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TRENDS IN THE SAFETY OF THE NEW ZEALAND VEHICLE FLEET: 1964 TO 2022

SUPPLEMENT TO REPORT 371 - VEHICLE SAFETY RATINGS ESTIMATED FROM POLICE-REPORTED CRASH DATA: 2024 EVALUATION

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SUPPLEMENT TO REPORT NO. 371

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Transport for New South Wales, New South Wales State Insurance Regulatory Authority, Department of Transport and Planning Victoria, Transport Accident Commission, Waka Kotahi NZ Transport Agency, Queensland Department of Transport and Main Roads, South Australian Department of Infrastructure and Transport, and the Australian Government Department of Infrastructure, Transport, Regional Development, Communications and the Arts, and the Road Safety Commission of Western Australia.

Abstract:

Crashworthiness is an estimate of the occupant protection provided by a vehicle, namely the risk of a driver of a vehicle being killed or admitted to hospital when involved in a crash. This project further investigated the relationship between vehicle crashworthiness and both the year of manufacture and the year of first registration in New Zealand. Analysis was based on New Zealand light passenger vehicles manufactured from 1964 to 2022 and crashing during 1991 to 2022. Analysis by year of first registration in New Zealand was aimed at assessing crashworthiness trends in the fleet of used imported vehicles in New Zealand whilst analysis by year of manufacture examined trends in the fleet as a whole. Crashworthiness was measured by combining estimates of injury severity (of injured drivers) and injury risk (of drivers involved in crashes). The ratings were adjusted for the sex and age of the driver, the speed limit at the crash location, the number of vehicles involved in the crash and the year in which the crash occurred. The crashworthiness rating estimates the risk of the driver being killed or admitted to hospital when involved in a crash, to a degree of accuracy represented by the confidence limits of the rating in each case.

Analysis of trends by year of vehicle manufacture showed statistically significant improvement in the crashworthiness of New Zealand light passenger vehicles over the years of manufacture studied. The most rapid improvement (70%) occurred over the years of manufacture from 1983 to 2007. During this period, vehicle safety in New Zealand was affected by several competing effects: a general increase in both active and passive safety features in vehicles; increasing proportions of used imported vehicles entering the New Zealand fleet; and increases in the regulation of vehicle safety standards by the New Zealand Government. Over the period 1983 to 2022, the risk of death or serious injury to drivers reduced by 74% for the fleet as a whole (relative to 1983). Estimates of crashworthiness trends in the used import vehicle fleet by year of first registration in New Zealand from 1986 to 2022 showed improved crashworthiness of the used import fleet over these years. A difference in safety between the new and used imported vehicles was identified along with a trend to improving crashworthiness for new vehicles sold in recent years. As the average age of used imported vehicles increased from seven and a half years in the early 2000s to just over nine years by 2022, the gap between the safety of new vehicles and used imports brought into New Zealand each year has widened.

This report also presents the updated Used Car Safety Ratings (UCSR) that measure the relative safety of vehicles in preventing severe injury to people involved in crashes. Where a particular vehicle is not sufficiently common in the Australasian light vehicle fleets, the Vehicle Safety Risk Rating (VSRR) shows the likely safety level of the vehicle based on similar vehicles but produced at a more aggregated level than the UCSR. The VSRR applies to specific market groups (e.g., small cars) for each year of manufacture. For a very small proportion of vehicles, the average rating for a given year of manufacture across all market groups is the best safety rating available as information regarding the market group of the vehicles is lacking.

The results of this report are based on a number of assumptions and warrant a number of qualifications that should be noted.

Key Words: (IRRD except when marked*)

Injury, Vehicle Occupant, Collision, Passenger Car Unit, Passive Safety System, Statistics, Crashworthiness, Aggressivity, Primary Safety, Secondary Safety, Used Car Safety Ratings

PREFACE

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Contributorship Statement

Professor Stuart Newstead:	Project oversight, statistical design, review of analysis design, preparation of the final ratings presentation and review of the technical report
Casey Rampollard:	Data collection, assembly and coding, data analysis, preparation of the report and final ratings presentation
Laurie Budd:	Data assembly and coding
Professor Michael Keall:	Statistical design, analysis design and analysis
Professor Max Cameron:	Statistical and analysis design

Ethics Statement

This project was approved by the Monash University Human Ethics Research Committee project number: 43722.

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EXECUTIVE SUMMARY

This report describes the update of New Zealand crashworthiness ratings by year of vehicle manufacture for 1964-2022 model vehicles. New Zealand crashworthiness ratings by year of manufacture were first estimated by Newstead and Watson (2005) for 1964-2002 model vehicles. Crashworthiness ratings of vehicles by year of first registration in New Zealand were also examined, focusing on the fleet of used imported vehicles sold in New Zealand. Crashworthiness ratings measure the relative risk of death or serious injury (hospitalisation) to drivers of vehicles involved in crashes. The estimates are derived from analysis of data on real-world crashes. The estimates were subsequently updated in the annual updates of the Used Car Safety Ratings (UCSR) and most recently in Newstead et al. (2023b) for 1964-2021 model vehicles as a continual monitor of the crashworthiness progress of the New Zealand vehicle fleet. The analysis in this study is based on data from police reports on injury crashes occurring in New Zealand during 1991-2022.

Crashworthiness is an estimate of the occupant protection provided by a vehicle in a crash, namely the risk of a driver of a vehicle being killed or seriously injured (admitted to hospital) when involved in a crash. It is obtained from the product of injury severity (of injured drivers) and injury risk (of drivers involved in crashes) for the drivers of vehicles of the specified year of manufacture or specified year of first registration in New Zealand. The method of analysis, first demonstrated in the study of Newstead and Watson (2005), gives unbiased estimates of injury risk from injury crash data where the total number of uninjured drivers is unknown, as seen in the New Zealand crash data reported by police. It was again used here. The method was used separately to obtain crashworthiness for vehicles by year of manufacture and by year of first registration in New Zealand.

The injury risk estimates were based on crash data for 175,584 drivers involved in crashes between two vehicles in New Zealand during 1991-2022, where one or both drivers was injured and the vehicle was manufactured between 1964 and 2022. The injury severity estimates were based on data for 227,748 drivers injured in crashes in New Zealand during 1991-2022, and where the vehicle was manufactured between 1964 and 2022.

The injury risk ratings were adjusted for the sex and age of the driver, the speed limit at the crash location and the year in which the crash occurred. The injury severity ratings were also adjusted for the number of vehicles involved in the crash. These factors are known to be strongly associated with injury risk and injury severity. Adjustments were made via logistic regression analysis techniques with the aim of measuring the effects of vehicle factors alone, uncontaminated by other factors available in the data that affected crash severity and injury susceptibility. The degree of accuracy of the crashworthiness ratings is represented by the confidence limits of the rating in each case.

Analysis successfully estimated trends in the crashworthiness of the light passenger vehicle fleet (cars, station wagons, four-wheel drives, vans and utilities) in New Zealand by both year of manufacture and year of first registration for used imports in New Zealand. Estimates of crashworthiness by year of vehicle manufacture for the New Zealand light passenger vehicle fleet as a whole along with 95% confidence limits are shown in Figure E1. Analysis of trends by year of vehicle manufacture show statistically significant improvement in the crashworthiness of New Zealand light passenger vehicles over the years of manufacture studied. Measured improvement was most rapid over the years of manufacture from 1983 to 2007 with a reduction of 70%. During this period, vehicle safety in New Zealand was affected by several competing effects: a general increase in both active and passive safety features in vehicles; increasing proportions of used imported vehicles entering the New Zealand fleet; and increases in the regulation of vehicle safety standards by the New Zealand Government. Over the period 1983 to 2022, the risk of death or serious injury to drivers reduced by 74% for the fleet as a whole (relative to 1983). Further monitoring of recent trends is warranted to continue to track the safety performance of the New Zealand light vehicle fleet.

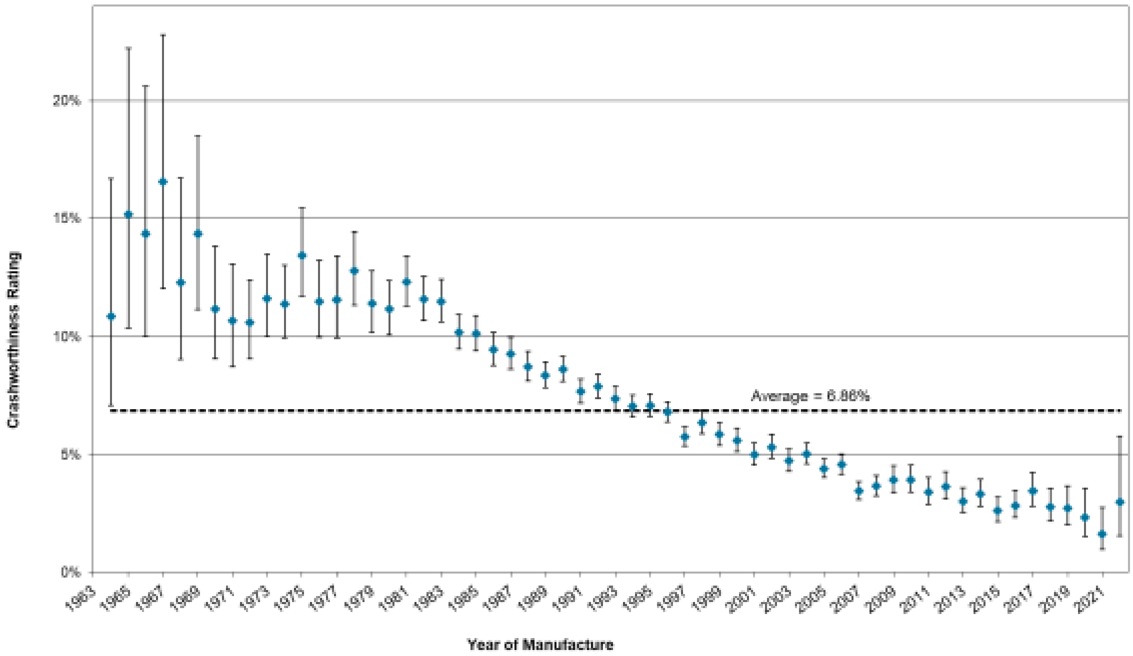

Figure E1: Crashworthiness by year of manufacture (with 95% confidence limits)

Estimates of crashworthiness trends in the vehicle fleet by year of first registration in New Zealand from 1986 to 2022 for used imported vehicles were also obtained and are shown in Figure E2 along with 95% confidence limits. They showed a numerically high crashworthiness rating (indicating poor occupant protection performance) of newly registered vehicles in the early 1990's, the years when used imports began to penetrate the New Zealand market in significant numbers. This was followed by statistically significant improvements in crashworthiness over the later years of that decade. Analysis shows that the new vehicles entering the fleet in any particular year are more crashworthy than the cohort of second-hand (used) imports brought into New Zealand in the same year highlighting the concern about the safety implications of the used imported vehicle program. Because the average age of used imported vehicles in New Zealand has increased from seven and a half years in the early 2000s to just over nine years by 2022, the gap between the safety of new vehicles and used imports brought into New Zealand each year has been widening. The differential in safety between the new and used imported vehicles continues to need further monitoring.

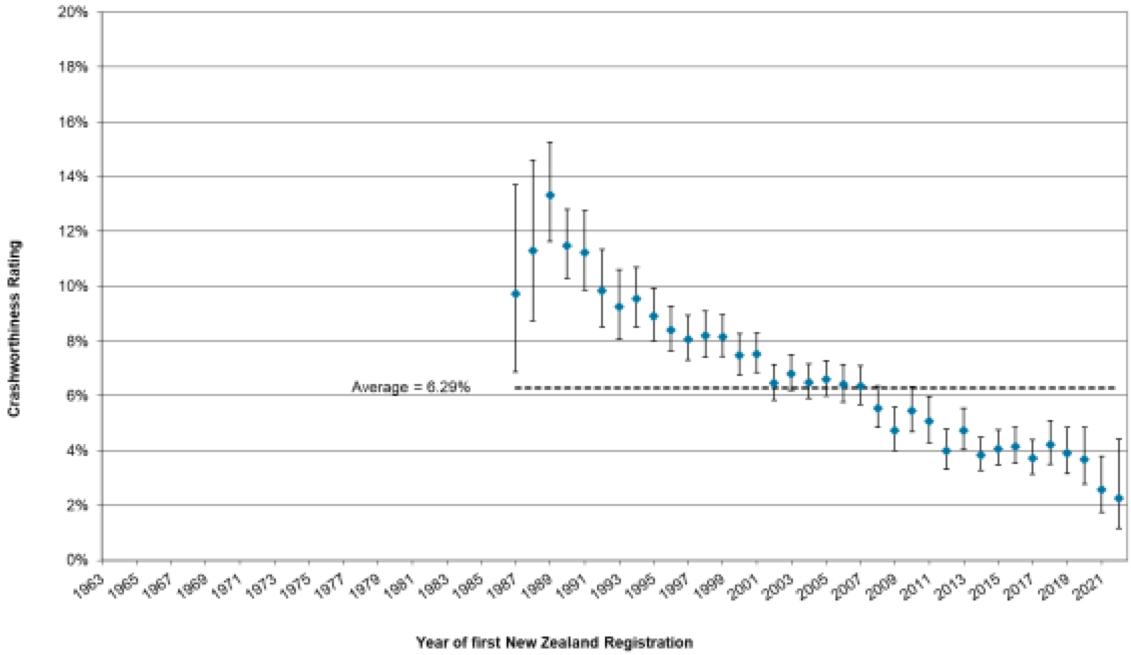

Figure E2: Crashworthiness by year of first registration in New Zealand (with 95% confidence limits) - Used Imports

This report also describes the development of updated vehicle safety ratings for 1982-2022 model vehicles by make, model and market group. The produced ratings cover vehicle crashworthiness, aggressivity and total secondary safety and are published annually under the UCSR banner. A new rating described here is the primary safety rating that measures the safety benefits of advanced driver assistance systems (ADAS) in preventing crashes. As described above, crashworthiness ratings measure the relative safety of vehicles in preventing death or serious injury to their own drivers in crashes whilst aggressivity ratings measure the death or serious injury risk vehicles pose to other road users with which they collide. The aggressivity rating measure is based on collisions between the vehicle being rated and both other vehicles and unprotected road users including pedestrians, bicyclists and motorcyclists. The total secondary safety index measure integrates the combined crashworthiness and aggressivity performance of a vehicle into one measure in a way most representative of the crash population involving the vehicle fleet being rated. It considers relative injury outcomes to all people involved in the full range of crashes involving light passenger vehicles including single and multi-vehicle crashes, crashes with heavy vehicles and crashes involving unprotected road users.

As the development of the updated ratings for the New Zealand fleet was conducted alongside development of the ratings for the Australian fleet using the combined police-reported crash data of Victoria and New South Wales during 1987-2022; from Queensland, Western Australia and New Zealand during 1991-2022; and from South Australia during 1995-2022, the methodology and results are presented in detail in Newstead et al. (2024).

The UCSR are calculated for particular vehicles (make/models) where there are sufficient crash and injury data available to achieve a sufficient level of accuracy for the rating. Where a particular vehicle is not sufficiently common in the Australasian light vehicle fleets, the Vehicle Safety Risk Rating (VSRR) shows the likely safety level of the vehicle based on similar vehicles but produced at a more aggregated level than the UCSR. The VSRR ratings apply to specific market groups (e.g., small cars) for each year of manufacture. For a very small proportion of vehicles in the New Zealand fleet, the average rating for a given year of manufacture across all market groups is the best safety rating available as information regarding the market group of the vehicles is lacking.

The results and conclusions are based on a number of assumptions and warrant a number of qualifications that should be noted.

