


Figure 5: Trend in death rate per 10,000 vehicles and highlight measures in Chile (CONASET, 2014f).
1993 Creation of CONASET
1996 Introduction of breathalyzer as a measure of supervision
2000 Mandatory security elements on cars, motorbikes and trucks
2005 Mandatory use of seatbelt in light vehicles, child restraints and prohibition of mobile phones use while driving.
2011 Mandatory usage of seatbelts in interurban buses
2012 Law "cero tolerance to alcohol"
2014 Law "Emilia"

This multisectoral collaboration is formed by:

- Ministry of Interior and Public Security. Branch: National service for prevention and rehab of drugs and alcohol (SENDA)
- Ministry of Education (MINEDUC)
- Ministry of Justice
- Ministry of Public Works
- Ministry of Health
- Ministry of Transport and communication
- Police Department (PD)
- Minister Secretary general of the President
- Ministry of Housing and Town planning
- Minister secretary general of government

The CONASET has joined the mission of the UN to reduce a 50% the number of deaths by traffic accidents between the years 2010-2020, by achieving progress in the traffic regulations, enforcement and education of the citizenship.

Since their creation, there have been several law implementations related to traffic safety such as: drinking and driving enforcement, mandatory security elements in vehicles, mandatory use of seatbelts/child restraints, prohibition of mobile phone use and modification in the alcohol law (see figure 5)(CONASET, 2014f). Further information and strategies are discussed in the next chapter.

3.5.4 Cultural and Social Norms

Growing economy, longer travel distances plus lack/bad quality of public transport, boosted the increase in vehicles(Gutiérrez, 2015). Traffic is a cause of mortality and morbidity, because automobile circulation creates a higher chance of collision and other accidents.

There are also cultural and social norms that dictate the meaning of having a car. A qualitative study on "Automobility" done in a vulnerable area of Santiago, found that a car offered a sense of freedom, empowerment, flexibility, comfort and social inclusion. A lot of people in this study referred to it as "the dream of having a car". Women perceived themselves as "hysteric" and unable of driving a car, therefor participating less in traffic and relying in the "man of the house"(Icaza, 2009). It is seen as a way of saving time, compared with the usage of public transport and also providing more accessibility to far away areas. Has the advantage of providing a safe environment, were people are protected of undesired contact with others. In places were there is a danger perception, allows the safe transport of people through those areas. (Tapia Granados, 1998).

This chapter revised the information available on the different contributing factors of the DPSEEA framework. The last element of the framework is "actions" that can take place at any level. The next chapter will revise the actions that are relevant to the country context as well as provide examples of best practices in other countries.

CHAPTER 4: ANALYSING CURRENT ACTIONS FOR INJURY PREVENTION ON ROAD SAFETY IN CHILE AND BEST PRACTICES.

This chapter will discuss the results found on the previous chapter, as well as the limitations found in the development of the framework, current policies in the country related to road safety and best practices implemented in other countries with experience in road safety.

4.1 Limitations found

In this study the adapted version of the DPSEEA framework was used. This model seemed more appropriate for the analysis of the Chilean context of RTAs. During the research, several problems appeared. It was difficult to find enough information to fit all levels of the framework. Usually more information is found at the higher levels of this chain, but in this case it was the other way around. This issue makes decision-making very difficult and stakeholders should take this into account when planning and implementing policies. More research is certainly needed to find an appropriate model that adapts better to the Chilean context.

4.2 Driving Forces and Pressure

For actions to make a difference and decrease the level of inequality they need to start acting the highest upstream possible. In the framework, these are actions at "Driving Forces and Pressure"; Transport policies (safer vehicles, speed limits), Alcohol policies, Health Policies, Education policies. It's important that these policies tackle inequities in the population in order to have a positive effect on the outcomes.
This section examines the policies that are related to RTA currently in place; Lead Transport Agency (CONASET); Road safety legislation (speed, alcohol, helmets, seatbelts, child restraints, mobile phone use); Education policies; Health Policies. In this section is also important the economic and cultural background of the country.

4.2.1 Speed Law

High speed driving is a major problem worldwide, it has an effect on both the crash risk and severity of injuries. Collisions at high speeds produce more serious injuries and material damage. VRU have the highest risk of severe injuries; passengers and drivers are more protected inside the vehicle cabin. Establishing comprehensive speed limits and enforcing them can have major reductions on the number of accidents and deaths(WHO, 2013a). A 20% reduction on

deaths and 10% on accidents with injuries, can be achieved with a 5% reduction on average speed(WHO, 2010c).

Injuries and their severity have an exponential increase with speed. Collisions at 20km/hr almost all pedestrians survive, small increases in speed can lower those chances. At 40km/hr 90% survival, 80km/hr <50% survival and at 100km/hr <10% survival(SWOV, 2012c).

