

Study on the Effect of Vehicle Age and the Importation of Vehicles 15 Years and Older on the Number of Fatalities, Serious Injuries and Collisions in Canada

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Abstract

The number of vehicles 15 years and older imported into Canada is increasing every year. In fact, in 2002, 10,072 vehicles 15 years and older were imported; in 2003, 12,012 were imported; in 2004, 14,594 were imported; and in 2005, 17,390 were imported, an average annual increase of 24%. None of these vehicles has to meet any standards. Conversely, approximately 60,000 vehicles less than 15 years old must meet the standards of the Registrar of Imported Vehicles (RIV) program.

The fatality, serious injury and collision rates rise rapidly with increasing vehicle age, except for vehicles 0 to 2 years old. For example, the fatality rate involving occupants of vehicles 15 years and older is approximately three times as high as that of vehicles 3 to 5 years old.

This begs the question: Why are the fatality, serious injury and collision rates involving occupants of vehicles 15 years and older so high?

Is it because:

- 1) Occupants are not as well protected during collisions?
- 2) Mechanical problems are a contributing factor for vehicles 15 years and older?
- 3) Young drivers and high-risk drivers tend to drive these vehicles for several reasons (lower insurance premiums, lower purchase price)?

An association was found between older vehicles and mechanical failure as a contributing factor in crashes. This could be an indication of vehicle deterioration with age or poor maintenance of older vehicles. A literature review of annual vehicle inspections of older vehicles should be conducted to assess whether or not such a measure would be beneficial in the Canadian context.

Other associations were found with older vehicles, namely, the use of alcohol and drugs, unbelted occupants and suspended or unlicensed drivers. This indicates that the way the older vehicles are driven contributes to the high casualty rates that are associated with them. These findings point to an enforcement issue; while there is nothing illegal about driving an older vehicle, illegal behaviors appear to be more frequent for drivers of older vehicles.

Older vehicles are driven less than other vehicles and are not driven by a disproportionately large percentage of drivers younger than 25. The increased risk for vehicles 15 years and older is, therefore, not the result of increased exposure to risk.

Between 2000 and 2004, 25,550 imported vehicles 15 years and older accounted for 80 collisions, including one fatality and one severe injury. With mechanical failure being a very infrequent contributing factor; it is astonishing that three of these collisions involved mechanical failure.

The US has a 25-year-old cut-off importation rule and Australia has a 30-year-old one [10,11]. A market for imported vehicles 15 years old and over has developed in Canada over the last few years. The literature shows that vehicle crashworthiness affects casualty rates [7,8,9]. The high volume importation of older vehicles will likely “push the casualty rates upward”. Older vehicles should be subject to the rules of the Registrar of Imported Vehicles, just as newer vehicles are.

Résumé

Le nombre de véhicules de 15 ans ou plus importés au Canada augmente chaque année. En fait, 10 072 véhicules de 15 ans ou plus ont été importés en 2002, 12 012 en 2003, 14 594 en 2004, et 17 390 en 2005, soit une augmentation annuelle moyenne de 24 %. Aucun de ces véhicules n'était tenu de respecter certaines normes. En comparaison, environ 60 000 véhicules de moins de 15 ans doivent respecter les normes du Registraire des véhicules importés (RVI).

Le nombre de décès, de blessures graves et de collisions augmente rapidement avec l'âge des véhicules, sauf dans le cas des véhicules de 0 à 2 ans. Par exemple, le nombre de décès impliquant des occupants de véhicules de 15 ans ou plus est environ trois fois plus élevé que celui des véhicules de 3 à 5 ans.

Cette constatation mène à la question suivante : pourquoi le nombre de décès, de blessures graves et de collisions impliquant des occupants de véhicules de 15 ans ou plus est-il si élevé? Voici certaines réponses possibles :

- 1) Les occupants ne sont pas aussi bien protégés lors d'une collision,
- 2) Les défauts mécaniques représentent un facteur contributif pour les véhicules de 15 ans ou plus,
- 3) Des conducteurs plus jeunes et à risques plus élevés ont tendance à conduire ces véhicules (primes d'assurance moins chères, prix d'achat plus bas).

On a identifié les véhicules plus âgés et les défauts mécaniques comme un facteur contribuant aux collisions. Il peut s'agir d'une indication de la détérioration des véhicules avec l'âge ou d'un mauvais entretien de ces derniers. Un examen des documents d'inspection annuelle des véhicules devrait être effectué afin d'évaluer si une telle mesure serait bénéfique dans le contexte canadien.