TRENDS IN THE SAFETY OF THE NEW ZEALAND VEHICLE FLEET: 1964 to 2022

SUPPLEMENT TO REPORT 371:

VEHICLE SAFETY RATINGS ESTIMATED FROM POLICE-REPORTED CRASH DATA: 2024 EVALUATION

1 INTRODUCTION

1.1 Secondary Safety Ratings by Make, Model and Market Group

For over two decades, the Monash University Accident Research Centre (MUARC) has been involved in a program of research rating light passenger vehicles according to their actual on-road safety performance using crash data from Australia and New Zealand through the analysis of mass data records on crashes reported to police. These ratings are published annually under the Used Car Safety Ratings (UCSR) program.

The most comprehensive safety rating is the total secondary safety rating, which evaluates vehicles according to the protection the vehicle offers to all parties involved in the range of crashes that occur in the real world (Newstead et al., 2011). The total secondary safety rating is relevant to 100% of injury crashes. The most important contributing factor to this rating is the safety of the vehicle for its own occupants, which is also separately evaluated by the crashworthiness rating. The other main component of the total secondary safety rating is aggressivity, being the safety of other road users with whom the vehicle may crash, occupants of other vehicles as well as cyclists, motorcyclists and pedestrians. The crashworthiness of a light vehicle is relevant to injury outcomes in around 90% of crashes in Australasia (it is irrelevant only for vulnerable road user crashes) whilst vehicle aggressivity is relevant in around 55% of crashes (irrelevant for single vehicle crashes only). Consequently, the total secondary safety rating is weighted more highly towards the crashworthiness performance than aggressivity performance of each vehicle. Around 62% of its value comes from the crashworthiness and around 38% from the aggressivity, although this varies according to the way that particular vehicles are used.

The total secondary safety rating along with the crashworthiness and aggressivity ratings are discussed in further detail below.

1.1.1 Crashworthiness Ratings

A principal focus of the research has been to rate the relative performance of different vehicle models in preventing injury to their occupants in the event of a crash, commonly known as the crashworthiness of the vehicle. The crashworthiness ratings developed as part of the MUARC research rate the relative safety of vehicles by examining injury outcomes to drivers in real crashes. More specifically, the defined crashworthiness rating of a vehicle is a measure of the risk of death or serious injury to a driver of that vehicle when it is involved in a crash. This risk is estimated from large numbers of records of injury to drivers of that vehicle type involved in real crashes on the road and it is measured in two components:

1. Rate of injury for drivers involved in crashes where a vehicle is towed away or someone is injured (injury risk);
2. Rate of serious injury (death or hospital admission) for injured drivers (injury severity).

Multiplying these two rates together forms the crashworthiness rating. This is a measure of the probability of serious injury for drivers involved in crashes where a vehicle is towed away or someone is injured. Measuring crashworthiness in two components reflecting risk and severity of injury was first developed by Folksam Insurance, which published Swedish ratings (Gustafsson et al., 1989). In addition to the speed zone and driver sex, the Australasian crashworthiness method of analysis adjusts for the effects of driver age and the number of vehicles involved, producing results with all those factors taken into account.

1.1.2 Aggressivity Ratings

The aggressivity measure used in the Australasian vehicle safety rating system estimates the risk of the driver of another car or an unprotected road user (pedestrian, bicyclist or motorcyclist) being killed or seriously injured when involved in a collision with the subject model vehicle. Because an estimate of the risk of injury cannot be calculated for unprotected road users since crashes are generally not reported to the police when the unprotected road user is uninjured, the measure of aggressivity injury risk is based only on the injury risk to the drivers of other vehicles. In contrast, complete records of both other drivers and unprotected road users injured in crashes are available in police-reported crash data and can be used to examine injury severity outcomes in the aggressivity measure. Like the crashworthiness measure, the aggressivity rating is calculated as the product of the two component measures, injury risk and injury severity.

Like the crashworthiness rating, the aggressivity measure was adjusted for the effects of non-vehicle factors differing between the subject car models which may have affected injury outcomes to the driver of the other vehicle. These factors include the sex and age of the driver and other vehicle occupants; speed limit at the crash location; and the collision partner type (for the injury severity analysis only).

1.1.3 Total Secondary Safety Index

Building on the approach to modelling vehicle total secondary safety demonstrated in Newstead et al. (2004a) and Newstead et al. (2004b), the study of Newstead, Watson, and Cameron (2007c) developed and applied an integrated single index of total secondary safety for light passenger vehicles in the Australian and New Zealand vehicle fleets. The index measures the average risk of death or serious injury to light passenger vehicle drivers and unprotected road users (pedestrians, cyclists and motorcyclists) when involved in a crash with a light passenger vehicle to a degree of accuracy represented by the confidence limits of the index in each case. It provides an overall summary of the combined crashworthiness and aggressivity performance of a vehicle. The index combines measures of injury severity (the risk of death or serious injury given an injury was sustained), and injury risk (the risk of injury given crash involvement). As far as possible, the index reflects the total secondary safety performance related to vehicle design alone by controlling for a range of non-vehicle related factors known to affect injury outcome. The index is adjusted for the sex and age of the person whose injury outcome was being measured; speed limit at the crash location; number of vehicles involved; the jurisdiction in which the crash occurred; and the year in which the crash occurred. These factors are strongly related to injury risk and/or severity. In addition to the above factors, this rating is also adjusted for the type of crash and road user combination as this factor is also strongly related to injury risk and/or severity.

The index serves as a valuable summary of overall secondary safety of light passenger vehicles both for consumer information as well as for regulators and vehicle safety advocates in identifying and promoting vehicle safety characteristics that optimise overall secondary safety characteristics.

1.1.4 Vehicle Market Groups

Previous updates of the UCSR have classified vehicle models, for the purpose of publication, into one of a number of market groups. The market groups defined are based heavily on those used by the Federal Chamber of Automotive Industries (FCAI) for reporting Australian vehicle sales as part of their VFACTS publication (see www.fcai.com.au for further details). The ten market groups defined for analysis are as follows with a broad description of the classification criteria used to define each (although the criteria are not strictly applied and some judgement on classification used according to where a vehicle is classified by VFACTS).

Passenger Cars

Light	Passenger car, hatch, sedan, coupe or convertible, tare mass < 1,200kg
Small	Passenger car, hatch, sedan, wagon, coupe or convertible, tare mass 1,200-1,450kg
Medium	Passenger car, hatch, sedan, wagon, coupe or convertible, tare mass 1,450-1,650kg
Large	Passenger car, hatch, sedan, wagon, coupe or convertible, tare mass > 1,650kg
People Movers	Passenger usage seating capacity > 5 people

Sports Utility Vehicles (SUVs) (also called Four-Wheel Drive Vehicles) (high ground clearance, wagon generally with off road potential)

SUV Small	typically less than 1,550kg tare mass)
SUV Medium	typically between 1,550kg and 1,850kg tare mass)
SUV Large	typically greater than 1,850kg tare mass

Light Commercial Vehicles

Van	Blind & window vans
Utility	Two and four-wheel drive, normal control (bonnet), utility, cab chassis and crew-cabs

Some departures from the VFACTS classification have been made in presenting the ratings in this study. VFACTS defines a luxury SUV category based on vehicle price as well as classifying sports cars priced above the luxury car tax threshold as luxury vehicles. Here, the luxury SUVs have been distributed amongst the three defined SUV categories based on tare mass.

There have also been some departures from the classification principles defined above for certain vehicle models based on how they are classified by VFACTS noting that mass variations of specific models or variants may fall outside of the general ranges described above.

1.2 Crashworthiness by Year of Vehicle Manufacture and Year of First Registration

One focus of the vehicle crashworthiness ratings study in Australia has been to track historical improvements in the average crashworthiness of the vehicle fleet by year of manufacture. The original study of Cameron, Newstead, Le, and Finch (1994b) showed that the crashworthiness of passenger vehicles in Australia has improved over the years of manufacture 1964 to 1992 with rapid improvement over the years from about 1970 to 1979. Improvements were related to implementation of a number of Australian Design Rules (ADRs) for motor vehicle safety which previous research had shown to be effective in providing occupant protection. The study has been regularly updated with the most recent analysis covering Australian vehicles with years of manufacture from 1964 to 2022 (Newstead et al., 2024).

Although New Zealand data have been combined with data from Australian states in producing the UCSR, since Newstead, Cameron, and Watson (2004) the information from New Zealand was not included in the estimates of crashworthiness by year of manufacture. This was because trends in crashworthiness by year of vehicle manufacture reflect the composition of a particular vehicle fleet in terms of the makes and models of vehicles in the fleet as well as the regulatory framework for vehicle safety in the country being examined.

The New Zealand and Australian vehicle fleets differ significantly in their mix of vehicle makes and models as well as the standards they were manufactured to meet. This is partly a result of the program of importing used vehicles into New Zealand (mainly from Japan) which began to have a noticeable effect in 1987 when the percentage of used imports in new registrations in New Zealand rose from about 5% to about 13%. The levels of used imports rose again to about 50% over the next three years and peaked at two thirds of newly registered vehicles in the mid-2000s. Since most vehicles in Australia are first registered when they are new, estimation of combined trends for the two countries by year of manufacture would not be particularly meaningful. There is also the problem that innovations and new safety standards potentially flow more slowly into a fleet such as that in New Zealand which allows the import of large numbers of second-hand (used) vehicles from other countries.

The regulatory framework governing vehicle safety in New Zealand is also quite different to that in place in Australia. Partly reflecting the historical presence of a local vehicle manufacturing industry, Australia requires that all vehicles must be manufactured in compliance with the ADRs, so the quality is controlled at manufacture. All new vehicles imported into the country, which account for the vast majority of new registrations in Australia, must also comply with the ADRs. By contrast New Zealand imports all its light vehicles and their quality is controlled at import. The various Land Transport Rules require that vehicles must have been manufactured in accordance with approved standards but they also provide a choice of equivalent standards, including the ADRs, reflecting that the vehicles are sourced from different markets. Although both countries mandate many of the same standards, the timing of their implementation is quite different, which would be expected to lead to differences in crashworthiness by year of vehicle manufacture. For example, compliance with a frontal impact standard for occupant protection was implemented for cars manufactured after 1996 in Australia. A similar rule was only mandated for cars entering New Zealand after April 2002.

New Zealand crashworthiness ratings by year of manufacture were first estimated by Newstead and Watson (2005) for 1964-2002 model vehicles using a method of analysis that gives unbiased estimates of injury risk from injury crash data where the total number of uninjured drivers is unknown. It examined trends in crashworthiness both by year of manufacture and by year of first registration for the New Zealand light vehicle fleet. Reflecting differences in the mix of specific vehicle models in the New Zealand light vehicle fleet, crashworthiness trends by year of vehicle manufacture in New Zealand were shown to be substantially different to those observed in Australia. Whilst the largest gains in crashworthiness in Australia were measured during the 1970s years of manufacture, the bulk of the gains in crashworthiness of the New Zealand vehicle fleet have occurred since the mid-1980s. Relative to 1983, the risk of death or serious injury to drivers in a crash in 2022 has reduced by around 74% for the New Zealand fleet as a whole. Both levels of absolute crashworthiness and trends on a year of manufacture basis were similar for used imports and for vehicles sold new in New Zealand. The difference in observed trends between Australia and New Zealand is likely due to different patterns in the implementation of regulation governing vehicle safety performance between the two countries.

As was the case with the original study of crashworthiness by year of vehicle manufacture in Australia, this study set the basis for ongoing monitoring of crashworthiness trends by year of manufacture for all vehicles and first registration in the New Zealand vehicle fleet for used imports. Addition of further crash data extended the years of manufacture covered by the ratings and improved the statistical confidence on the estimates for the years previously covered. Updates also provided a potential means to evaluate the effect of vehicle safety rules and other interventions by the New Zealand Government. The New Zealand crashworthiness ratings were subsequently updated annually with the most recent results published in Newstead et al. (2023b) for 1964-2021 model vehicles.

1.3 Vehicle Safety Measures for the New Zealand Fleet

The Waka Kotahi NZ Transport Agency currently provides safety ratings for consumers for all vehicles in the fleet via the RightCar website rightcar.govt.nz. These ratings can be classified into three general categories:

- For newer vehicles, ANCAP (Australasian New Car Assessment Program) conducts crash tests of various scenarios to measure the safety of vehicle occupants in the event of a crash, including the protection other road users such as pedestrians and cyclists, and tests of ADAS for crash avoidance.
- For used vehicles, the UCSR produced by MUARC (see Newstead et al., 2024) assess the crashworthiness, aggressivity, total secondary safety, and primary safety of older, used vehicles already being driven on New Zealand roads, using real-world police-reported crash data. The crashworthiness component of the UCSR measures how well a specific vehicle (make, model and year of manufacture) protects occupants in the event of a crash, referred to in this report as the Method 1 ratings.
- MUARC also produce ratings at a more aggregated level for vehicles where there are insufficient crashes to rate the specific vehicle. These ratings apply to specific market groups (e.g. small cars) for each year of manufacture (Method 2 ratings). On the RightCar website, these are referred to as the Vehicle Safety Risk Rating

(VSRR). For a very small proportion of vehicles, the average rating for a given year of manufacture across all market groups is the best safety rating available (Method 3) as information regarding the market group of the vehicles is lacking.

1.4 Project Aims

The aim of this project was to update the ratings previously published in Newstead et al. (2023b) of New Zealand crashworthiness by year of manufacture for the New Zealand passenger vehicle fleet as a whole, and by year of first registration for used vehicle imports in New Zealand, by including additional crash data from the year 2022 for New Zealand. The latter analysis aimed to assess the safety of the used imports brought into New Zealand in any particular year. The updated ratings focussed on light passenger vehicles including cars, station wagons, four-wheel drive vehicles, passenger vans, and light commercial vehicles manufactured during 1964-2022 and crashing in New Zealand during 1991-2022.

This project also aimed to assign updated vehicle safety ratings for 1982-2022 model vehicles by make, model and market group in New Zealand based on the Used Car Safety Ratings estimated on combined Australian and New Zealand data. The assigned ratings cover vehicle crashworthiness, aggressivity and total secondary safety. Since 2023, the Overall Safety star rating, calculated from a vehicle's total secondary safety score, has been the primary focus of the vehicle safety rating information presented under the UCSR Program. New Zealand was an early adopter of this new focus, with the Overall Safety rating becoming the headline rating from 2021. Although having a vehicle with good crashworthiness may be the obvious focus for a vehicle purchaser, from the point of view of reducing road trauma overall, the Overall Safety rating provides a more relevant measure. It indicates the average relative risk of being killed or seriously injured (resulting in hospital admission) across all people in a crash involving the rated vehicle including the driver of the rated vehicle and other road users, both vulnerable road users (pedestrians, cyclists and motorcyclists) and occupants of other vehicles. The focus on the Overall Safety Rating acknowledges that consumers are increasingly concerned with how a vehicle will protect its own occupants, in addition to how a vehicle can protect the other road users involved in a crash.

A measure of primary safety has been produced as part of the UCSRs. Primary safety measures the relative risk of crash involvement of a vehicle per unit of travel exposure on the road. In the case of the UCSRs, the primary safety rating developed represents the reduction in crash risk associated with the fitment of various Advanced Driver Assistance Systems (ADAS) which have become widely available in newer vehicle over recent years. ADAS included in the UCSR primary safety index are those which have been proven to reduce crash risk in Australia and New Zealand through rigorous real world evaluation studies. A further aim of this study was to integrate the primary safety index into the New Zealand vehicle safety information reflecting the combination of ADAs which are fitted to vehicles in New Zealand by make and model of vehicle.

The development of the updated ratings for the New Zealand fleet was conducted alongside development of the ratings for the Australian fleet using the combined police-reported crash data of Victoria and New South Wales during 1987-2022; from Queensland, Western Australia and New Zealand during 1991-2022; and from South Australia during 1995-2022. The methodology and results are presented in detail in Newstead et al. (2024).