Speed limits in Chile are set according to the type of road and its location. Usually in urban areas is 60km/hr, while highways can be between 80-120km/hr. In many areas, especially residential areas, this is not well signalled or even existent. Unclear speed limits create a hazardous environment, for example; for children playing outside. This is why urban speed limits should not be higher than 50km/hr and even lower (30 km/hr) in areas where VRU can be found(WHO, 2010c). Even though there is a law that control speed in the country. Even though the database shows that recklessness is one of the most common causes of accidents, the Mtt affirmed that 40% of the accidents had speed as a contributing factor(Mery, 2015).

4.2.2 Seat belt and child restrain laws

Seat belts reduce the chances of fatal injury by 40-50% for people seating in front and by 25-75% for people seating at the back. For child restraint the reduction is between 54%-80% depending on age (WHO, 2013a). Air bags have a greater importance when they are combined with the seat belt, adding an 11% effectiveness against fatal injuries(SWOV, 2012a). A combination of seatbelt and child restraint laws, enforcement and public awareness has shown to be effective in increasing rates of usage(WHO, 2010c).

In Chile, since 2005 the use of seatbelts in front and rear seats is mandatory, as well as the use of child restraints. Although the law exists, the use rate varies among sources, ranging from 50-82% in front seats and 10-14% in rear seats(CONASET, 2013c; WHO, 2013a). Seat belt reminders in new cars for all seats might be an effective way of increasing usage among drivers and occupants. According to a United States study, seatbelt reminders could increase usage a 7% among drivers of cars(Peden et al., 2004). Although this measure will take years before it is effective, only people with a high socioeconomic status (SES) are able to buy a new car with this feature incorporated. This means that the vehicle fleet turnover will take many years to occur. Further studies are needed for lower budget options that can cover the population at a higher risk.

An important factor to take into account is that child seats are temporary and must be changed according to size or age. This might deter usage, because poor people either cant have a restraint or cant change it if necessary. Children in Chile are more injured as passengers than as any other user, not using restrains or using them inappropriately might be the reason. Loan programs were parents get child seats at the maternity ward and are instructed on how to use them have shown increased usage(Anund A et al., 2003).

4.2.3 Drinking and driving law

Crash rate increases exponentially with higher BAC levels. With BAC of 0,8gr/L there is x100 more chance to be severely injured. Groups that are more at risk are young males (18-24 years old) and professional drivers(Swov, 2011). Combining laws with sobriety checkpoints and random breath testing can decrease number of accidents by 20%(WHO, 2010c). Lowering BAC levels to zero for drivers under the age of 26 has been thought in Australia due to this group high involvement in RTAs(ATC, 2011). A 10% decrease in alcohol related accidents after lowering BAC levels to <0.02 gr/L was reported in Sweden(Borschos, 2001).

In 2012, started the law to lower the maximum allowed BAC level while driving, from 0,5g/L to 0,3g/L and lowering intoxication levels from 1g/L to 0,8g/L. In 2014, the law Emilia complemented the alcohol policy with tougher penalties (minimum of 1 year jail time) for drunk drivers that cause severe injuries or death. This law was created thanks to the community that actively asked for more severe penalties(CONASET, 2014h).

Other measures are managing the supply-side of alcohol consumption; closing time of bars, increasing the price of alcohol (specially hard spirits) and increasing legal age to start drinking (WHO, 2010b). Which in the Chilean context of young drivers and alcohol, and higher involvement in accidents, could have good results. Further study and community acceptance among the population should be investigated.

4.2.4 Drivers licensing

Graduated drivers licensing (GDL) has proven to be an effective measure to lower the amount of accidents caused by young drivers, specially in those countries were legal driving age begins at 16 years old. Regardless of age, the risk of being involved in an accident is highest during the first year after the license is

given(Peden et al., 2004). Currently there is no law supporting graduated drivers licensing in Chile, but the fact that legal age to drive is 18 might make this less of a priority. In 2012 started the new drivers licensing law, with modifications in the Theoretic and Practical exams, as well as a more accurate medical examination(Gobierno de Chile, 2014).

4.2.5 Multisectoral Collaboration

Road safety has multiple factors involved and hence multiple stakeholders share responsibility and have to collaborate in order to achieve the formulation of an action plan that might be implemented. For this to occur, more data should be collected (see data systems) and research should be done for finding which are the most cost-effective measures.

Having a lead agency that is formed by multiple stakeholders is a good practice and has brought good results. An example is the French Inter-ministerial Road Safety Committee (CISR), which has had positive results on lowering the number of deaths(Chapelon & Lassarre, 2010). Unfortunately there is a lack of proper communication between members in CONASET, seen by the inconsistent information, which is the same problem that the CISR has experienced.

Countries have better results when they set targets for their plans. Even though the target is not reached, they do better than without them(Council, 2010). Another factor that should be taken into account is the institutional capacity of CONASET and the government (human resources and financial), especially under the strain of the natural disasters that have hit the country.