D'autres associations avec les véhicules plus âgés ont été identifiées; notamment, la consommation d'alcool et de drogues, les ceintures de sécurité non bouclées et les conducteurs sans permis de conduire ou avec permis de conduire suspendu. Ceci indique que la façon dont les véhicules plus âgés sont conduits contribue au nombre élevé de victimes associé à ceux-ci. Cette conclusion met en relief un problème d'application de la loi; bien qu'il n'y ait rien d'illégal à conduire un véhicule plus âgé, les comportements illégaux semblent plus fréquents dans le cas des conducteurs d'un tel véhicule.

Les véhicules plus âgés sont moins fréquents que les autres véhicules et ils ne sont pas conduits par une portion plus élevée des moins de 25 ans. Les risques plus élevés dans le cas des véhicules plus âgés ne sont donc pas le résultat d'une plus grande exposition aux risques.

Dans le cas des 25 550 véhicules importés entre 2000 et 2004 seulement, 80 collisions impliquant un véhicule importé de 15 ans ou plus sont survenues durant la même période, alors qu'un décès et une blessure grave ont été signalés. Les défauts mécaniques étant un facteur contributif très rare, il est étonnant de constater que trois de ces collisions étaient liées à la mécanique.

Les États-Unis ont une règle de limitation des importations de 25 ans, alors que l'Australie en a une de 30 ans [10,11]. Un marché des véhicules importés de 15 ans ou plus s'est développé au Canada au cours des dernières années. Les documents montrent que la résistance aux impacts des véhicules influence le nombre de victimes de la route [7,8,9]. Le volume élevé d'importation de véhicules plus âgés devrait vraisemblablement « faire augmenter le nombre de victimes. » Ces véhicules devraient être assujettis aux règles du Registraire des véhicules importés, au même titre que les véhicules plus récents.

1. Introduction

The number of vehicles 15 years and older imported into Canada is increasing every year. In fact, in 2002, 10,072 vehicles 15 years and older were imported; in 2003, 12,012 were imported; in 2004, 14,594 were imported; and in 2005, 17,390 were imported, an average annual increase of 24%. [1]

None of these vehicles has to meet any standards. Conversely, approximately 60,000 vehicles less than 15 years old must meet the standards of the Registrar of Imported Vehicles (RIV) program. The safety standards governing the manufacture of these vehicles are different from Canadian standards. Therefore, these vehicles cannot be imported if they are less than 15 years old. However, all vehicles 15 years and older can currently be imported into Canada.

2. Fatality, serious injury and collision rates by vehicle age

Let us now look at the fatality, serious injury and collision rates by vehicle age. The fatality and serious injury rates for vehicle occupants¹ and the collision rates for the various vehicle age groups are calculated from the number of fatalities, serious injuries and collisions from the NCDB [3] and the number of vehicle-kilometres driven for vehicles in each age group from the Canadian Vehicle Survey (CVS) [2]. Tables 1, 2 and 3 provide the fatality, serious injury and collision rates by vehicle age from 2001 to 2003.

The fatality, serious injury and collision rates rise with increasing vehicle age, except for vehicles 0 to 2 years old². The difference between vehicles 12 to 14 years old and those 15 years and older is quite large. For example, the fatality rate for 2001 to

2003 for vehicles 15 years and older was 13.77, versus 9.68 for vehicles 12 to 14 years old.

Table 1: Occupant fatalities per billion vehicle-kilometers by vehicle age from 2001 to 2003

Vehicle age group	2001	2002	2003	2001-2003
0-2 years	7.12	8.86	7.59	7.82
3-5 years	4.38	3.95	4.04	4.10
6-8 years	5.95	5.22	4.60	5.23
9-11 years	6.85	7.93	8.25	7.61
12-14 years	8.46	10.96	9.99	9.68
15 years and older	15.79	13.53	12.56	13.77
All vehicles	6.74	6.92	6.64	6.75

Table 2: Serious injuries per billion vehicle-kilometers by vehicle age from 2001 to 2003³

Vehicle age group	2001	2002	2003	2001-2003
0-2 years	42.29	51.98	48.82	47.41
3-5 years	26.45	25.16	26.90	26.05
6-8 years	35.77	34.75	33.70	34.65
9-11 years	45.40	47.42	50.77	47.56
12-14 years	50.95	69.79	67.21	61.48
15 years and older	92.77	109.33	75.43	90.09
All vehicles	40.72	43.50	42.80	42.23

Table 3: Collisions per trillion vehicle-kilometers by vehicle age from 2001 to 2003

Vehicle age group	2001	2002	2003	2001-2003
0-2 years	2.49	2.80	2.70	2.66
3-5 years	1.36	1.26	1.45	1.35
6-8 years	1.65	1.51	1.51	1.55
9-11 years	1.81	1.89	2.01	1.89
12-14 years	1.85	2.40	2.17	2.11
15 years and older	3.01	3.06	2.53	2.83
All vehicles	1.85	1.88	1.91	1.88

The fatality, serious injury and collision rates for the other vehicle age groups are much lower; therefore, the difference between newer and older vehicles is large. For example, the fatality rate involving vehicles 15 years and older is approximately three times as high as that of vehicles 3 to 5 years old.