The current report outlines the procedures used to attach crashworthiness and total secondary safety ratings (the UCSR and the VSRR) to the New Zealand vehicle fleet snapshot using the most recent crash data available, including crashes occurring up to and including 2022 in Australia and New Zealand.

2 DATA

Data provided by the Waka Kotahi NZ Transport Agency which were used to produce the crashworthiness by year of manufacture published in the ratings of Newstead et al. (2023b) covering vehicles manufactured over the period 1964-2021 and crashing during the years 1991-2021 was again used here. Police-reported crash data for 2022 was obtained and integrated bringing the total period of crash data covered to 1991-2022. The methods of selecting appropriate cases from each data source are detailed here.

In addition, this study utilised registration data giving details of all crash-involved vehicles on the New Zealand register in each year from 1991 to 2022. Extracts from both data sources used in the estimation of the crashworthiness by year of manufacture and year of first registration are described below.

2.1 Calculation of the Used Car Safety Ratings by Make, Model and Market Group

Data utilised in the calculation of the crashworthiness, aggressivity and total secondary safety ratings by make, model and market group, in addition to the primary safety index, are described in Newstead et al. (2024, see Section 2).

2.2 Crashworthiness by Year of Vehicle Manufacture and Year of First Registration

2.2.1 Crash Data

New Zealand has an established database of police-reported crashes over many years. Amongst many other things, the data are used to produce the annual crash statistics for the New Zealand fleet. The crash data are stored in the Crash Analysis System (CAS) database managed by the Te Manatū Waka Ministry of Transport (MoT) and covers both injury and non-injury crashes. Whilst non-injury crashes are available from CAS, the reporting coverage of non-injury crashes in New Zealand is not as clear. This is because it is not mandatory for a non-injury crashes to be reported to the police so the number, nature and degree of vehicle damage, if any, are not known. Because of this, and because of problems with vehicle model identification documented by Voyce (2000), only injury crash data from New Zealand were used for estimating vehicle safety ratings.

To facilitate the use of New Zealand crash data in computing vehicle crashworthiness ratings, there were a number of key variables in the crash data supplied. These variables were required to represent the effects of non-vehicle factors on injury outcome in order to be able to estimate crashworthiness ratings that represented only the vehicle influences on injury outcome. The key variables available in the data were as follows:

- Year of crash (1991, 1992, …, 2022)
- Speed limit at crash location (<80km/h; >=80km/h)
- Number of vehicles involved (1; more than 1)
- Level of urbanisation of crash location (urban, rural)
- Driver age (<=25 years; 26-59 years; >=60 years)
- Driver gender (male, female)
- Injury level of driver (killed, hospitalised; other injury; not injured)

Data in CAS are stored as a relational database, comprising a series of linked tables with each covering a different theme related to a crash. The New Zealand Ministry of Transport supplied details of the data fields available in CAS through a data dictionary of the database. Data from three tables - crash, person and vehicle - covered all the required data fields listed above. Linking data in the tables together was achieved using the crash identification number (crash_id), traffic unit identifier (ltsa_role) and person identifier (pers_id) fields.

Complete extracts of each data table for the years 1991 to 2022, without personal identifier information, were supplied for analysis. From these, it was possible to select the required data for analysis from the supplied tables. It is noted that each unit in the file did not necessarily represent a vehicle that could be rated. A unit also included a motorcycle, bicyclist, pedestrian or heavy vehicle.

2.2.2 Registration Data

Information from the New Zealand motor vehicle register on vehicle make, model and year of manufacture was required to enhance the crash data for estimation of vehicle crashworthiness ratings. Data were requested from the Waka Kotahi NZ Transport Agency covering all vehicles appearing in the 1991-2022 New Zealand crash data with current or historical (archived) registration records. Registration records for vehicles appearing in the crash data were selected based on registration plate number, assuming the plate number had been recorded accurately by the police in the crash data.

Variables required from the registration database were selected with reference to information required for accurate vehicle model decoding. Variables requested were as follows:

- Vehicle registration number (plate number)
- Vehicle Identification Number (VIN)
- Vehicle type
- Registration indicator
- Date of first New Zealand registration
- Date of registration
- Deregistration date (where applicable)
- Country of previous registration
- Make
- Model
- Sub-model name
- Industry model code
- Chassis number
- Import status
- Year of manufacture
- Body type

- Country of origin
- Assembly type
- CC rating
- From date
- Colour

Of the variables requested, a number were vital for clustering vehicles appearing in the New Zealand crash data for analysis by year of manufacture. These were vehicle type, year of manufacture, registration number, the date of registration, the date of the first registration in New Zealand and whether the vehicle was sold new in New Zealand, was a used import or re-registered. For some years there was a confusion in the recording of year of manufacture and date of first registration, but the errors are reported to be small.

One difficulty in retrieving vehicle registration information details for crashed vehicles based on only the registration plate number arose for registration plates that had been used on more than one vehicle model over time. It was not possible for the Waka Kotahi NZ Transport Agency to find the registration record that was current for a plate number just before the time the vehicle crashed. Instead, all records for the plate number of a crashed vehicle were retrieved from the registration system and archive. Where multiple records for a single plate number were provided, the most appropriate match based on the date of the crash, the date of registration and the date of first registration of the vehicle in New Zealand needed to be established. The process for doing so is described below. In some cases, a registration record could not be found for a crashed vehicle. This was most likely because either the registration plate details had been recorded incorrectly in the crash data or the vehicle was not registered. This means that the total number of registration records is less than the number of crash-involved units. There are also some units that are pedestrians and bicycles that are therefore not registered.

2.2.3 Merging the Crash and Registration Data

The New Zealand registration and crash files were matched to provide full vehicle and crash information for each crash-involved unit. This required the vehicle details obtained from the registration files to be matched with the crash files based on the registration number. This process raises some unique difficulties. First, in some instances the same vehicle may have crashed more than once between 1991 and 2022 causing multiple records for the same vehicle to appear in the registration file. Selecting those cases where the date of registration, the date of the vehicle was first registered in New Zealand, vehicle make, model and registration details were identical identified these cases. Multiple entries were then deleted from the registration file.

Second, it was possible that the same registration number may be associated with more than one vehicle over time and with multiple registrations of the same vehicle due to re-registration. If any of these vehicles were involved in a crash during the relevant period, all vehicles on the New Zealand register between 1991 and 2022 with the relevant registration numbers appeared as unique entries in the registration data file. In cases of multiple entries with the same registration number, it was necessary to identify which of the vehicles on the registration file best matched the vehicle involved in the crash as shown in the crash file. Registration details were matched to crashes by selecting the most recently registered vehicle prior to the accident date using both the date of the first New Zealand registration and the registration date of the vehicle.

Finally, in cases where the registration number was unknown or incomplete the crash and registration data could not be matched. This process of matching used here is an enhancement of that described in Newstead et al. (2003) for matching New Zealand crash and registration data.

Only vehicles manufactured after 1964 and only entries coded as cars, station wagons, vans or utilities were relevant to the analysis. This left 439,888 light passenger vehicles for analysis from which the driver's injury outcomes were used for estimation of the crashworthiness measure. Records on the uninjured drivers in the New Zealand injury crash data are incomplete because non-injury crashes in New Zealand, and hence uninjured driver details from these crashes, are not required to be reported. This meant driver injury risk could not be directly estimated from the available data. To overcome this limitation, a method of calculating injury risk from incomplete data was utilised. This injury risk estimator is referred to in Section 1.2 and described in Section 3 and involved matching two-vehicle crashes and comparing the injury outcome of the drivers in the two vehicles. The nature of the injury risk estimator means it only analyses two-car crashes in which the partner vehicle's driver has been injured, a subset of the total available data. Hence injury risk was estimated from the data on 175,584 drivers involved in a two-vehicle collision during 1991 to 2022 where the other driver was injured. This data set is referred to as the "involved drivers". Established methods were used for measuring the injury severity of injured drivers recorded in the data. The data on "injured drivers" covered 227,748 drivers who were injured in crashes in New Zealand during 1991-2022.

2.3 Attaching Ratings to the New Zealand Fleet

2.3.1 Fleet Data

Waka Kotahi NZ Transport Agency provided a snapshot of all vehicles on the New Zealand vehicle register as at December 2022, together with a unique identification number and Waka Kotahi-assigned information regarding the make and model, the model generation start and end years, the market group and the VRSG code.

2.3.2 UCSR

This VRSG code is used by MUARC to define homogeneous groupings of vehicles for which the safety ratings are estimated. There were 4,840,767 records in the provided data, of which 3,669,582 had a valid VRSG code for which UCSR were available.

2.3.3 VSRR

The remainder of the New Zealand light passenger vehicle fleet were given VSRR ratings. These were mostly provided for given market groups and years of manufacture. For a small proportion of the fleet (as at December 2022), 235,834 vehicles (5%) could only be provided a star rating based on year of manufacture. These were mostly older vehicles that only received a single star. Calculation of the VSRR for the New Zealand vehicle fleet were done as part of the annual update of the UCSR. Data and methods utilised in the calculation of the 2024 UCSR are described in Newstead et al. (2024, see Section 2).

3 ANALYSIS

3.1 Overview of Analysis Methods: Calculation of the Used Car Safety Ratings by Make, Model and Market Group

The methodology employed in the calculation of the crashworthiness, aggressivity and total secondary safety ratings by make, model and market group, in addition to the primary safety index, are described in Newstead et al. (2024, see Section 4).

3.2 Overview of Analysis Methods: Crashworthiness by Year of Vehicle Manufacture and Year of First Registration

The crashworthiness rating (C) is a measure of the risk of serious injury (hospitalisation or death) to a driver of a car when it is involved in a crash. Following the method traditionally used by MUARC, it is defined to be the product of two probabilities (Cameron et al., 1994d):

I. the probability that a driver involved in a crash is injured (injury risk), denoted by R;

II. the probability that an injured driver is hospitalised or killed (injury severity), denoted by S.

That is:

$$C = R \times S.$$

Folksam Insurance, who published the Swedish ratings, first measured crashworthiness in this way (Gustafsson et al., 1989). This method has previously been used to produce the Australian and New Zealand vehicle fleet crashworthiness ratings (most recently in Newstead et al., 2024; Newstead et al., 2023b).

In the present study, each of the two components of the crashworthiness rating were obtained by logistic regression modelling techniques. Such techniques are able to simultaneously adjust for the effect of a number of factors (such as driver age and sex, number of vehicles involved, etc.) on probabilities such as the injury risk and injury severity.

For the analysis of both crashworthiness by year of manufacture and year of first registration for used imports (in New Zealand) of New Zealand light passenger vehicles another method is required. Because non-injury crashes are not reliably reported in the New Zealand crash data, injury risk cannot be measured directly from the data (as a simple ratio of injured drivers over total involved drivers) as it is in calculating the vehicle specific ratings of Newstead, Watson, and Cameron (2014a). The alternative of calculating the proportion of injured drivers amongst those involved in injury crashes results in a biased estimate of injury risk as the denominator is missing crashes that resulted in no injuries to any road user involved. To overcome these problems, an alternative measure of injury risk has been used here which is based on the paired comparison approach but leads to unbiased estimates. Newstead and Watson (2005) give a description of the derivation of the injury risk estimator.

Logistic regression models were used to adjust the injury risk and severity measures for the effects of possible factors other than those related to the vehicle that might have influenced the crash outcomes in terms of driver injury risk or severity. This was particularly important when the parameter of interest in the logistic regression, in this case the year of manufacture, was confounded with the non-vehicle factors. A stepwise procedure was used to identify which factors of those available in the data had an important influence on injury outcome. This was done without considering the year of manufacture in the model, as the aim was to determine which other factors were most likely to have had an influence across a broad spectrum of crashes. Furthermore, it was also not considered appropriate to interact vehicle year of manufacture with other factors in the logistic model. This is because it was not the aim of the analysis to investigate variation in relative vehicle crashworthiness by year of manufacture by the crash circumstance and occupant characteristics. Rather, the aim was to estimate the average crashworthiness by year of manufacture averaged across all crash and occupant characteristics.

Logistic models were obtained separately for crashworthiness injury risk and crashworthiness injury severity because it was likely that the various factors would have different levels of influence on these two probabilities. The factors considered during this stage of the analysis for both crashworthiness injury risk and crashworthiness injury severity were as follows:

- **sex:** driver sex (male, female)
- **age:** driver age (≤25 years; 26-59 years; ≥60 years)
- **speedzone:** speed limit at the crash location (<80 km/h; ≥80 km/h)
- **year:** year of crash (1987, 1988, … ,2022)

For crashworthiness injury severity the following factor was also considered:

- **nveh:** the number of vehicles involved (one vehicle; >1 vehicle)

These variables were chosen for consideration because they were part of the New Zealand database and are variables that have been shown to have a significant relationship to injury outcome in the Australian and New Zealand combined vehicle safety ratings. Inclusion of the year of the crash in the logistic model was necessary to account for different long-term trends. All data was analysed using the Logistic Regression procedure (PROC LOGISTIC) of the SAS statistical package (SAS, 1989).

Crashworthiness injury risk and crashworthiness injury severity for individual years of vehicle manufacture or first registration were estimated after adding a variable representing year of manufacture to the terms identified as being statistically significant in each respective logistic model. The regression analyses were performed on 59 individual years of manufacture. A list of all years considered, with those with sufficient data for analysis indicated, is given in each of Appendices 1 and 2. For each year of manufacture or first registration, a 95% confidence interval for estimated injury risk and injury severity were obtained using methods described in Newstead and Watson (2005).

For a given year of manufacture, j, the crashworthiness rating, C_j, was calculated as:

$$C_j = R_j \times S_j$$

where

R_j denotes the injury risk for year of manufacture j;
S_j denotes the injury severity for year of manufacture j.

The 95% confidence limit for the crashworthiness rating was obtained using methods described in Newstead and Watson (2005). Because each of the two estimated crashworthiness components have been adjusted for the effect of other factors by logistic regression prior to their incorporation into the combined ratings, the resultant crashworthiness rating is also intrinsically adjusted for the influence of these factors. It should be noted that the confidence interval for the combined rate reflects the variability in the year of manufacture or first year of registration only, and not the variability in the other factors included in the logistic models.

3.3 Overview of Analysis Methods: Calculation of the Star Ratings

3.3.1 Determining Star Ratings

The published ratings classify vehicles according to where their total secondary safety, crashworthiness and aggressivity ratings lie in relation to quintiles of performance defined for the Australasian crash fleet.

For the current update, the vehicles with the best (numerically lowest) total secondary safety rating estimates were assigned 5-stars, the next best 4-stars and so on down to the worst rated vehicles which were assigned 1-star. The star rating categorisation cut-off points derived from the post 2000-year total secondary safety ratings were also used to classify the crashworthiness and aggressivity ratings into star rating categories.

3.3.2 Allocating Ratings to the Fleet

There are three resolutions at which vehicle secondary safety rating information can be applied to light passenger and light commercial vehicles appearing on the New Zealand vehicle register. They are (in descending order of specificity):

- **Method 1.** **UCSR:** By particular make and model (VRSG group)
- **Method 2.** **VSRR:** By year of manufacture and market group
- **Method 3.** **VSRR:** By year of manufacture only

The published ratings are attached to the particular make/model groupings (Method 1, above). Less specific (grouped) ratings are applied for the lower levels, with the third level being most approximate. These less specific ratings are used for two main reasons: (i) the vehicle is relatively rare in the fleet and there are too few crashes to form a rating for it (and equivalent vehicles) alone; (ii) there is insufficient (or contradictory) information for the particular vehicle on the register.

The ratings used and their method of derivation is described in detail in Newstead et al. (2024).