The Safe Community Movement in Sweden introduced the concept that community-level programs can be effective in reducing RTAs. People who live and work in an area could also have a good understanding of its needs in road safety. Covering all age groups and genders for different subjects; injuries, violence and suicide(Rahim, 2005). An example of this in Chile, would be the "Emilia Law" (mentioned above). The community expressed their concerns about insufficient penalties against the drunk-drivers who caused a fatal injury, and this helped the government understand the need of this law. This was done through the Civil Society founded in 2012 as a branch of the Mtt, were non-profit organizations related to transport can bring their inputs about road safety(Mtt, n.d.-a).

4.2.6 Social Policies

As mentioned before RTAs do not distribute randomly across the population. The literature says that lower SES and education level, minorities, poorer areas and children with jobless parents are at higher risk of accidents and injuries. Not all risk groups are affected in the same way by social determinants. For example; there is no clear relationship between young adults (15-24 years old), with accidents and lower SES; or mild injuries with lower education level(ACIP, 2012).

Social policies have to target specific groups that are more at risk for lowering inequalities, otherwise this might perpetuate over time. In Chile, there are several policies that target the most vulnerable groups with extreme poverty like: Chile grows with you, Chile solidarity, Provisional reform, and unique family subsidy(Gobierno de Chile, 2015). Most of these programs have impact studies and follow-up studies to evaluate their effectiveness. There are still issues that need to be addressed. For example; providing child restraints and helmets for the vulnerable families that own a car or motorbike; Extending house visitations for education and awareness of road safety.

The "Emergency Law" says that any person that is suffering from a life threatening condition (for example: high degree burns, traffic accidents, heart attacks, etc.) must be attended in the nearest emergency health facility, regardless of the socioeconomic level or type of insurance. All costs must be covered by their respective insurance (private or public) until the patient is stable enough to be transported to their corresponding hospital (Superintendencia de Salud, n.d.). The capacity of the health centre has to be taken into account; waiting for operation room, staff, MRI or CT, beds available, which in the public system are always lacking and could still determine a worse outcome compared with the private system. Places with a higher population density probably will have less delay for arriving at a trauma centre, than in rural areas. Even though they have treatment in the closest centre, the rest of the treatments and rehabilitation will be subjected to the hospital assigned to the person. Which again limits the outcomes of those with less resources.

All vehicle owners must hire a private mandatory insurance for Personal Accidents (SOAP) in order to have a circulation permit. Every passenger, driver or third party involved in an accident with a vehicle that has the insurance is covered by it. Covers treatment and rehabilitation, and in case of permanent disability or death, a compensation is given to the family affected according to the

damage (max. $11.000 USD)(CONASET, 2014i). Research on populations' knowledge about this benefit and usage of the insurance among victims should be done.

4.2.7 Health promotion through school education

Traffic accidents are the first cause of death among children between 4-14 years old. In this context traffic safety education is of utmost importance for developing the skills and knowledge of young road users. Even though many schools worldwide provide traffic safety education, there is little information that supports its effectiveness(SWOV, 2012d).

The MINEDUC in collaboration with Mtt and CONASET launched a new curriculum for primary school in 2011. Their main objective is to promote the respect for life and a "safer road culture". This way they want to change the culture of risky behaviour at different levels of road users (pedestrians, passengers, cyclists)(MINEDUC & CONASET, 2012). This is now part of the certified education programs in the new modified traffic law(Mtt, 2015).

These are important long-term interventions; their results will not be immediate but might create the social awareness that certain behaviours should not be allowed (drinking-driving, speeding). Maybe also help bringing down the myth, that having a car is synonym of freedom, autonomy, power or style(Icaza, 2009). All this taught behaviours, should also be reinforced at home by the parents.

4.2.8 Data Systems

In order to properly identify risks, create strategies/interventions to address them and to monitor their results, it's extremely important to have a reliable data system in the country. This is a difficult task and therefor multiple agencies have to be involved(WHO, 2010a).

In Mexico, they created a Geographic Information System (GIS) which has helped identifying high-risk places and trends in accidents, in order to guide resources efficiently(Secretaría de Salud, 2009). In Argentina, the Injury Surveillance System (SEVILE) collects information from hospitals about injuries and keeps the information into an online platform available at any time. SEVILE increased the amount of injury reports, even though not all regions participated, it allowed for actions to take place at local level(Msal, 2008).

In Chile, PD collects information at the crash site and health departments provide feedback on types of injuries. CONASET and INE collect the data and formulate reports. Even though the country data system is considered good by WHO standards(WHO, 2013a), because it covers outcomes (crashes, deaths, injuries), it doesn't fully cover exposure measures, intermediate outcomes (speeding, usage of seatbelt-helmets-child restraints), socio-economic costs or enforcement efforts, which are key for actions and their results on the population. Review the possibility of recording multiple causes, because for an accident to occur there is always an interaction of different factors and assuming that there is only one reason (e.g. Table 1) is an underestimation of the situation.