¹Among collision victims, our focus here is on vehicle occupants; pedestrians and cyclists are therefore excluded.

² A study on vehicles 0 to 2 years old should be done to understand the cause of these high rates.

³ B.C. did not provide data on serious injuries for the period 2001-2003. Serious injury rates were calculated excluding vehicle-kilometers from B.C.

The fatality, serious injury and collision rates are much higher for vehicles 15 years and older than for all vehicles. In fact, the rates are higher than the average once vehicles reach 9 to 11 years old.

3. Purpose of the study

So, why are the fatality, serious injury and collision rates involving vehicles 15 years and older so high?

Is it because:

- 1) Occupants are not as well protected during collisions?
- 2) Mechanical problems are a contributing factor in crashes for vehicles 15 years and older?
- 3) Young drivers and high-risk drivers tend to drive these vehicles for several reasons (lower insurance premiums, lower purchase price, etc.)?

Vehicles 15 years and older clearly offer less protection to occupants. Vehicle manufacturing standards are constantly changing and, over the past 15 years, many new regulations have been introduced, such as air bags in the early 1990s.

An article that appeared in the magazine Status Report [7], points to a report by the Insurance Institute for Highway Safety [8]. The report shows that improvements in vehicle design effectively reduce fatality rates on the roads (see Figure 2 and Table 1 of Ref.8). The article states: “the problem is that people who are not driving the newest vehicles aren’t benefiting from the design changes” and even adds “In fact, the risk is worsening for them”.

The article also states “Researchers don’t know exactly why death rates go up as vehicles get older. It’s probably not from deterioration, at least during the early years of a vehicle’s use. It probably has more to do with who drives the older vehicles versus newer ones and how they drive them”.

Therefore, we will examine whether there is a greater incidence of mechanical problems in vehicles 15 years and older involved in collisions and whether there are more young drivers and high-risk drivers at the wheel of collision-involved vehicles 15 years and older.

4. Distribution of the vehicle fleet by vehicle age

Let us briefly examine the composition of the Canadian vehicle fleet. The Canadian Vehicle Survey (CVS) [2] provides such information as the number of vehicles registered in Canada by vehicle type as well as the year of manufacture. Vehicle age can be determined from the year of manufacture. For example, for 2003 vehicle registration data, a vehicle is 15 years old if it was manufactured in 1988, since $2003 - 15 = 1988$.

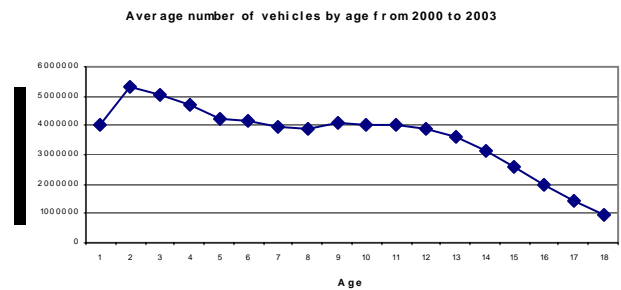


Figure 1: Average number of vehicles by age from 2000 to 2003

Figure 1 shows the average number of vehicles by age for 2000 to 2003. The average attrition (the slope of the graph) for the number of vehicles between 2 and 5 years old is 7% per year⁴. The number of vehicles between 5 and 13 years old is relatively stable, with the average attrition being 1.8% per year. For vehicles between 13 and 15 years old, the average attrition is 14.6% per year. However, for vehicles between 15 and 18 years old, the average attrition falls to 12.3% per year.

⁴ Fleet vehicles (taxi, rental cars, etc.) have a short life, which explains this fast attrition for vehicles between 2 and 5 years old.

5. Analysis of the characteristics of fatalities, serious injuries and collisions by vehicle age

The National Collision Data Base (NCDB) [3] provides data on the number of fatalities, serious injuries and collisions in Canada according to various criteria. The following table indicates the number of fatalities, serious injuries and collisions by vehicle age for 2000 to 2003.

The percentages obtained in the rest of this report were obtained by dividing the number of fatalities, serious injuries or collisions in the given category and the vehicle age group in question by the total number of fatalities, serious injuries or collisions in this age group minus the number of fatalities, serious injuries or collisions for which data are not available in this age group.