3.3.3 Calculation of the Primary Safety Index

Over the last decade, there has been a pressing need to rate a vehicle's crash avoidance features, particularly emerging vehicle safety technologies (Advanced Driver Assistance Systems – ADAS) made possible by the integration of computing technology with the control of the vehicle and communication with the driver. To form a measure of crash avoidance capability, a primary safety index was defined as the proportion of crashes estimated to be avoided due to the technologies, taking account of the exposure of each vehicle type to crash situations and potential overlap of the safety effects of different technologies installed in the same vehicle (Keall & Newstead, 2024). As described in that paper, some technologies are effective in preventing similar crashes to another technology (such as Lane Keep Assist and Electronic Stability Control), in which case the combined benefit of both technologies is a little less than the benefit of each of the technologies added together. Waka Kotahi NZ Transport Agency obtained details of safety technology fitment of each vehicle in the fleet from year of manufacture 2008 onwards (the period over which key safety technologies started to be installed in new vehicles). This information was used to form a primary safety index for each vehicle manufactured from 2008 onwards, the period spanning the introduction of the most important ADAS in vehicles. For this update, ADAS systems considered in the New Zealand primary safety rating were:

- Electronic Stability Control
- Autonomous Emergency Braking
- Lane keep assist systems
- Reversing cameras and sensors.

3.3.4 Adjusting Total Safety Ratings

The Total Safety Rating was adjusted where there were also primary safety technologies fitted to the vehicle that had proven safety benefits according to evaluations using real-world crash data. This combined rating was defined to be:

(Injury Risk)(Injury Severity)(Proportion of crashes not avoided)

Where Proportion of crashes not avoided = $1 - \sum_{t=1}^{p}(c_t a_t)$

p is the total number of proven crash avoidance technologies *t* fitted to the vehicle

c_t is the proportion of all crash-involved vehicles that would have benefitted from technology *t*

a_t is proportion of these sensitive crashes that are estimated to be avoided by technology *t*

A further minor adjustment was made to the rating. As described in Section 1.1, total safety incorporates both crashworthiness and aggressivity, with crashworthiness being most closely correlated due to the fact that the protection a vehicle offers to its own occupants is relevant to the injury outcomes from a crash in all crashes except those involving unprotected road users. Normally this means that the total safety rating falls between the crashworthiness rating and the aggressivity rating. As each of these three ratings is estimated independently (although using similar crash data and similarly formulated statistical models), there are rare occasions when the total safety rating does not fall between the crashworthiness rating and the aggressivity rating for a particular vehicle. In such situations, the total safety rating was adjusted (by a very small numerical value) so that it did fall within the range of the other two secondary safety ratings.

The thresholds for determining the number of total secondary safety rating stars each vehicle gets are set each year so that one fifth of the Australasian fleet manufactured from the year 2000 onwards obtains five stars, the next best fifth receive four stars, etc. The safety of the fleet improves over time as more safety features become standard in newer vehicles. This means that the threshold for obtaining a given number of stars also improves from year-to-year.

The headline star rating given to each vehicle was the total safety rating adjusted for primary safety technologies fitted to the vehicle in relation to these thresholds, with a further small adjustment made on rare occasions where this rating fell outside the range of the aggressivity and crashworthiness ratings.

4 RESULTS

4.1 Crashworthiness by Year of Manufacture of the New Zealand Vehicle Fleet

4.1.1 Injury Risk

Injury risk was estimated from the data on 175,584 drivers involved in a two-vehicle collision during 1991 to 2022. This reduced to 95,370 drivers where the other driver was injured. This data set is referred to as the "involved drivers". Because of missing values for some of the factors to be included in the logistic regression, and the exclusion of pre-1964 vehicles and unknown years, analysis was performed on data relating to 92,698 involved drivers, 37,762 of whom were injured.

The overall (average) injury risk for involved drivers in matched two-vehicle casualty crashes in New Zealand where the opposing driver was injured was 40.7%. In other words, the estimated probability that a driver involved in a two-vehicle crash in New Zealand was injured, where the colliding vehicle driver was also injured, was 40.7%.

Appendix 1 gives the estimates of injury risk derived by logistic regression for each individual year of manufacture for all vehicles combined. The variability in the injury risk estimates relative to the year of manufacture can be seen from the width of the corresponding 95% confidence intervals.

Figure 1 plots injury risk by year of vehicle manufacture with associated 95% confidence limits.

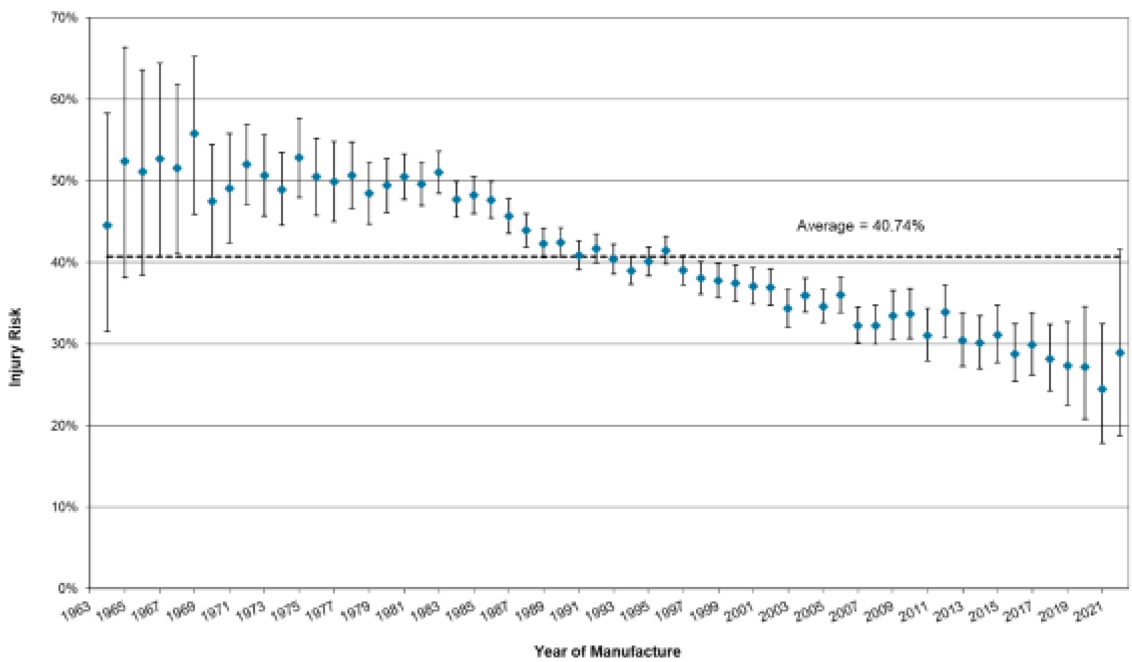

Figure 1: Injury risk by year of manufacture (with 95% confidence limits)

4.1.2 Injury Severity

The data on "injured drivers" covered 227,748 drivers who were injured in crashes in New Zealand during 1991-2022 (as described in Section 2). Because of missing values for some of the associated crash factors and the exclusion of pre-1964 vehicles and unknown years, logistic regression was performed on data relating to 224,442 injured drivers 37,774 of whom were severely injured (killed or admitted to hospital).

The overall (average) injury severity for injured drivers in all vehicles was 16.8%. In other words, the estimated probability that a driver injured in a crash was severely injured was 16.8%.

Appendix 1 gives the estimates of injury severity derived by logistic regression for the individual years of manufacture for all vehicles. The variability in the estimates of injury severity relative to year of manufacture can be seen from the width of the corresponding 95% confidence intervals.

Figure 2 plots injury severity by year of vehicle manufacture with associated 95% confidence limits.

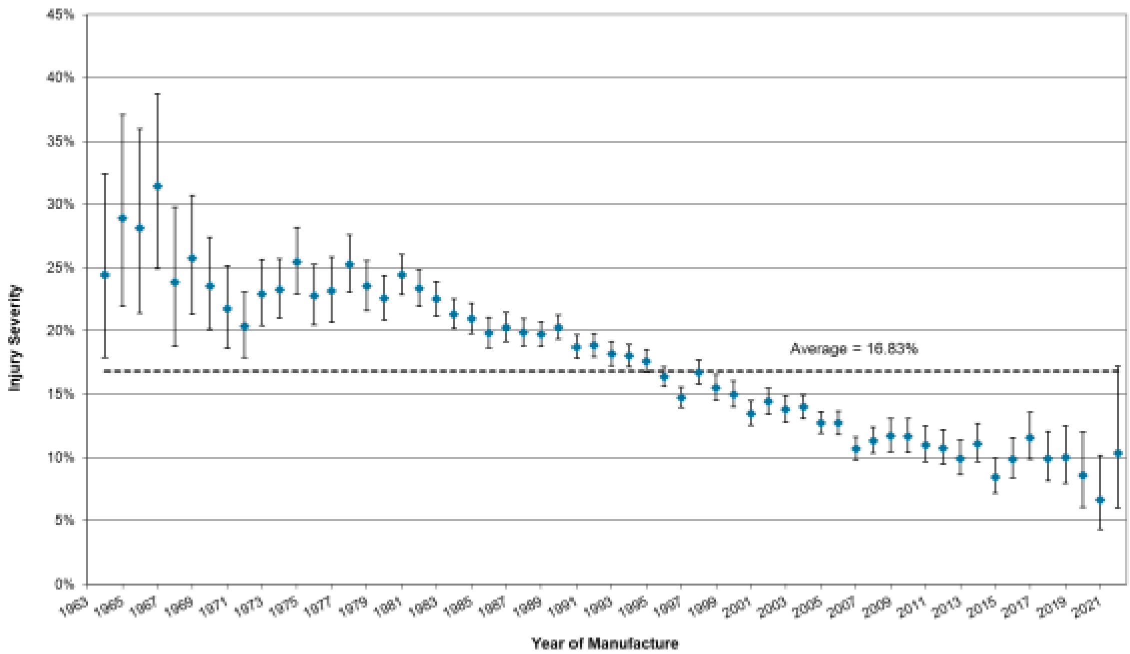

Figure 2: Injury severity by year of manufacture (with 95% confidence limits)

4.1.3 Crashworthiness by Year of Manufacture

The crashworthiness estimates for each year of manufacture were obtained by multiplying the corresponding individual injury risk and injury severity estimates. Because each of the two components has been adjusted for the confounding factors, the resultant crashworthiness estimate is also intrinsically adjusted for their influence.

Appendix 1 gives the crashworthiness estimates and the associated 95% confidence intervals for each of the years of manufacture included in the analysis. Each estimate is expressed as a percentage, representing the relative number of drivers killed or admitted to hospital per 100 drivers involved in a crash where the opposing vehicle driver was injured.

The true risk of a driver being killed or admitted to hospital in a crash when the opposing vehicle driver is injured is only estimated by each figure, and as such each estimate has a level of uncertainty about it. This uncertainty is indicated by the confidence limits in Appendix 1. There is 95% probability that the confidence interval will cover the true risk of serious injury (death or hospital admission) to the driver of a vehicle of the particular year of manufacture.

The crashworthiness estimates and their confidence limits are plotted for each year of manufacture for all vehicles in Figure 3. The relatively wide confidence intervals observed on the estimates of crashworthiness for years of manufacture 1964 to 1969 reflects the smaller numbers of crashes involving vehicles manufactured in these years appearing in the data. Figure 3 shows general and significant improvement in vehicle crashworthiness with increasing year of manufacture over the years considered. Specifically, little improvement can be seen in the years 1964 to 1983 followed by rapid improvement over the period 1984 to 1997, with vehicles manufactured from 2000 onwards being statistically significantly safer on average than those manufactured before 1996. There is visual evidence of a decreasing trend in the period after 1998. Examination of the corresponding risk and severity plots for all vehicles in Figure 1 and Figure 2 respectively show the improvements in crashworthiness with year of manufacture observed in Figure 3 are due to improvements in both injury risk and injury severity by year of vehicle manufacture.

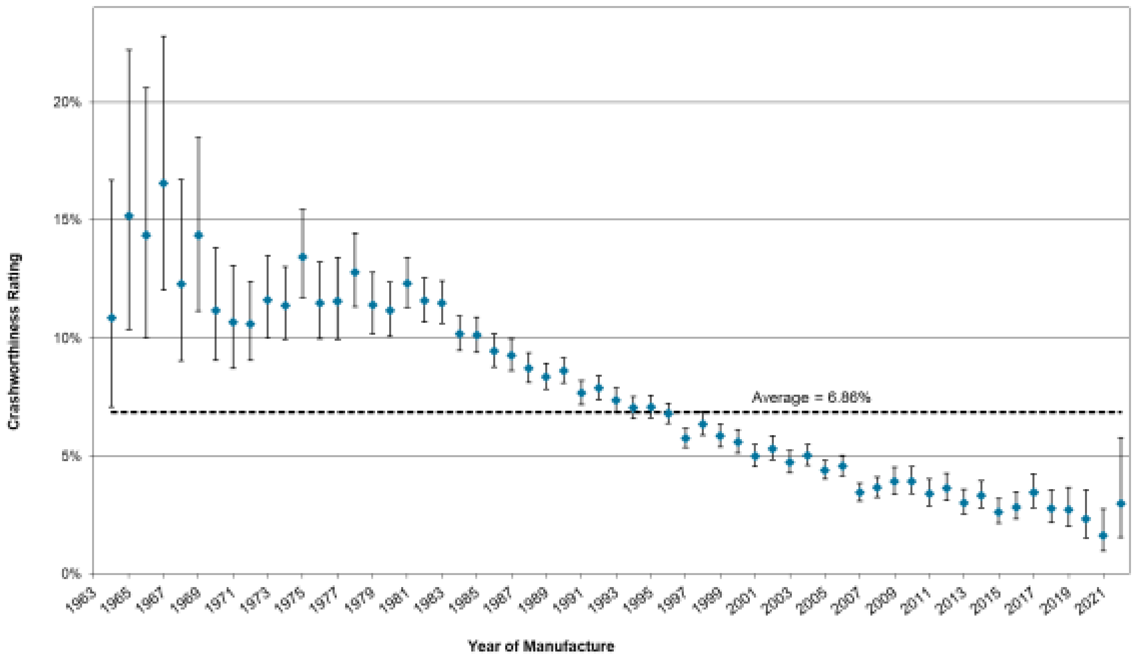

Figure 3: Crashworthiness by year of manufacture (with 95% confidence limits) for all vehicles (both new vehicles and used imports)

4.1.4 Discussion on the Analysis of Crashworthiness by Year of Manufacture of the New Zealand Vehicle Fleet

Before interpreting the results of the analysis, it is useful to give a brief summary of the history of the vehicle industry and its regulation in New Zealand.

For most of the twentieth century, starting with the General Motors assembly plant in 1926, New Zealand had a local vehicle industry. In the late 1980s, however, the face of the industry changed dramatically as a result of the progressive removal of import controls from all automotive products and reduction of tariffs on both vehicles and components. There seem to have been a number of motivating factors for the Government decision to allow used vehicles to be imported into New Zealand. One was to provide a wider source of relatively new and relatively affordable vehicles for New Zealand consumers (which in turn put pressure on new-vehicle prices). The need for this was highlighted by a trend towards an ageing vehicle fleet in New Zealand at that time. Another motivation for the used import program was to attempt to reduce the number of motorcycles in the New Zealand fleet. New motorcycle registrations had been at a high level during the 1970s and early 1980s, and they were known to be a considerably less safe means of transport than a car.

The 1990s saw a boom in the sale of used import vehicles in New Zealand along with a corresponding decline in the sales of new vehicles. Figures quoted in Transport Registry Centre (2000) show the percentage of used imports in annual vehicle registrations from 1960 to 1986 was generally well less than 10%. The period from 1987 onwards saw a sharp rise in this percentage and by 2002 around 68% of all vehicle registrations in a year were used imported vehicles. Annual registrations of vehicles sold new in New Zealand have shown a corresponding decline over the period from around 90,000 units in the early 1980s to around 75,000 units by the early 2000s. Under these economic constraints, by the late 1990s the local light-vehicle assembly industry had ceased operation.