Important information that could help identify vulnerable population involved in accidents is the Social Protection card from the Ministry of Social Development. This card identifies people that are at risk of poverty and therefor candidates for social and economic benefits(Ministerio de Desarrollo Social, n.d.).

4.3 State

A decrease in VRU victims doesn't necessarily mean that policies that regulate traffic safety are working. In a highly motorized country, this can also mean that VRU no longer feel safe transiting and therefor participate less in traffic, they get gradually expelled from the system(Tapia Granados, 1998). Safer vehicles and roads can improve the state of the environment, so VRU and drivers feel safe.

4.3.2 Safer Vehicles

Several studies have shown that secondary safety measures in vehicles can reduce casualties from RTAs. In the United Kingdom, a review found a 15% reduction on deaths thanks to secondary safety measures in vehicles(Broughton, 2000). The European Transport Safety Council found almost a 20% reduction in deaths with car protection standards(European Road Safety Action Programme, 2003).

CONASET and Center of Control and Certification of Vehicles (3CV) approved vehicle safety standards in Chile, following the international standards from United Nations Economic Commission for Europe (UNECE) and Federal Motor Vehicle Safety Standards (FMVSS). Safety features included in the 2014 resolution are; audible seatbelt reminders, ISOFIX for child restraints, front and rear seatbelts, double airbags, safety vests and warning triangles(Mtt, 2015).

Every year vehicles must go through a periodic vehicle inspection (MOT) in order to obtain a circulation permit. Consisting of mechanical, safety and emission check-ups and the objective is to lower the risk of crashes due to technical defects. Evidence differs on the effectiveness of MOT on reducing RTAs. A study in New Zealand reported a higher chance of having an accidents when MOT and checking for tyre pressure was not done(Blows, Ivers, Connor, Amerantunga, & Norton, 2003). A Norwegian study found no change in accidents rate after mechanical defects were corrected with an inspection(Christensen & Elvik, 2007). No evidence that shows that MOT lowers crash rates in general, with the exception of commercial vehicles older than 12 years. In this case, checking for overloading and defective brakes do have an impact(Peden et al., 2004).

In 2014, there were 1,6% of car crashes as a result of mechanical defects(CONASET, 2014a). No information was found that crossed referenced with commercial vehicles in the country with this particular cause. MOT regulation could have an impact in the 12% of accidents occurred among M4-W heavy trucks in 2014. Even though MOT might help lower a small percentage of accidents, other benefits like lowering contaminant emissions might have an impact on the most contaminated cities in the country (specially Santiago during the worst months of contamination during the winter). This would also have an impact on respiratory diseases and creates a healthier environment for outdoor activities on those areas.

Improving visibility of vehicles so that other road users can see and act accordingly is very important, this is done with daytime running lights (DRL). A study that involved crashes with more than one vehicle, found that having DRL had between 10-15% reduction on crashes(Peden et al., 2004). A study in Hungary found a 13% reduction in crashes after introduction of DRL(Holló, 1998). A meta-analysis by European Commission (EC) found a 5-10% reduction in crashes involving motorcycles(Elvik, R., Christensen, P. & Olsen, 2003). In Chile, DRL by law are not mandatory in urban areas. CONASET recommends turning them on during the day, but there are no studies of their effectiveness or how many people follow this recommendation in the country. Besides having to change the lamps more often, this measure appears to be cost-effective.

4.3.3 Safer Roads

Adjusting the road network to road users by making them safer is an area that can have major impact on reducing deaths and injuries. This can be done by; planning road-networks with safety awareness, adding safety features and remedial action at sites with higher crash risk(Peden et al., 2004).

Location of working areas, housing, supermarkets, medical centres or schools into account to find the most common destinations and planning the shortest routes possible, should be taken into account when planning the road network(SUPREME, 2007). As well as awareness of the function for which roads were designed and properly separate VRU from other high-speed traffic. The objective of this is to shorten travelling times, so that users spend the least amount of time possible interacting with traffic and therefor lowering their chances of having an accident.

Traffic calming are measures in the infrastructure for decreasing the amount of traffic or lowering their speed in order to help protect VRU. These include; roundabouts, narrowing roads, speed bumps. A systematic review, found that these measures reduced between 11-15% the number of traffic injuries(Bunn et al., 2003). In Ghana, placing speed bumps in a high-risk intersection achieved a 35% reduction on accidents, 55% number of deaths and 76% number of serious injuries(Afukaar, Antwi, & Ofosu-Amaah, 2003).

Currently the annual budget is not focused on road planning. Several natural disasters have left great structural damage to peoples houses and road accesses to the most affected areas(Gobierno de Chile, 2015). Trying to overcome the infrastructure deficits in the country will be a challenge in the future, because of the climate issues. Since 87% of the population live in urban areas, road planning in should be a priority for the construction and reconstruction of comprehensive roads.

A 38,5% of the population either walked and/or cycled as their main source of transport in Santiago(SECTRA, 2012). The government has the objective of building comprehensive infrastructure for this road users in the "Santiago Master plan 2015-2025" (Mtt, 2012). Actual benefits might not be visible until years from now with this 10 year plan and with the current budget going to other important areas this plan might be also affected. Other issues like increasing security in vulnerable areas should be also taken into account. In New York, there was a 35-58% reduction in all road user crashes after the first protected bicycle lanes was built(New York City Department of Transportation, 2013).

The analysis of road projects is done through safety audits. Evaluated by an independent party that has nothing to do with the project and usually another independent party approves the project. CONASET provides a guideline for this type of procedures(Dourthé & Salamanca, 2003). Even though this process is common, there are still many "black spots" were not only more accidents occur, but also very long traffic jams.

Decrease motorization by encouraging other safer modes of travel (bus or train) can also lower the amount of RTAs(Peden et al., 2004). This can be achieved by improving public transport; offer more frequent trips in rush our, shorter travelling times (exclusive lanes), cheaper costs for the vulnerable population. Implementing the measures listed above, might improve peoples' perception of the quality of public transport and therefor become a more common way of mobilisation. Unfortunately this will not happen in short term, that is why other cost-effective solutions, that benefit the current type of transportation must be put in place.

4.4 Exposure

The continuous growth of cities, especially residential areas, make travel distances even longer and with the segregation that occurs because of the transport system, it is inevitable that this population spend more time travelling and therefor have a higher risk of suffering an accident. In the current situation it is unlikely that people will lower their exposure, but it is possible to create awareness on how they can safely interact with traffic, to protect themselves and others against hazardous environments.

4.4.1 Safer Road Users and Behaviour

All measures mentioned above help reducing RTAs from a legislative and infrastructural way, but all these measures will not have a real impact if road users don't follow the laws and transit in a responsible way. Education, enforcement measures and increasing penalties can further improve peoples behaviour(ATC, 2011).

This section will discus behaviours like; speeding, drinking and driving, fatigue, distraction and usage of safety devices. Examples of other countries actions to deter this behaviour will also be mentioned in this section.

4.4.1.1 Education and Awareness campaigns

The main objective of this measure is to change behaviours and attitudes towards a particular problem, e.g. making behaviours like drinking and driving less socially acceptable. The Mtt through CONASET is in charge of developing guides for roads users, as well as campaigns on road safety. The "We're all pedestrians" campaign aims to create consciousness among road users about pedestrian vulnerability. A sector campaign, "Share the road" advises drivers, pedestrians and cyclist/motorcyclists for respecting each other (Providencia, 2014).

Drivers training raises road safety awareness and in some cases driving skills. Theoretically they can reduce RTA by reducing the amount of mistakes that drivers make and improve their road behaviour. No significant impact on the number of accidents after following these types of courses was found in Germany and Luxemburg(SWOV, 2009). Although a systematic review found a positive effect on drivers performance and knowledge after the courses(Korner-Bitensky, Kua, von Zweck, & Van Benthem, 2009). These programs can target high-risk road users, like novice drivers or those that have committed a violation of traffic rules. Recklessness of drivers and loss of control of the vehicle were found some of the first causes of accidents in Chile, a combination of drivers training programs with proper enforcement might help reducing this cause of RTAs.

A distraction is a diversion of the attention from safe driving towards another activity(eating, drinking, music, billboards, mobile phones, make-up or navigation system). This distraction may affect the drivers' performance and create risky situations that could cause an accident. With the growing number of smartphones usage in the country, this should be a focus of concern.

According to The Word Report on Road Traffic Injury, the major group fatally affected is VRU(Peden et al., 2004). In Chile, this is the second most affected group, after drivers. Individual cause of pedestrian death is mainly due to recklessness of the pedestrian itself, they don't respect laws or are distracted. Some create accidents without getting injured and therefor the mistake is not reported as the pedestrian fault. Most of the fatal cases occur between 18:00-21:00 hrs, when there is bad visibility or poor illumination(crossing suddenly in the middle of the street)(CONASET, 2014b). Children and elderly pedestrians are the most affected by RTA. Small children are not visible enough or play on the street unsupervised by adults. The elderly population lack the physical abilities to compensate other users mistakes (driver

missing a red light or public bus driver braking suddenly), or have vision/hearing impairments. Elderly are a growing population in the country and specific educational campaigns to protect this group are necessary. Reflective jackets might be a cheap solution to increase their visibility to other road users.