The increase in the percentage of used import vehicle registrations in New Zealand is also reflected in crash data summaries such as provided by the New Zealand Ministry of Transport (2014). As was shown in Newstead and Watson (2005), the proportion of crashed vehicles by year of first registration in New Zealand that are used imports generally follows the trends expected from the registration statistics with rapid growth between 1987 and 2002. New Zealand vehicle registration figures show that over the period 2000 to 2022 54.1% of all light vehicles entering the fleet were used imports as shown by Figure 4 derived from data provided by the Ministry of Transport (2022).

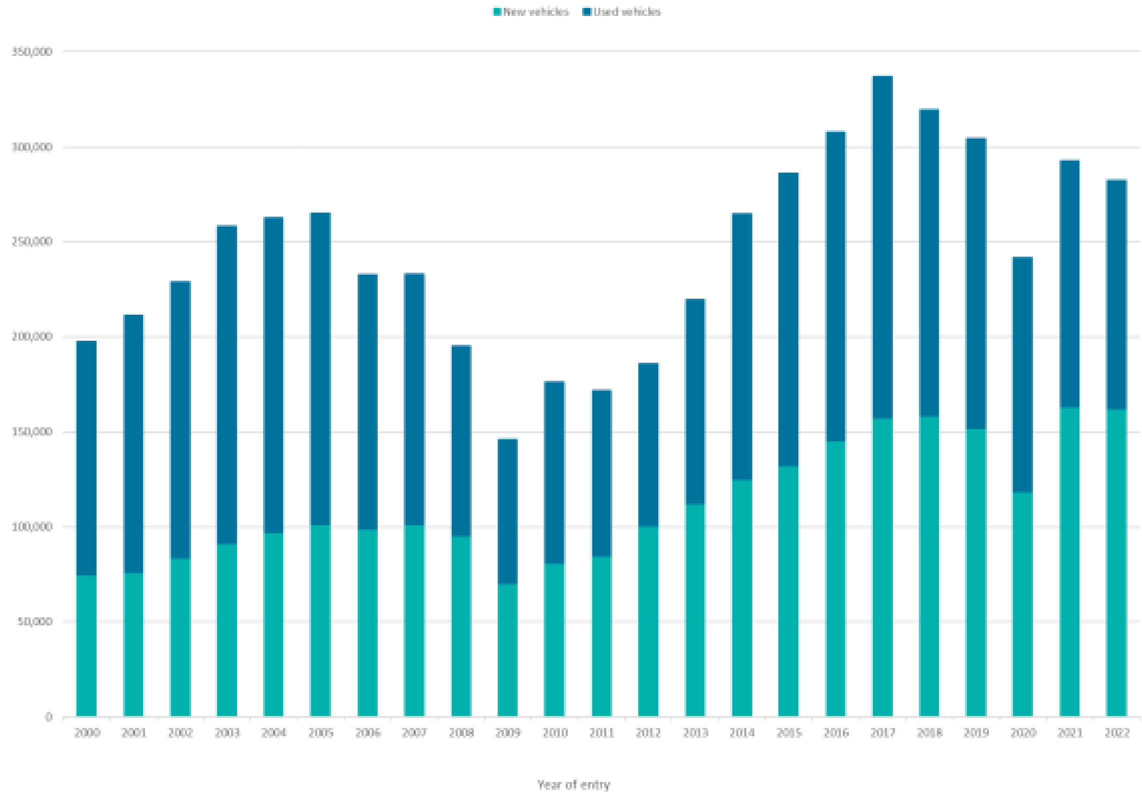

Figure 4: Light passenger vehicles entering the New Zealand fleet

Source: New Zealand Ministry of Transport

The vast majority of the used light passenger vehicles imported into New Zealand come from Japan.

Like most countries, New Zealand has a system of regulations to govern the safety of vehicles on the road. The earliest of these were the Traffic Regulations 1936 (TR36), updated in 1954 (TR54) and 1976 (TR76). For many years, the general focus of the Traffic Regulations was to set requirements for vehicles built in New Zealand. However, a separate set of regulations governing vehicle standards was developed in order to align New Zealand legislation with that of standard-setting bodies in the safety-conscious jurisdictions overseas from which the vehicles were sourced, namely Australia, Japan, Europe and the United States of America. These Transport (Vehicle Standards) Regulations (1990) (VSRs) set out the technical standards with which motor vehicles must comply in order to be registered in New Zealand.

Over the period since 1990, the vehicle standards policy in New Zealand has been clarified by Government in consultation with the vehicle industry using the consultative rule-making procedure, and today the VSRs have been replaced by Land Transport Rules covering standards and safety requirements. In addition, the important Compliance Rule sets out requirements for inspection and certification of vehicles to ensure they meet the safety requirements at import and when on the road in New Zealand. Details of the vehicle standards requirements are available on the New Zealand Transport Agency web site (https://www.nzta.govt.nz/vehicles/vehicle-types/vehicle-classes-and-standards/list-of-approved-standards/).

It is with this history of vehicle safety standards regulation in New Zealand in mind that the analyses presented in this report should be interpreted. Because the analysis presented in this study is based on a census of all reported injury crashes in New Zealand over the period 1991 to 2022, they can be considered as representative estimates of the trends in secondary safety performance of the entire light passenger vehicle fleet in New Zealand.

Trends in estimated crashworthiness by year of vehicle manufacture for the New Zealand light passenger vehicle fleet as a whole show statistically significant improvement in crashworthiness in vehicles manufactured over the period 1964 to 2008. Estimates in Figure 3 show that the crashworthiness of vehicles manufactured in the 1960s was relatively poor, although the confidence limits on these estimates are relatively wide due to the small numbers of these vehicles in the available data. For vehicles manufactured during the 1970s, the crashworthiness estimates are relatively static showing no trend to improving or worsening crashworthiness. From about 1984 onwards, however, there is a consistent trend to improving crashworthiness by year of vehicle manufacture in the New Zealand fleet through to about 2007. The trend from 2010 onwards also looks to follow the previous pattern although should be treated with some caution as the confidence limit widths on the estimates become wider due to the smaller number of vehicles in the available data. Estimates suggest that the risk of driver death or serious injury in a crash in a vehicle manufactured in 2022 is approximately 76.9% less than that for the driver of an early 1980s vehicle.

Major legislative change in New Zealand governing vehicle safety standards only started to come into force from around 1990 through the VSRs and Land Transport Rules, particularly the Compliance Rule, which required proof of standards compliance if a vehicle was to enter the New Zealand fleet. It is also important to note that there was a revision to the Frontal Impact Rule on 1 April 2002, which now requires that a Class MA vehicle (passenger car) must have been manufactured in accordance with an approved frontal impact standard if it is to enter the New Zealand fleet. (Frontal impact protection systems of course contribute to improving vehicle crashworthiness). The crashworthiness ratings for 1996-year vehicles onwards show an improvement in crashworthiness possibly as a result of the introduction of the new Frontal Impact Rule (similar in intent to ADR 69).

The estimates of vehicle crashworthiness by year of manufacture for the New Zealand fleet as a whole are an average of the estimates for vehicles sold new and the used imports. The average is weighted from the number of each registration type crashing for each year of manufacture.

As has been noted in analysing safety trends in the Australian vehicle fleet (Newstead & Cameron, 2001), the estimates of crashworthiness by year of vehicle manufacture for any particular year of manufacture reflect the composition of the fleet by market group and specific makes and models in that year. This comment certainly also applies to the analysis of the New Zealand vehicle fleet presented here.

4.2 Crashworthiness by Year of First Registration in New Zealand for Used Imports

A further analysis that is of great interest with respect to the safety impacts of the used import program in New Zealand is the crashworthiness of the used import subset of the vehicle fleet by year of first registration in New Zealand. The purpose of this analysis was to monitor trends in the average crashworthiness of used imports coming into New Zealand by year of import.

This is in contrast to the year of manufacture analysis which examines trends in crashworthiness-related safety engineering improvements in vehicles over time.

Analysis of crashworthiness by year of first registration in New Zealand was carried out in the same way as for the year of manufacture analysis. The only fundamental difference was that the variable indicating year of manufacture in the analysis was replaced by the variable indicating year of first registration. Analysis by year of first registration in New Zealand has focused on used import vehicles as the year of manufacture and first registration in New Zealand will generally be the same for vehicles sold new in New Zealand.

4.2.1 Injury Risk by Year of First Registration in New Zealand for Used Imports

Injury risk was estimated from the data on 70,614 drivers of used imported vehicles involved in a two-vehicle collision during 1991 to 2022. This reduced to 37,285 drivers where the other driver was injured. This is the used import subset of the same data used for the analysis by year of first registration. Because of missing values of some of the factors to be included in the logistic regression, and the exclusion of pre-1964 vehicles and unknown years of first registration, analysis was performed on data relating to 34,282 involved drivers, 13,914 of whom were injured.

The resulting estimates of injury risk by year of first registration for used imported vehicles are plotted along with 95% confidence limits in Figure 5. Full details of the estimates are given in Appendix 2.

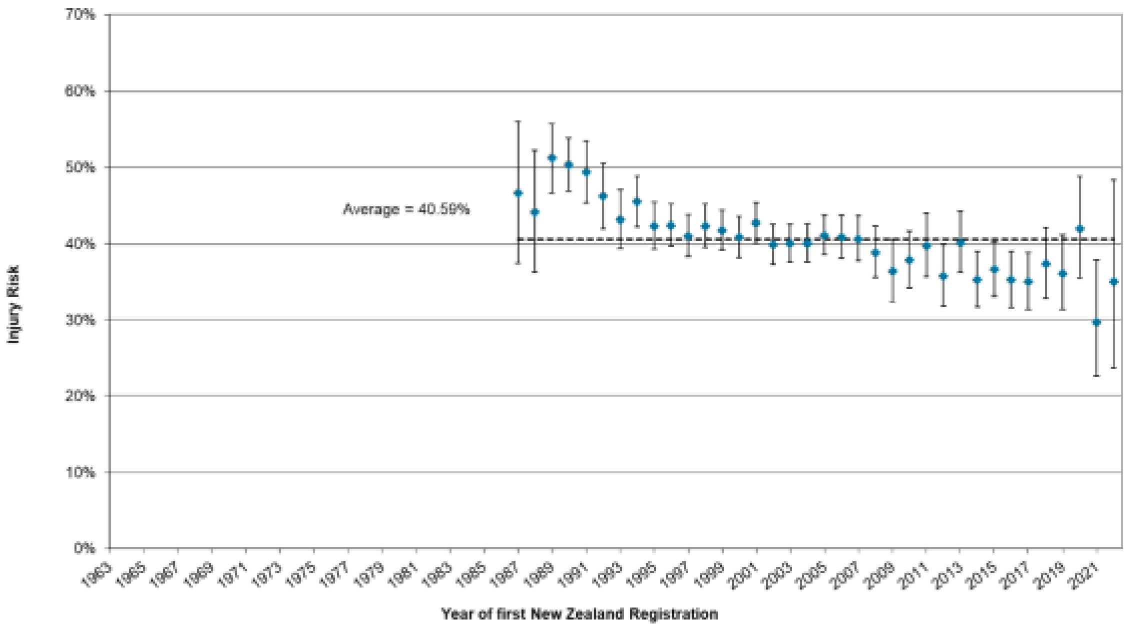

Figure 5: Injury risk by year of first registration in New Zealand (with 95% confidence limits) for used imports

4.2.2 Injury Severity by Year of First Registration in New Zealand for Used Imports

Injury severity by year of first registration in New Zealand for used imports was estimated from the data on 94,691 drivers who were injured in crashes in New Zealand during 1991-2022, a subset of the data used in the analysis by year of manufacture. After exclusion of cases with missing values of some of the associated crash factors and the exclusion of pre-1964 vehicles and unknown years, logistic regression was performed on data relating to 89,328 injured drivers, 13,835 of whom were severely injured (killed or admitted to hospital).

The resulting estimates of injury severity by year of first registration for used imports are plotted along with 95% confidence limits in Figure 6. Full details of the estimates are given in Appendix 2.

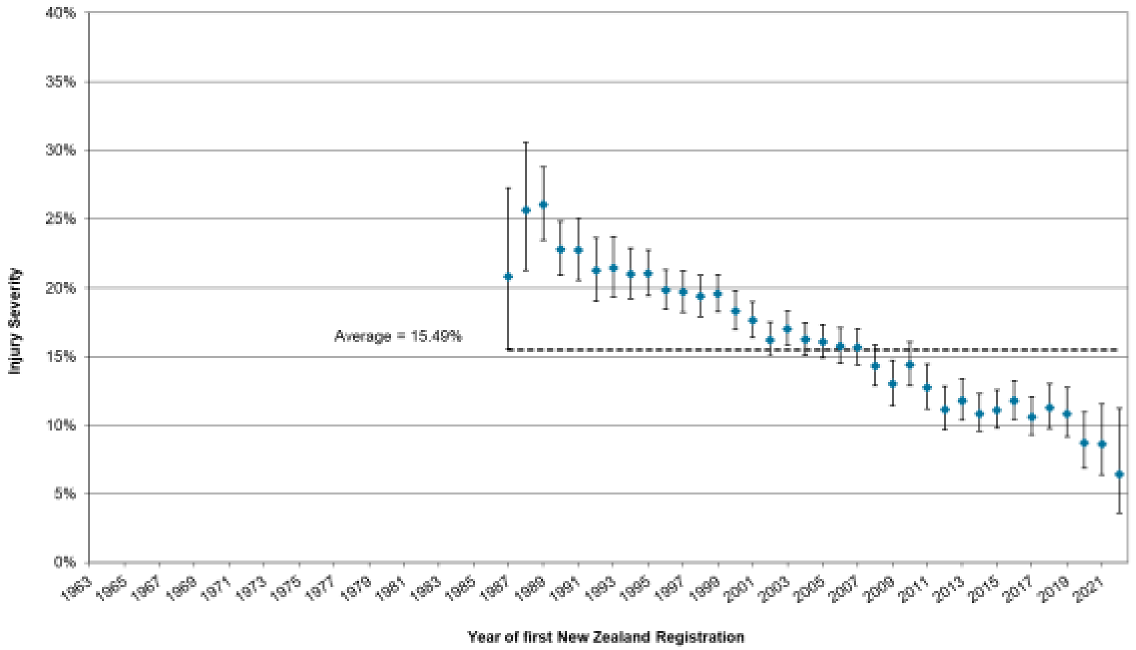

Figure 6: Injury severity by year of first registration in New Zealand (with 95% confidence limits) for used imports

4.2.3 Crashworthiness by Year of First Registration in New Zealand for Used Imports

Estimates of crashworthiness by year of vehicle first registration in New Zealand for used imports were obtained by multiplying the corresponding estimates of injury risk and injury severity presented previously. The resulting crashworthiness estimates and their 95% confidence limits are presented in full in Appendix 2. Plots of the estimates and their 95% confidence limits are in Figure 7. Interpretation of the estimates is the same as for the analysis by year of manufacture presented previously.