Drivers fatigue is another cause of concern; this can be caused by lack of sleep or a sleep cycle disorder. People at risk are professional drivers, those who work night shifts, night drivers or driving long distances or having a sleeping disorder. This people may have between 3-8 times higher risk of having a traffic accident(SWOV, 2013a). Raising awareness of the risks of driving while tired, comprehensive infrastructure (roadside stops with appropriate facilities) and enforcement of the working law conditions should be considered.

4.4.1.2 Enforcement and Penalties

The ministry of Interior and Public security through their branch SENDA were in charge of "Zero Tolerance to alcohol" massive media campaign, as well as enforcement of the law in collaboration with the PD doing sobriety checkpoints. A systematic review found that mass media campaigns plus enforcement reduced the number of crashes related to alcohol in 13%(Elder et al., 2004).

Police enforcement is key in order to increase the perception of being caught, this can be achieved through public media and making the police visible to the public on the roads(Peden et al., 2004). In the general population, primary enforcement on average, can increase seatbelt usage in around 22%(Gazmuri, Muñoz, & Rizzi, 2006). In some countries usage rates increased 10-15% after a year of enforcement(Hagenzieker, Bijleveld, & Davidse, 1997). The Denmark target seatbelt enforcement and raised fines, increased usage from 80% to 87% between 2000-2005(SUPREME, 2007). In Thailand, after enforcement on helmet laws for moped drivers, usage increased five times and amount of deaths decreased 20%(Ichikawa, Chadbunchachai, & Marui, 2003). This type of enforcement raises peoples perception of being caught and future consequences(Peden et al., 2004). The higher the usage rates, the harder it is to raise it. In Chile, according to the results, usage varies greatly between studies, from 67-82% in front seats and 14% rear seats. A targeted enforcement campaign would help increase the rate of usage and in the long term help maintaining it.

A private clinic in the capital city did a campaign ("Tie yourself to life") for increasing seatbelt usage and decreasing drinking and driving behaviour(Alemana, n.d.). Without studies of the usage

before the campaign is impossible to know the impact that this had. The clinic is in the wealthiest sector of the capital, and coverage didn't reach the most vulnerable population and it wasn't accompanied by police enforcement. In order for this type of campaigns to work, there must be a joint effort between stakeholders and enough media coverage for making population aware. Just informing might not be enough, but adding penalties for non usage through police checkpoints, would help deter people from disobeying.

Measures that have proven effective are speed cameras. France showed an important effect after the introduction of the Automated Speed Enforcement Program (ASEP); 21% reduction on traffic fatality rate and 26% reduction on non-fatal traffic injuries. At least 72% of the decrease was due to the ASEP introduction(Carnis & Blais, 2013). In Chile, it's estimated that only 3/10.000 cases of excess speed are detected and 40% of crashes have speed as a factor of occurrence. In 2014, the Automatized Centre for Infractions (Cati) law project was passed to the congress; this has not yet been approved. Their main objective is to dissuade people from speeding by alerting road users of the presence of a "Speed Radar" in high risk areas. This centre is completely automatic and doesn't require policeman to control speed, saving resources for other purposes(Yáñez, 2014).

4.5 Event and Effect

Disabilities bring great burden to victims and family members. They cause emotional, physical and economic damage. An injured person can drive the whole family into economic strain. Less income, high medical bills, house adaptations for disabled, caretakers, funerary costs, are some examples that can drive a family into poverty.

The effect level is at the lowest level in the framework to take actions. This has a direct influence on the accidents rather that at the actual problem. In this section, treatment (pre-hospital care) and rehabilitation will be discussed.

4.5.1 Pre-hospital and Hospital care

Having a reliable and effective pre-hospital and hospital care system is key to prevent deaths/disability and reduce severity of injuries by traffic accidents. Around 50% of the deaths after a crash occur within a few minutes after the accident or on the way to an emergency care facility. After arriving at the hospital 15% die in the following hour and 35% within the next 4 hours(Peden et al., 2004).

A study done in the United Kingdom showed that 12% of people with injuries ended up with disabilities that could have been prevented(Peden et al., 2004). First aid training with driving courses in several countries in Europe, universal emergency number, emergency road lanes implemented by law in Germany, mobile intensive care transportation in Denmark are some measures that can be taken(SUPREME, 2007). In Chile, there is no mandatory first aid training, there are 3 emergency numbers (ambulance, firemen, police) and the ambulances provided by the emergency number (public system) are scarce, lacking enough supplies and with insufficiently trained personnel.

Even though the health system in Chile provides financial support for the public system, there are several issues missing for accomplishing universal health coverage. As stated before, the capacity of the system is not enough for the amount of population. The distribution of resources is balanced towards the richer (private system). Government expenditure has decreased, and is lower than some of their neighbouring countries like Argentina (8,3%) and Uruguay (8.1%)(WHO, 2013b). This might not be directly related to RTAs outcome, but influences the effects on the population at a much greater extent and therefor should be evaluated by authorities in the future. In order to make changes at the hospital settings, laws and regulations must change at a government level for increasing resources available for the public system and providing smart governance among stakeholders.