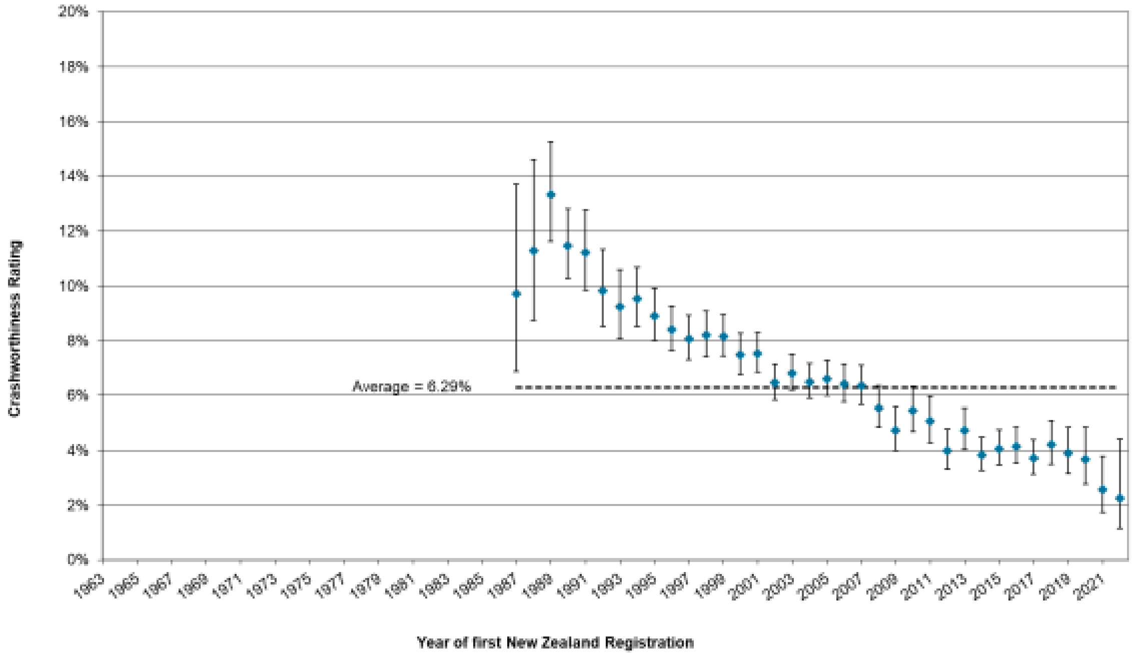

Figure 7: *Crashworthiness by year of first registration in New Zealand (with 95% confidence limits) for used imports*

4.2.4 Discussion on the Analysis of Crashworthiness by Year of First Registration in New Zealand for Used Imports

Analysis of trends in vehicle crashworthiness by year of first registration in New Zealand of the used import vehicle fleet has aimed to assess the average crashworthiness of used vehicles being imported into New Zealand in each calendar year, and assess the impact of the used import program on the overall safety of all vehicles registered in New Zealand each year.

Estimates of crashworthiness trends in the used import subset of the vehicle fleet by year of first registration in New Zealand from 1986 to 2022 showed improvement in crashworthiness with time, over the years of first registration analysed. There is some suggestion that vehicles, particularly in the years of importation 2002 to 2007, reached a plateau in crashworthiness performance compared to the continued improvement estimated for new vehicles. From 2007 the data suggest a trend to improved crashworthiness. However, this interpretation should again be tempered by the overlapping confidence limits on the estimates, indicating uncertainty regarding the trend.

If the age profile of used import vehicles was fixed for each year of first registration in New Zealand and the vehicle type mix of the used imports reflected that of new vehicles of the same years of manufacture, it would be expected that the estimates of crashworthiness by year of first registration in New Zealand would mirror those of vehicles sold new. The only difference would be a shift in the estimates equal to the average age of the used import vehicles at their time of first registration in New Zealand. Figure 8, derived from data provide by the Ministry of Transport (2022), shows the average age of used imports registered in the New Zealand fleet from 2000 to 2022.

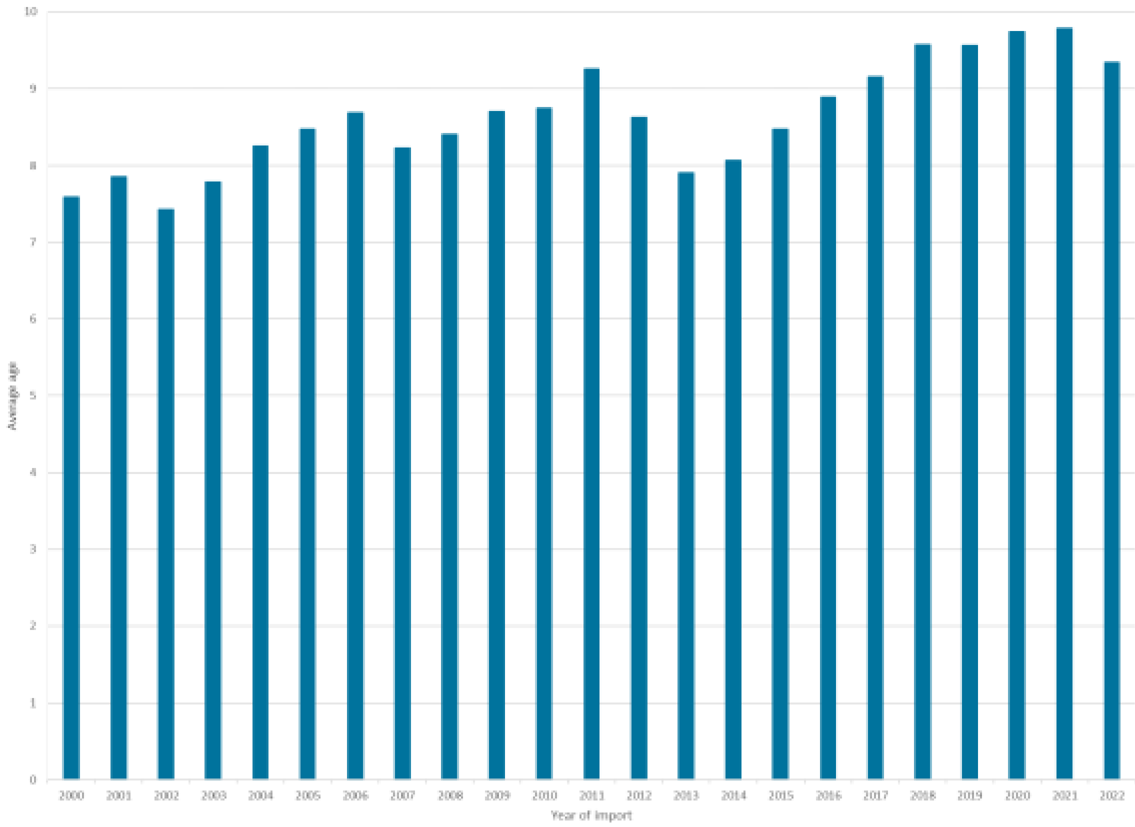

Figure 8: Average age of used light passenger vehicles imported into the New Zealand fleet

Source: New Zealand Ministry of Transport

Figure 8 shows the average age of used light vehicle imports has been increasing slowly on average from around seven and a half years in early 2000s to just over nine years in 2022. As noted, from April 2002, all vehicles newly registered in New Zealand were required to comply with frontal impact occupant protection standards (Land Transport Rule 32006/1, Frontal Impact 2001), as compared to only vehicles manufactured from March 1999 in the previous rule. The modified rule made it difficult to import used vehicles manufactured before 1996, the date after which Japanese domestic vehicles manufactured had to meet the Japanese frontal impact standard accepted under the New Zealand rule. This appears to have had only a small and transient effect on the average used import age around 2002. A further rule, the Vehicle Exhaust Emissions Rule, took effect in January 2012, requiring all imported used vehicles to be built to 2005 emissions standards. Again, this reduced the average age of used import registrations in 2012 and 2013. However, the average age was again on the rise from 2015 showing only transient effects of this rule on vehicle age. The observed ageing of the New Zealand used import fleet will be at least partially responsible for the slowing in improvement of average crashworthiness of these vehicles entering the New Zealand fleet each year from 2000 onwards observed in Figure 7.

Previous analysis of Newstead and Watson (2005) showed that the used import vehicles being brought into New Zealand were as safe on average as the vehicles sold new in New Zealand when compared on a year of manufacture basis. It pointed out that because the used vehicles were on average six years old when entering the country, the safety benefits of the latest vehicle technologies took six years longer to be seen in the New Zealand fleet than if the vehicles were sold new in New Zealand. The current analysis shows that the new vehicles entering the fleet in any particular year are more crashworthy than the cohort of used imports brought into New Zealand in the same year. Furthermore, the average age of the used imports is increasing to just over nine years which will further widen the gap between the safety of new and used vehicles brought into New Zealand each year. These trends highlight the concern about the safety implications of the used imported vehicle program. The widening differential in safety between the new and used imported vehicles continues to need careful monitoring.

4.3 Comparison of Crashworthiness by Year of Manufacture for the Australian and New Zealand Vehicle Fleets

Because of the similarity between the types of vehicles in the Australian and New Zealand vehicle fleets, it is interesting to compare the relative trends in safety improvement between the vehicle fleets of the two countries. This comparison is also of interest to determine if the quite different strategies for vehicle safety regulation adopted in the two countries have led to a fundamental difference in the patterns of vehicle safety improvement from year to year. One difficulty in making this comparison occurs because the measure of crashworthiness by year of manufacture used in each jurisdiction was scaled differently, reflecting the differences in the available data. Unfortunately, the estimates from each country cannot be scaled to a common basis for comparison because the average absolute injury risk cannot be calculated from the injury-only crash data available from New Zealand (see Newstead & Watson, 2005 for a full explanation). This means that comparisons between absolute crashworthiness cannot be made between the two countries. However, because the analysis method used here provides unbiased estimates of relative crashworthiness between each year of manufacture, as does the method used to analyse the Australian data, comparisons in relative changes in crashworthiness by year of manufacture can be made between the two countries.

Using 1964 as the base year, the relative change in crashworthiness by year of vehicle manufacture is shown in Figure 9 for both Australia and New Zealand. Crashworthiness by year of vehicle manufacture in Australia showed an improvement of 31.9% between the end of the 1960s and the end of the 1970s in response to the introduction of a program of new ADRs concerning vehicle safety. After a relative plateau in the early 1980s, a further steady improvement of about 49.7% in vehicle crashworthiness has been estimated between 1985 and 2022. This means that the average risk of death or serious injury to a driver in a crash in an Australian vehicle manufactured in 2022 is on average 85.3% less than that of a vehicle manufactured in the 1960s. The crashworthiness of New Zealand vehicles manufactured in the 1960s was also poor compared to subsequent years. However, whilst consistent improvement in crashworthiness was seen in vehicles manufactured in the 1970s, New Zealand had little improvement in crashworthiness of vehicles manufactured during the 1970s and early 1980s. Only since years of manufacture from about 1984 has New Zealand seen consistent and dramatic improvements in average vehicle crashworthiness. In fact, the crashworthiness of New Zealand vehicles manufactured from the early 1980s to 2007 has improved as much as the total improvement seen in Australian vehicles over the period from 1964 to 2009 (about 74%). Over the years 1983 to 2022, the risk of death or serious injury to drivers in a crash reduced by around 78.2% for the New Zealand fleet as a whole.

More recent trend estimates for both countries should be treated with some caution since they are based on relatively small quantities of data. Continued monitoring is recommended to assess the relative improvement between the two countries.

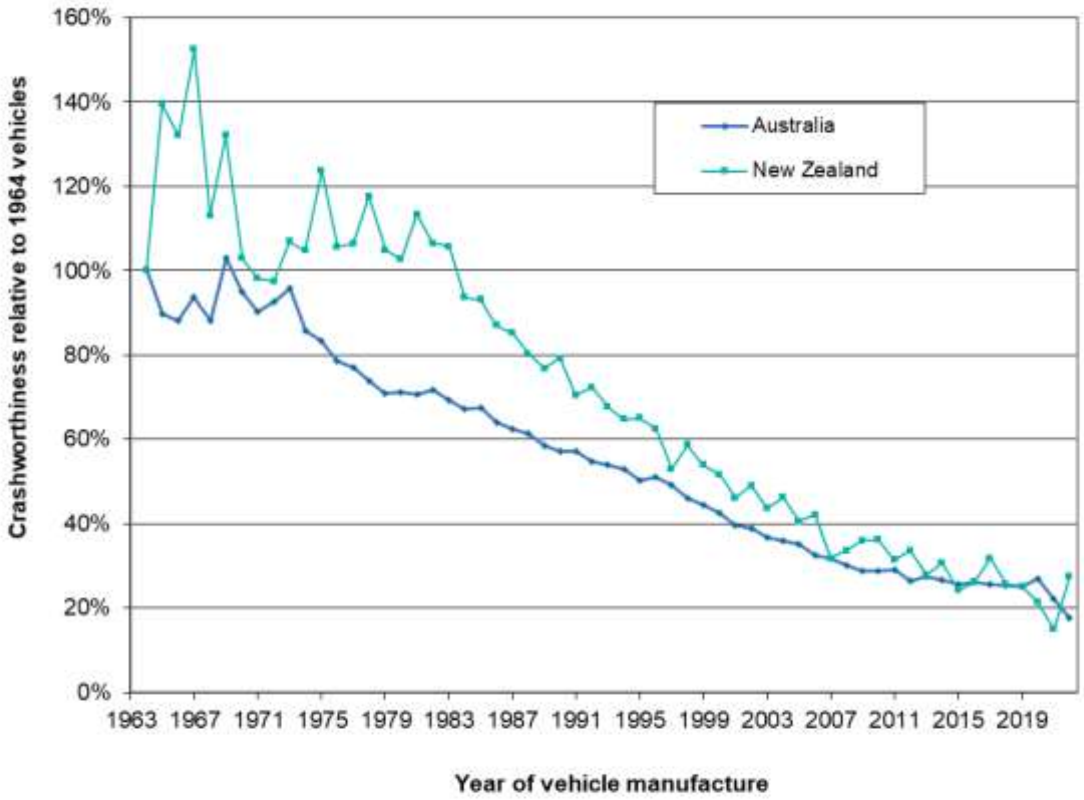

Figure 9: Crashworthiness by year of vehicle manufacture as a percentage of 1964 vehicle crashworthiness: Australia and New Zealand

The key difference in crashworthiness improvement by year of vehicle manufacture between Australia and New Zealand then appears not to be the magnitude of the improvement but the relative timing of the improvement. The greatest improvements in Australia were observed during the 1970s, the period during which the greatest numbers of new regulations concerning vehicle safety were introduced. Although improvements have also been estimated in Australia after these years of manufacture they have occurred at a slower rate. In contrast, the greatest improvement in crashworthiness has been observed in New Zealand for vehicles manufactured from the mid-1980s to 2015. This is also the period in which the greatest movement in introducing vehicle safety regulations in the form of the VSRs and Land Transport Rules took place. Estimated trends from both countries suggest that regulation of vehicle standards is one of the best ways to achieve gains in vehicle safety performance.

4.4 Presentation of the Used Car Safety Ratings for Consumer Information

The results of the annual update of the crashworthiness, aggressivity and total secondary safety ratings by make, model and market group, in addition to the primary safety index and development of the consumer presentation, are described in Newstead et al. (2024, see Sections 5.1 through 5.8).

As described in Newstead et al. (2024), for the current update, the Overall Safety star rating remains the primary focus of the vehicle safety rating information presented. The UCSR Overall Safety star ratings indicate the average relative risk of being killed or seriously injured (resulting in hospital admission) across all people in a crash involving the rated vehicle including the driver of the rated vehicle and other road users, both vulnerable road users (pedestrians, cyclists and motorcyclists) and occupants of other vehicles. This change acknowledges that consumers should be concerned with how a vehicle will protect its own occupants, in addition to how a vehicle can protect the other road users involved in a crash. The component ratings for Driver Safety and Other Road User Safety are shown along with the Overall Safety rating in Newstead et al. (2024). These component ratings reflect a vehicle's crashworthiness and aggressivity ratings respectively.

To reflect the focus of the ratings in 2024, the following methodology for classifying vehicles into the five broad performance bands was employed:

- The primary safety adjusted total secondary safety rating estimates for each vehicle were placed in order of magnitude from smallest (best) to largest (worst).
- The ratings were then divided into five groups (quintiles of performance) from best to worst crashworthiness performance.
- The 20% of vehicles with the best (numerically lowest) total secondary safety rating estimates were assigned 5-stars, the next 20% best 4-stars and so on down to the worst 20% rated vehicles which were assigned 1-star.
- The star rating categorisation cut-off points derived from the post 2000-year primary safety adjusted total secondary safety ratings were also used to classify the primary safety adjusted crashworthiness and aggressivity ratings into star rating categories to ensure consistency in the ratings presentation and interpretation.

Using the methods described in Keall and Newstead (2024) and based on the data on ADAS features fitted to vehicles in the New Zealand fleet, the primary safety index was calculated for each vehicle rated. The estimated primary safety ratings were then used to adjust each of the crashworthiness, aggressivity and overall safety rating using the methodology described in Section 3.3.4. Star rating categories were then re-calculated based on the percentile cutoff values determined froe the unadjusted ratings. For vehicle models with ADAS features fitted, this had the potential to improve the star rating category of the vehicle although not necessarily depending on how close the rating was to the percentile boundary and how many ADAS features were fitted and their effectiveness. Consequently, After the adjustment process, the number of vehicles in each star rating category was no longer necessarily equal.

It is important to note that the primary safety adjusted crashworthiness, aggressivity and total secondary safety ratings presented in the current report only applies to the ratings calculated for the New Zealand vehicle fleet. This is because the New Zealand fleet has a different profile of ADAS fitment compared to the Australia fleet. The ratings applicable to the Australian fleet are presented in Newstead et al. (2024), See Appendix 6).

Where vehicles were able to be assigned a Total Secondary Safety rating, but were missing either the crashworthiness or aggressivity rating, the missing rating was imputed based on available data using the following known relationship between the three ratings (which reflects that crashworthiness is relevant to injury outcomes in 90% of crashes and aggressivity is relevant to injury outcomes in 55% of crashes).

$$TSSR = \frac{55 \times A + 90 \times CWR}{55 + 90}$$

Quintiles for the ratings categories were estimated from vehicles manufactured from year 2000 onwards as this represented the majority of vehicles that are currently actively being used in the light vehicle fleet in 2024 (with year of manufacture up to and including 2022). Vehicles manufactured before 2000 were also rated although many of these will be rare in the fleet in 2024. These earlier vehicles were rated based on the quintile ranges defined using the overall safety ratings for vehicles manufactured from year 2000 onwards (i.e., where the rating point estimate fall relative to the four quintile cut points defined) unadjusted by primary safety rating. Presentation of the estimated ratings for all vehicles rated in this way is shown on the New Zealand RightCar web site (https://rightcar.govt.nz/).

This presentation style has the advantage that it combines information about both the rating point estimate based on those vehicles with sufficient rating accuracy as represented by the confidence limit to classify the safety performance of the vehicle. Like the previous presentation format, this method of presentation takes the potential focus of the consumer off comparison of only the point estimate ratings, an emphasis that can be potentially misleading from the point of view of the broader statistical accuracy of the ratings. Public presentation typically uses star ratings in place of the colour coding with green representing five-stars down to red representing one-star.

For the current update ratings were excluded from publication:

- The vehicle is still available new and has a current ANCAP rating;
- The UCSR year range overlaps with the year range for which the ANCAP rating is applicable;
- The date stamp on the ANCAP rating is less than or equal to six years old (i.e., from 2018 onwards only).

This final exclusion was to avoid confusing comparisons with ANCAP new vehicle ratings acknowledging that the ANCAP safety ratings are determined through a series of physical crash tests and collision avoidance tests and assessments undertaken in controlled conditions in test laboratories and on test tracks, unlike the Used Car Safety Ratings and the Total Secondary Safety Rating, which use real-world crash and injury data. As a result, the two ratings systems cannot be compared.

5 CONCLUSIONS

Analysis presented in this report has been able to extend the analysis of the long-term trends in the crashworthiness of light passenger vehicles (cars, station wagons, four-wheel drives, vans and utes) in New Zealand both by year of vehicle manufacture and year of first registration in New Zealand for used imports. Crashworthiness is a measure of the relative risk of death or serious injury (hospital admission) to vehicle drivers given involvement in a crash.

This report covers the analysis of years of vehicle manufacture from 1964 to 2022 from police-reported data on crashes involving injury in New Zealand over the period 1991 to 2022. This study further updates Newstead et al. (2023b) to include the year 2022 for years of manufacture and year of first registration for used imports. It shows similar patterns of improvements in crashworthiness as found in the past: the trends by year of vehicle manufacture showed statistically significant improvement in the crashworthiness of New Zealand light passenger vehicles over the years of manufacture studied. Most of the measured improvement occurred over the years of manufacture from 1983 to 2007 with a reduction in risk of 70%. This period corresponded with significant increases in vehicle safety regulation took place in New Zealand. Over the years 1983 to 2022, the risk of death or serious injury to drivers in a crash reduced by around 78.2% for the New Zealand fleet as a whole.

Estimates of crashworthiness trends in the used import subset of the vehicle fleet by year of first registration in New Zealand were also updated to show separate analysis for vehicles imported over the years 1986 to 2022. Estimates showed improvement in crashworthiness with time for the years of first registration analysed. Absolute levels of crashworthiness and improvements by year of first registration in the used import fleet paralleled those seen in the analysis by year of manufacture, but occurred some seven to nine years later, a lag equivalent to the average age of the used imported vehicles over the study period. Analysis shows that the new vehicles entering the fleet in any particular year were more crashworthy than the cohort of used imports brought into New Zealand in the same year, highlighting the safety implications of the used imported vehicle program. With the average age of the used imported vehicles in New Zealand increasing, the differential in safety between new and used vehicles entering the New Zealand fleet each year is also increasing. The current analysis is useful to highlight some of these unintended safety consequences of large-scale importation of used vehicles.

Safety star ratings are an essential way of communicating the importance of the safety ratings to consumers who are making a choice about which used car to purchase. These ratings measure the relative safety of these vehicles in preventing severe injury to people involved in crashes. Each year, the safety performance of the Australasian fleet is assessed by MUARC using the crash and injury data collected by state and national police forces to produce numerical ratings estimating the risk of severe or fatal injury. Thresholds are then set for the numerical ratings applicable to each year so that vehicles manufactured from 2000 onwards are allotted each number of stars from one (worst performance) to five (best performance). There are two main methods used to provide star ratings for particular vehicles. The most specific is the UCSR, defined for particular makes and models. A detailed discussion of the methodology and estimated UCSRs is presented in Newstead et al. (2024). Where a particular vehicle is not sufficiently common in the Australasian light vehicle fleets, the VSRR shows the likely safety level of the vehicle based on similar vehicles but produced at a more aggregated level than the UCSR. The VSRR ratings apply to specific market groups (e.g., small cars) for each year of manufacture. For a very small proportion of vehicles, the average rating for a given year of manufacture across all market groups is the best safety rating available as information regarding the market group of the vehicles is lacking or the vehicle is too old for a market group rating to be calculated.

For the first time in New Zealand, this update of the ratings also includes a measure of primary safety or crash avoidance capability due to the fitment of various Advanced Driver Assistance Systems to vehicles. Technologies considered included Electronic Stability Control Autonomous Emergency Braking, Lane Keep Assist and reversing cameras and sensors. Each of the ratings for driver protection, other road user protection and overall safety assessment were adjusted for the fitment of these crash avoidance technologies based on data on their fitment to vehicles in the New Zealand fleet.

Full details of the ratings produced can be found at the New Zealand Government RightCar web site (rightcar.govt.nz).

6 ASSUMPTIONS AND QUALIFICATIONS

The results and conclusions presented in this report are based on a number of assumptions and warrant a number of qualifications that the reader should note. These are listed in the following sections.

6.1 Assumptions

It has been assumed that:

- New Zealand Police crash reports accurately recorded driver injury, hospitalisation and death.
- Crashed vehicle registration numbers were recorded accurately on police crash reports and that they correctly identified the crashed vehicles in the New Zealand vehicle registers.
- The adjustments for driver sex, age, speed zone, the number of vehicles involved and the year in which the crash occurred removed the influences of the other main factors available in the data that affected crash severity and injury susceptibility.
- The form of the logistic models used to relate injury risk and injury severity with the available factors influencing these outcomes (including the year of manufacture) was correct.

6.2 Qualifications

The results and conclusions warrant at least the following qualifications:

- Only driver crash involvements and injuries have been considered due to data on passengers involved in crashes not being consistently recorded. Passengers occupying the same model cars may have had different injury outcomes.
- Some models with the same name through the 1982-2022 years of manufacture may have varied substantially in their construction, specification and mass. Although there should be few such models in these updated results, the rating score calculated for these models may give a misleading impression and should be interpreted with caution.
- Other factors not collected in the data (e.g. crash impact severity) may differ between the models and may affect the results. However, earlier analysis has suggested that the different secondary safety rating scores are predominantly due to vehicle factors alone (Cameron et al., 1994a).

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APPENDIX 1

CRASHWORTHINESS, INJURY RISK AND INJURY SEVERITY ESTIMATES BY YEAR OF VEHICLE MANUFACTURE FOR THE NEW ZEALAND VEHICLE FLEET

CRASHWORTHINESS INJURY RISK BY YEAR OF MANUFACTURE
FOR ALL NEW ZEALAND VEHICLES

Year of Manufacture	Coefficient of Car Year of Manufacture	Standard Error of Coefficient	Pr(Risk) %	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
AVERAGE	**-0.3749**		**40.74**			
1964	0.1538	0.2841	44.50	31.48	58.32	26.84
1965	0.4717	0.2960	52.42	38.15	66.31	28.16
1966	0.4190	0.2616	51.10	38.49	63.57	25.08
1967	0.4841	0.2473	52.73	40.72	64.43	23.71
1968	0.4373	0.2146	51.56	41.14	61.85	20.71
1969	0.6069	0.2022	55.77	45.90	65.21	19.31
1970	0.2738	0.1421	47.48	40.62	54.42	13.80
1971	0.3382	0.1370	49.08	42.43	55.77	13.34
1972	0.4549	0.1006	52.00	47.07	56.89	9.81
1973	0.4009	0.1018	50.65	45.67	55.62	9.94
1974	0.3327	0.0915	48.95	44.48	53.42	8.94
1975	0.4881	0.0994	52.83	47.96	57.64	9.68
1976	0.3938	0.0975	50.47	45.71	55.23	9.53
1977	0.3706	0.1015	49.89	44.94	54.85	9.91
1978	0.3998	0.0836	50.62	46.53	54.71	8.17
1979	0.3139	0.0774	48.48	44.70	52.27	7.56
1980	0.3521	0.0672	49.43	46.15	52.72	6.58
1981	0.3948	0.0574	50.50	47.69	53.31	5.62
1982	0.3580	0.0541	49.58	46.93	52.23	5.30
1983	0.4162	0.0523	51.03	48.47	53.59	5.12
1984	0.2832	0.0452	47.71	45.51	49.92	4.42
1985	0.3050	0.0463	48.25	45.99	50.52	4.53
1986	0.2802	0.0455	47.64	45.42	49.86	4.45
1987	0.1999	0.0442	45.64	43.50	47.79	4.30
1988	0.1292	0.0424	43.89	41.85	45.94	4.09
1989	0.0664	0.0374	42.35	40.57	44.15	3.58
1990	0.0706	0.0359	42.45	40.74	44.18	3.44
1991	0.0060	0.0378	40.88	39.10	42.68	3.58
1992	0.0401	0.0367	41.71	39.97	43.47	3.50
1993	-0.0127	0.0385	40.43	38.63	42.26	3.63
1994	-0.0716	0.0366	39.02	37.33	40.74	3.41
1995	-0.0241	0.0372	40.16	38.42	41.92	3.50
1996	0.0315	0.0347	41.50	39.86	43.16	3.30
1997	-0.0706	0.0383	39.04	37.27	40.84	3.57
1998	-0.1111	0.0432	38.08	36.11	40.10	3.99
1999	-0.1249	0.0455	37.76	35.69	39.88	4.19
2000	-0.1385	0.0475	37.44	35.29	39.65	4.36
2001	-0.1532	0.0493	37.10	34.87	39.38	4.51

Year of Manufacture	Coefficient of Car Year of Manufacture	Standard Error of Coefficient	Pr(Risk) %	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
2002	-0.1596	0.0496	36.95	34.71	39.24	4.53
2003	-0.2726	0.0523	34.36	32.08	36.70	4.62
2004	-0.2029	0.0464	35.94	33.88	38.06	4.19
2005	-0.2605	0.0463	34.63	32.60	36.71	4.11
2006	-0.2005	0.0483	36.00	33.85	38.21	4.36
2007	-0.3668	0.0514	32.26	30.10	34.50	4.40
2008	-0.3659	0.0559	32.28	29.94	34.72	4.79
2009	-0.3113	0.0698	33.49	30.51	36.60	6.09
2010	-0.3023	0.0702	33.69	30.69	36.83	6.14
2011	-0.4226	0.0771	31.06	27.92	34.38	6.46
2012	-0.2915	0.0740	33.93	30.76	37.25	6.50
2013	-0.4508	0.0793	30.46	27.27	33.84	6.58
2014	-0.4681	0.0795	30.09	26.92	33.47	6.55
2015	-0.4204	0.0840	31.10	27.69	34.74	7.05
2016	-0.5306	0.0878	28.79	25.40	32.45	7.05
2017	-0.4789	0.0929	29.86	26.20	33.81	7.62
2018	-0.5629	0.1035	28.14	24.22	32.41	8.19
2019	-0.6047	0.1316	27.30	22.49	32.70	10.22
2020	-0.6121	0.1786	27.15	20.80	34.59	13.79
2021	-0.7549	0.2033	24.42	17.83	32.49	14.67
2022	-0.5255	0.2876	28.90	18.78	41.66	22.88

CRASHWORTHINESS INJURY SEVERITY BY YEAR OF VEHICLE MANUFACTURE FOR ALL NEW ZEALAND VEHICLES

Year of Manufacture	Coefficient of Car Year of Manufacture	Standard Error of Coefficient	Pr(Severity) %	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
AVERAGE	**-1.5977**		**16.83**			
1964	0.4689	0.2013	24.44	17.90	32.43	14.53
1965	0.6994	0.1892	28.94	21.94	37.11	15.17
1966	0.6590	0.1847	28.12	21.40	35.97	14.56
1967	0.8182	0.1650	31.44	24.92	38.79	13.87
1968	0.4368	0.1546	23.85	18.79	29.78	10.99
1969	0.5383	0.1257	25.74	21.32	30.72	9.40
1970	0.4212	0.1028	23.57	20.13	27.39	7.25
1971	0.3165	0.0982	21.73	18.64	25.19	6.55
1972	0.2346	0.0809	20.37	17.92	23.07	5.15
1973	0.3863	0.0753	22.95	20.44	25.66	5.22
1974	0.4043	0.0669	23.26	21.01	25.69	4.68
1975	0.5243	0.0704	25.48	22.95	28.18	5.24
1976	0.3766	0.0691	22.77	20.48	25.24	4.76
1977	0.3997	0.0741	23.18	20.70	25.87	5.17
1978	0.5139	0.0610	25.28	23.09	27.60	4.52
1979	0.4192	0.0558	23.53	21.62	25.56	3.94
1980	0.3658	0.0514	22.58	20.87	24.39	3.52
1981	0.4673	0.0439	24.41	22.86	26.03	3.17
1982	0.4100	0.0411	23.37	21.96	24.84	2.88
1983	0.3616	0.0398	22.51	21.18	23.90	2.72
1984	0.2925	0.0357	21.33	20.18	22.53	2.35
1985	0.2716	0.0366	20.98	19.82	22.19	2.38
1986	0.2020	0.0376	19.85	18.70	21.05	2.35
1987	0.2303	0.0363	20.30	19.18	21.48	2.30
1988	0.2044	0.0345	19.89	18.83	20.99	2.15
1989	0.1951	0.0310	19.74	18.80	20.72	1.93
1990	0.2294	0.0297	20.29	19.36	21.25	1.88
1991	0.1313	0.0315	18.75	17.83	19.71	1.88
1992	0.1388	0.0308	18.86	17.96	19.80	1.85
1993	0.0956	0.0326	18.21	17.28	19.18	1.90
1994	0.0841	0.0305	18.04	17.17	18.94	1.77
1995	0.0553	0.0313	17.62	16.75	18.53	1.78
1996	-0.0321	0.0289	16.39	15.62	17.18	1.55
1997	-0.1566	0.0329	14.75	13.96	15.58	1.62
1998	-0.0067	0.0355	16.74	15.79	17.73	1.94
1999	-0.0978	0.0383	15.51	14.55	16.51	1.97
2000	-0.1378	0.0403	14.99	14.01	16.02	2.01