4.5.2 Rehabilitation

People that work with a formal contract are covered by the "law 16.744", which covers cost of treatment and rehabilitation in case that an accident occurred while working or heading to work(Mutual de Seguridad, 2014). When this does not apply, another insurance covers for the costs (SOAP; see social policies).

There is no information on how much people are actually able to access to timely rehabilitation. Factors that need to be taken into account are; type of insurance and extent of the coverage in case of private insurance; socioeconomic level because in the public system people with higher income must pay a percentage out-of-pocket; network of people that support and stimulate rehabilitation; source of income while the person is in rehab; personal will; available transport to the place of rehabilitation. In the public system, waiting lists are long (Specialists, physical/occupational therapists) and supplies lacking. For people to recover, early treatment should be a priority.

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This thesis objective was to describe the current situation of RTAs in Chile, also to identify factors that could determine their occurrence and improve understanding of this health problem, in order to make recommendations for future research and analysis of comprehensive policy making. The situation was analysed based on the adapted DPSEEA framework. This appeared to be a better option due to the combination of determinants of health and road traffic risk factors, but due to the lack of information in the countries database, there are still gaps to the linkage some factors.

The results show that in a country with growing economy, vehicle fleet increases while mortality rates per vehicles continue to be the lowest in LA. Recklessness, sign disobedience and loss control of the vehicle are the main individual causes of accidents. High speed appeared to be a common contributor to the occurrence, in around 40% of the cases. This overlap should be taken into account when implementing or creating policies, because addressing one factor may decrease the occurrence of some accidents, but not necessarily as much as expected.

Drivers are the most involved in accidents, while pedestrians are the group that is most fatally affected. Male population is the most affected in all age groups, but the group between 15-29 years old are the most involved in accidents and have more fatal victims. Drinking and driving appeared to be decreasing after the implementation of the BAC law. High speed is a growing problem. Older pedestrians and young children are at particular risk of suffering accidents. Use of safety devices is low in the country, specially seatbelts and child restraints. Helmet use appears to be more accepted among the population and has a higher usage.

The countries vehicle fleet is dominated by M4-W light vehicles (88%) and most of them are concentrated in the capital city (40%), but there has been an increase in M2-W in the last 2 years. Most trips are in motorized vehicles, secondly walking and cycling. Public transport is slightly more used than private vehicles. Women have a safer exposure towards traffic than men, who commit more traffic violations. Poor sector are more segregated and relay more on public transport, because they can't afford a car, they have to travel longer distances and spend more time interacting with traffic.

The country has several road safety laws in place. Speed limits are higher than what the WHO recommends in residential areas and they have poor signage. Seatbelts and child restraints laws apply for everyone, but there is no proper enforcement for improving usage. The drinking and driving law was recently modified and is now inline with WHO standards. Chile has created CONASET as their lead agency, with the collaboration of multiple Ministries and PD. The evidence showed that multiple stakeholders have better results in reducing RTAs. Their target is reducing 50% deaths by 2020, but there is no published national strategy on how to achieve it.

The country data system has a good death record, but road safety information necessary for decision-making is lacking. Missing information like; exposure measures (km-time travelled), intermediate outcomes (speeding, usage of seatbelt-helmets-child restraints), socio-economic costs or enforcement efforts are extremely necessary for comprehensive policies. The country database currently assumes that only one cause influence the occurrence and doesn't take into account more contributing factors. Having this information available will determine the formulation of the national strategy.

Missing information upstream, made it difficult for making an appropriate linkage between driving forces and pressure with the rest of the factors, as well as for exposure and event. Literature shows that low SES and education influence RTAs, but the lack of information and peered reviewed articles in this matter were not enough to make a stronger link.

Several actions were identified, some already implemented in the country. Experiences from other countries were also mentioned when relevant to this context. CONASET has approved several measures for safer vehicles according to international standards. MOT are done every year to check for mechanical deficiencies and that safety measures are working. The Chilean road network lacks enough safety measures. They don't protect VRU, which are the most at risk. There are almost no bicycle lanes, this makes cyclist either go on the pedestrian lanes or exposed to crashes when sharing the road with M4-W vehicles. Poor signage and poor traffic calming measures, contribute that the excessive traffic creates more accidents. Road infrastructure should be comprehensive in their design, provide appropriate highways, separation from road users, traffic calming measures, remedial action in black spots and create awareness about proper use. As mentioned before this is going to be a challenge for the country, not just for the current budget problem due to reconstruction after several disasters, but

also for the upcoming years of the continuous climate change and lack of sustainable development.

The lack of enforcement is one of the pitfalls in the country. Even with laws in place (speed law, drinking law, seatbelt laws), the enforcement hasn't been enough to deter people from unsafe behaviours. The population is not afraid of the consequences, because they feel that the chances of getting caught are very low. This is a very important point, as mentioned before, this is a common cause of accidents and it's expected that measures at this level can improve several issues. Unfortunately, without a strategy this is very hard to achieve.

Even though there is a Universal Health Insurance in place and other measures to mitigate traffic injuries costs (SOAP and Emergency law) the current health system has not enough capacity to offer treatment and timely rehabilitation. Distribution of wealth in the country is very unequal, this happens in the health system as well. Most resources are in the private system. Changes at this level are not directly related with the subject of this thesis and proposing to increase the government health budget might be unrealistic, but is an important matter because this influences the outcome once the injuries have occurred and therefor should be mentioned. Although any of them will take many years before their effects are visible and political will is critical for it to succeed.

In order to improve awareness, encourage research and understanding from stakeholders (researchers, population, practitioners and government), I will list a number of comprehensive recommendations, based on this thesis analysis that have been proven effective by other countries experience.

5.2 Prioritized recommendations

- Data Collection should be done more accurately and reviewed with all stakeholders. Police should gather additional relevant information, e.g. seatbelt usage, child restraint usage, distractions, contributing factors. Policy-makers need this information in order to make a comprehensive national strategy.
- CONASET should create a national strategy for Road Safety, with specific targets and detailed steps that are evidence-based and appropriate to the Chilean population.
- The congress should give the final approval to the implementation of Cati system for speed enforcement. This will provide revenue that can be directed to other areas, increase human resources available for other tasks, lower speed related accidents in risk areas.

- CONASET should present a DRL mandatory law proposal to the congress for all vehicles, including motorcycles.
- Identify higher risk areas black spots and create remedial actions to take action in short term. This should be done coupled with lowering speed limits and placement of speed cameras.
- Awareness campaigns specific to seatbelt/child restraint usage and speed should be done in the country. Coupled with checkpoints of police controls and fines for offenders, in order to create consciousness and the association that their violation is socially unacceptable.
- The government should review current speed limit laws and change to 30km/hr in residential areas to protect VRU.
- Promote safer, healthier and more sustainable ways of transport. e.g. walking, cycling and using public transportation (bus and subway), by increasing bicycle lanes and properly separating VRU from high speed traffic.

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Annex 1: General and detailed causes of accidents, deaths and injuries in the CONASET report of 2014(CONASET, 2014a)**.**

General Causes	**Detailed Causes**
Alcohol in driver	Driving under the influence of alcohol Drunk driving
Alcohol in passenger	Drunk passenger
Alcohol in pedestrian	Drunk pedestrian
Undetermined causes	Undetermined causes
Road deficiencies	Loose animals on public roads Incorrectly installed signage or poorly maintained Non-working or poorly maintained traffic light
Disobeying Traffic signage	Disobey policeman indication
	Disobey yellow traffic light
	Disobey red traffic light
	Disobey other signage
	Disobey Yield sign
	Disobey STOP sign
Drugs and/or fatigue on driver	Driving under the influence of drugs or narcotics
	Driving in poor physical conditions (fatigue)
Mechanical failure	Bodywork
	Direction
	Electric
	Brakes
	Engine
	Tires
	Suspension
	Non-signalled stopped vehicle without gasoline
Recklessness of the driver	Overtaking in intersection, curve, hill, bridge, etc.
	Overtaking through the berm
	Overtaking without signalling
	Overtaking without the necessary time or space
	Overtaking surpassing the continuous line
	Load spills on the road
	Greater load than authorized for the vehicle
	Load obstructed the drivers visual
	Load bigger than the vehicles structure
	Suddenly change lanes
	Driving against traffic direction
	Driving unaware of traffic conditions
	Driving on the left lane of the road
	Driving without keeping a save distance from the vehicle in front
	Not respecting pedestrians right of way
	Not respecting other vehicles right of way

	Drive vehicle in reverse
	Improper turn
Recklessness of the passenger	Recklessness of the passenger
	Passenger get in or out of moving vehicle
	Passenger traveling on vehicles footplate
Recklessness of the pedestrian	Pedestrian crosses the road in a sudden and careless way
	Pedestrian crosses the road without using the zebra crossing
	Pedestrian crosses road or highway without taking precautions
	Recklessness of the pedestrian
	Pedestrian stays on the road
Other Causes	Criminal act
	Other causes
	Suicide
Loss control of the vehicle	Loss control of the vehicle
Inappropriate speed	Excess speed on restricted area
	Higher speed than maximum allowed
	Lower speed than minimum allowed
	Not reasonable or prudent speed
	Higher speed in crossings, hills, curves, etc.