Year of Manufacture	Coefficient of Car Year of Manufacture	Standard Error of Coefficient	Pr(Severity) %	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
2001	-0.2611	0.0430	13.48	12.53	14.50	1.97
2002	-0.1830	0.0425	14.42	13.42	15.48	2.06
2003	-0.2333	0.0447	13.81	12.80	14.89	2.09
2004	-0.2185	0.0392	13.99	13.09	14.94	1.85
2005	-0.3268	0.0393	12.74	11.90	13.62	1.71
2006	-0.3291	0.0418	12.71	11.83	13.65	1.82
2007	-0.5253	0.0476	10.69	9.83	11.61	1.78
2008	-0.4604	0.0522	11.32	10.34	12.39	2.06
2009	-0.4240	0.0645	11.69	10.45	13.06	2.61
2010	-0.4263	0.0655	11.67	10.41	13.06	2.65
2011	-0.4946	0.0742	10.98	9.64	12.49	2.85
2012	-0.5188	0.0726	10.75	9.46	12.19	2.73
2013	-0.6095	0.0776	9.91	8.63	11.35	2.72
2014	-0.4861	0.0783	11.07	9.65	12.67	3.03
2015	-0.7853	0.0911	8.45	7.17	9.94	2.77
2016	-0.6148	0.0909	9.86	8.39	11.56	3.18
2017	-0.4368	0.0927	11.56	9.83	13.55	3.72
2018	-0.6097	0.1109	9.91	8.13	12.03	3.89
2019	-0.6013	0.1286	9.98	7.94	12.49	4.55
2020	-0.7690	0.1906	8.57	6.06	11.99	5.93
2021	-1.0445	0.2344	6.65	4.30	10.13	5.83
2022	-0.5630	0.3006	10.33	6.01	17.20	11.19

CRASHWORTHINESS BY YEAR OF VEHICLE MANUFACTURE FOR ALL NEW ZEALAND VEHICLES

Year of Manufacture	Pr(Risk) %	Pr(Severity) %	Serious injury rate per 100 drivers involved %	Overall rank order	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
AVERAGE	**40.74**	**16.83**	**6.86**				
1964	44.50	24.44	10.87	42	7.08	16.71	9.63
1965	52.42	28.94	15.17	58	10.36	22.22	11.86
1966	51.10	28.12	14.37	57	10.01	20.62	10.61
1967	52.73	31.44	16.58	59	12.05	22.80	10.75
1968	51.56	23.85	12.30	52	9.04	16.73	7.69
1969	55.77	25.74	14.36	56	11.14	18.50	7.35
1970	47.48	23.57	11.19	44	9.05	13.84	4.79
1971	49.08	21.73	10.67	41	8.70	13.07	4.37
1972	52.00	20.37	10.59	40	9.05	12.41	3.36
1973	50.65	22.95	11.62	51	10.00	13.51	3.51
1974	48.95	23.26	11.39	45	9.94	13.05	3.11
1975	52.83	25.48	13.46	55	11.72	15.45	3.72
1976	50.47	22.77	11.49	48	9.98	13.24	3.25
1977	49.89	23.18	11.57	49	9.96	13.43	3.47
1978	50.62	25.28	12.80	54	11.34	14.44	3.09
1979	48.48	23.53	11.41	46	10.17	12.79	2.62
1980	49.43	22.58	11.16	43	10.08	12.37	2.29
1981	50.50	24.41	12.33	53	11.31	13.43	2.11
1982	49.58	23.37	11.58	50	10.68	12.57	1.89
1983	51.03	22.51	11.49	47	10.62	12.43	1.81
1984	47.71	21.33	10.18	39	9.47	10.94	1.47
1985	48.25	20.98	10.12	38	9.41	10.90	1.49
1986	47.64	19.85	9.46	37	8.77	10.19	1.43
1987	45.64	20.30	9.27	36	8.61	9.97	1.37
1988	43.89	19.89	8.73	35	8.13	9.38	1.25
1989	42.35	19.74	8.36	33	7.84	8.92	1.08
1990	42.45	20.29	8.61	34	8.10	9.16	1.06
1991	40.88	18.75	7.66	31	7.17	8.19	1.02
1992	41.71	18.86	7.87	32	7.38	8.39	1.02
1993	40.43	18.21	7.36	30	6.87	7.89	1.02
1994	39.02	18.04	7.04	28	6.59	7.52	0.93
1995	40.16	17.62	7.07	29	6.62	7.56	0.95
1996	41.50	16.39	6.80	27	6.39	7.23	0.84
1997	39.04	14.75	5.76	24	5.36	6.19	0.82
1998	38.08	16.74	6.37	26	5.89	6.89	1.00
1999	37.76	15.51	5.85	25	5.38	6.37	0.99

Year of Manufacture	Pr(Risk) %	Pr(Severity) %	Serious injury rate per 100 drivers involved %	Overall rank order	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
2000	37.44	14.99	5.61	23	5.13	6.13	1.00
2001	37.10	13.48	5.00	20	4.55	5.50	0.95
2002	36.95	14.42	5.33	22	4.85	5.85	1.00
2003	34.36	13.81	4.75	19	4.29	5.25	0.96
2004	35.94	13.99	5.03	21	4.60	5.49	0.89
2005	34.63	12.74	4.41	17	4.03	4.82	0.79
2006	36.00	12.71	4.58	18	4.17	5.03	0.86
2007	32.26	10.69	3.45	11	3.10	3.84	0.74
2008	32.28	11.32	3.66	14	3.25	4.11	0.86
2009	33.49	11.69	3.92	15	3.39	4.52	1.13
2010	33.69	11.67	3.93	16	3.40	4.55	1.15
2011	31.06	10.98	3.41	10	2.89	4.03	1.14
2012	33.93	10.75	3.65	13	3.11	4.28	1.17
2013	30.46	9.91	3.02	8	2.53	3.59	1.06
2014	30.09	11.07	3.33	9	2.80	3.97	1.17
2015	31.10	8.45	2.63	3	2.15	3.21	1.05
2016	28.79	9.86	2.84	6	2.32	3.48	1.16
2017	29.86	11.56	3.45	12	2.81	4.24	1.43
2018	28.14	9.91	2.79	5	2.18	3.56	1.37
2019	27.30	9.98	2.73	4	2.03	3.66	1.63
2020	27.15	8.57	2.33	2	1.52	3.57	2.05
2021	24.42	6.65	1.62	1	0.96	2.74	1.78
2022	28.90	10.33	2.99	7	1.54	5.80	4.26

APPENDIX 2

CRASHWORTHINESS, INJURY RISK AND INJURY SEVERITY ESTIMATES BY YEAR OF FIRST REGISTRATION FOR IMPORTED USED VEHICLES IN THE NEW ZEALAND VEHICLE FLEET

CRASHWORTHINESS INJURY RISK BY YEAR OF FIRST NEW ZEALAND VEHICLE REGISTRATION FOR USED IMPORT VEHICLES

Year of First Registration	Coefficient of Car Year of First Reg.	Standard Error of Coefficient	Pr(Risk) %	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
AVERAGE	**-0.3811**		**40.59**			
1987	0.2466	0.1923	46.64	37.49	56.03	18.54
1988	0.1430	0.1661	44.08	36.27	52.19	15.91
1989	0.4288	0.0928	51.19	46.65	55.72	9.06
1990	0.3944	0.0710	50.33	46.86	53.80	6.95
1991	0.3551	0.0829	49.35	45.30	53.41	8.11
1992	0.2307	0.0875	46.25	42.02	50.53	8.51
1993	0.1053	0.0794	43.15	39.38	47.00	7.62
1994	0.2007	0.0683	45.50	42.21	48.84	6.63
1995	0.0725	0.0639	42.35	39.32	45.43	6.11
1996	0.0751	0.0563	42.41	39.74	45.12	5.39
1997	0.0185	0.0568	41.03	38.37	43.75	5.38
1998	0.0730	0.0580	42.36	39.61	45.16	5.55
1999	0.0486	0.0533	41.76	39.25	44.32	5.08
2000	0.0102	0.0571	40.83	38.16	43.56	5.40
2001	0.0870	0.0548	42.70	40.10	45.35	5.25
2002	-0.0289	0.0564	39.89	37.27	42.57	5.30
2003	-0.0217	0.0527	40.06	37.61	42.57	4.96
2004	-0.0210	0.0534	40.08	37.60	42.62	5.02
2005	0.0215	0.0538	41.11	38.58	43.68	5.10
2006	0.0120	0.0593	40.88	38.10	43.71	5.61
2007	0.0026	0.0619	40.65	37.76	43.61	5.85
2008	-0.0712	0.0723	38.88	35.57	42.30	6.73
2009	-0.1761	0.0904	36.42	32.42	40.61	8.19
2010	-0.1134	0.0810	37.88	34.23	41.69	7.46
2011	-0.0351	0.0888	39.74	35.66	43.98	8.32
2012	-0.2053	0.0908	35.75	31.77	39.93	8.16
2013	-0.0185	0.0842	40.14	36.25	44.16	7.91
2014	-0.2248	0.0811	35.30	31.76	39.01	7.25
2015	-0.1658	0.0793	36.66	33.13	40.34	7.21
2016	-0.2269	0.0821	35.25	31.67	39.01	7.33
2017	-0.2365	0.0837	35.03	31.40	38.85	7.46
2018	-0.1343	0.1009	37.39	32.89	42.13	9.24
2019	-0.1893	0.1087	36.12	31.36	41.16	9.80
2020	0.0600	0.1396	42.04	35.56	48.81	13.26
2021	-0.4801	0.1862	29.71	22.69	37.84	15.16
2022	-0.2368	0.2807	35.03	23.72	48.31	24.59

CRASHWORTHINESS INJURY SEVERITY BY YEAR OF FIRST NEW ZEALAND VEHICLE REGISTRATION FOR USED IMPORT VEHICLES

Year of First Registration	Coefficient of Car Year of First Reg.	Standard Error of Coefficient	Pr(Severity) %	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
AVERAGE	**-1.6968**		**15.49**			
1987	0.3609	0.1805	20.82	15.58	27.25	11.67
1988	0.6320	0.1244	25.64	21.27	30.55	9.28
1989	0.6522	0.0705	26.03	23.45	28.77	5.32
1990	0.4778	0.0562	22.81	20.93	24.81	3.88
1991	0.4733	0.0655	22.73	20.56	25.06	4.51
1992	0.3876	0.0704	21.26	19.04	23.66	4.62
1993	0.3985	0.0667	21.44	19.32	23.73	4.40
1994	0.3708	0.0562	20.98	19.21	22.87	3.65
1995	0.3744	0.0516	21.04	19.41	22.77	3.36
1996	0.2999	0.0458	19.83	18.44	21.30	2.85
1997	0.2908	0.0487	19.69	18.22	21.24	3.02
1998	0.2710	0.0491	19.37	17.92	20.92	3.01
1999	0.2827	0.0436	19.56	18.25	20.94	2.69
2000	0.2018	0.0483	18.32	16.94	19.78	2.83
2001	0.1564	0.0457	17.65	16.38	18.99	2.60
2002	0.0540	0.0469	16.21	15.00	17.50	2.50
2003	0.1126	0.0443	17.02	15.83	18.28	2.45
2004	0.0545	0.0452	16.21	15.05	17.45	2.41
2005	0.0431	0.0453	16.06	14.90	17.29	2.39
2006	0.0186	0.0498	15.73	14.48	17.07	2.59
2007	0.0112	0.0506	15.64	14.37	16.99	2.62
2008	-0.0947	0.0613	14.29	12.88	15.82	2.94
2009	-0.2059	0.0739	12.98	11.43	14.71	3.28
2010	-0.0864	0.0663	14.39	12.86	16.07	3.20
2011	-0.2268	0.0742	12.75	11.21	14.45	3.24
2012	-0.3782	0.0810	11.15	9.68	12.83	3.15
2013	-0.3147	0.0728	11.80	10.39	13.37	2.97
2014	-0.4091	0.0703	10.85	9.59	12.26	2.67
2015	-0.3832	0.0706	11.11	9.81	12.55	2.74
2016	-0.3183	0.0676	11.76	10.46	13.21	2.75
2017	-0.4346	0.0738	10.61	9.31	12.06	2.75
2018	-0.3649	0.0822	11.29	9.77	13.00	3.23
2019	-0.4107	0.0938	10.84	9.18	12.75	3.56
2020	-0.6512	0.1296	8.72	6.90	10.97	4.07
2021	-0.6633	0.1667	8.63	6.38	11.57	5.20
2022	-0.9822	0.3120	6.42	3.59	11.23	7.64

CRASHWORTHINESS BY YEAR OF FIRST NEW ZEALAND VEHICLE REGISTRATION FOR USED IMPORT VEHICLES

Year of Manufacture	Pr(Risk) %	Pr(Severity) %	Serious injury rate per 100 drivers involved %	Overall rank order	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Width of Confidence Interval
AVERAGE	**40.59**	**15.49**	**6.29**				
1987	46.64	20.82	9.71	31	6.88	13.71	6.83
1988	44.08	25.64	11.30	34	8.74	14.61	5.87
1989	51.19	26.03	13.32	36	11.64	15.25	3.62
1990	50.33	22.81	11.48	35	10.29	12.81	2.52
1991	49.35	22.73	11.22	33	9.86	12.76	2.90
1992	46.25	21.26	9.83	32	8.53	11.34	2.81
1993	43.15	21.44	9.25	29	8.08	10.60	2.52
1994	45.50	20.98	9.55	30	8.52	10.70	2.17
1995	42.35	21.04	8.91	28	8.00	9.92	1.92
1996	42.41	19.83	8.41	27	7.64	9.26	1.62
1997	41.03	19.69	8.08	24	7.30	8.94	1.63
1998	42.36	19.37	8.21	26	7.41	9.08	1.67
1999	41.76	19.56	8.17	25	7.45	8.95	1.50
2000	40.83	18.32	7.48	22	6.76	8.28	1.53
2001	42.70	17.65	7.54	23	6.85	8.30	1.45
2002	39.89	16.21	6.47	18	5.84	7.16	1.32
2003	40.06	17.02	6.82	21	6.20	7.50	1.30
2004	40.08	16.21	6.50	19	5.90	7.16	1.27
2005	41.11	16.06	6.60	20	5.99	7.27	1.28
2006	40.88	15.73	6.43	17	5.78	7.16	1.38
2007	40.65	15.64	6.36	16	5.69	7.10	1.41
2008	38.88	14.29	5.56	15	4.86	6.36	1.50
2009	36.42	12.98	4.73	11	3.99	5.60	1.61
2010	37.88	14.39	5.45	14	4.70	6.33	1.63
2011	39.74	12.75	5.07	13	4.30	5.97	1.68
2012	35.75	11.15	3.99	7	3.33	4.78	1.46
2013	40.14	11.80	4.74	12	4.04	5.56	1.52
2014	35.30	10.85	3.83	5	3.26	4.50	1.23
2015	36.66	11.11	4.07	8	3.48	4.77	1.29
2016	35.25	11.76	4.15	9	3.55	4.85	1.30
2017	35.03	10.61	3.72	4	3.14	4.39	1.25
2018	37.39	11.29	4.22	10	3.49	5.10	1.61
2019	36.12	10.84	3.91	6	3.16	4.84	1.68
2020	42.04	8.72	3.67	3	2.77	4.86	2.09
2021	29.71	8.63	2.56	2	1.73	3.80	2.07
2022	35.03	6.42	2.25	1	1.15	4.42	3.27

Further information

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