Table 4: Number of fatalities, serious injuries and collisions by vehicle age from 2000 to 2003

Vehicle age group	Fatalities	Serious injuries	Collisions
0-2	1,583	8,944	542,005
3-5	1,393	7,884	453,953
6-8	1,367	7,738	390,123
9-11	1,543	8,319	377,911
12-14	1,293	7,014	288,761
15 and older	961	4,670	195,245
15-29	925	4,550	190,663
30 and older	36	120	4,582
Undetermined	496	1,658	242,621
Total	8,636	46,227	2,490,619

5.1 Mechanical problems by vehicle age

First we want to determine whether mechanical problems are more often a contributing factor of collisions with increasing vehicle age.

Mechanical problems include all defective parts that may be found in vehicles (defective brakes, steering, lights, other vehicular parts and blown out tires). These data are taken from the "Vehicle contributing factors" column of the NCDB [4]. Table 5 shows the distribution of fatalities, serious

injuries and collisions for 2000 to 2003 according to whether or not the vehicles had mechanical problems.

Table 5: Distribution of fatalities, serious injuries and collisions from 2000 to 2003 according to the vehicle condition⁴

Vehicle condition	Fatalities	Serious injuries	Collisions
Mechanical problems	21 (0.3%)	60 (0.2%)	6,430 (0.4%)
No mechanical problems	5,937 (94.7%)	26,703 (97.4%)	1,486,031 (82.7%)
Data not available	316 (5.0%)	647 (2.4%)	304,237 (16.9%)
All vehicles	6,274	27,410	1,796,698

Table 6 shows the percentage of fatalities, serious injuries and collisions involving vehicles with mechanical problems by vehicle age.

Table 6: Percentage of fatalities, serious injuries and collisions involving vehicles with mechanical problems by vehicle age from 2000 to 2003

Vehicle age group	Fatalities	Serious injuries	Collisions
0-2	0.08% (1)	0.22% (12)	0.26% (909)
3-5	0.20% (2)	0.19% (9)	0.33% (994)
6-8	0.10% (1)	0.09% (4)	0.36% (923)
9-11	0.76% (8)	0.17% (8)	0.43% (1,073)
12-14	0.21% (2)	0.30% (12)	0.54% (1,041)
15 and older	0.90% (7)	0.44% (15)	1.06% (1,490)
15-29	0.94% (7)	0.43% (14)	1.01% (1,383)
30 and older	0.00% (0)	1.04% (1)	3.09% (107)
All vehicles	0.35% (21)	0.24% (60)	0.43% (6,430)

Vehicle mechanical failures appear to be an extremely infrequent contributing factor in collisions, with incidence rates less than 0.5%.

When vehicles reach 9 to 11 years of age, fatalities and collisions involving vehicles with mechanical problems are more frequent than they are for all vehicles.

The same trend can be observed for serious injuries when vehicles become 12 to 14 years old. However,

⁴ The provinces of Quebec, Newfoundland and Manitoba are excluded from these tables, because they do not provide data on vehicle condition.

the difference is considerable for vehicles 15 years and older. For example, fatalities, serious injuries and collisions involving vehicles 15 years and older where the vehicle had mechanical problems are approximately two and a half times more frequent than they are for all vehicles.

5.2 Do drivers engage in high-risk behaviour?

We now want to determine whether various high-risk behaviours are more frequent with increasing vehicle age. We examined the following high-risk behaviours: alcohol or drug use, high-risk driver actions, no driver's license or suspended license and not wearing a seat belt, at the time of the collision.

5.2.1 Drugs and Alcohol

The conditions included in the “Contributing factors – Driver condition” column of the NCDB [4] are the following: alcohol or drug use, fatigue, inexperience or a sudden illness. Of these, we selected only alcohol and drug use, as these are recognised high-risk behaviours.

Table 7 shows the distribution of fatalities, serious injuries and collisions by driver condition. Table 8 shows the percentages of fatalities, serious injuries and collisions where the driver was under the influence of alcohol or drugs by vehicle age.

For vehicles 12 years and older, fatalities and serious injuries where the driver was under the influence of alcohol or drugs are more frequent than they are for all vehicles. A similar trend can be observed for all collisions, except that collisions where the driver was under the influence of alcohol or drugs are more frequent than they are for all vehicles when the vehicle reach 9 to 11 years old. However, the difference is quite remarkable for vehicles 15 years and older: fatalities, serious injuries and collisions involving vehicles 15 years and older where the driver was under the influence

of alcohol or drugs are approximately 50% more frequent than they are for all vehicles.

Table 7: Distribution of fatalities, serious injuries and collisions by driver condition from 2000 to 2003⁵

Driver condition	Fatalities	Serious injuries	Collisions
Under the influence of alcohol	1,463 (23.3%)	4,217 (15.4%)	63,826 (3.6%)
Under the influence of drugs	97 (1.5%)	91 (0.3%)	1,934 (0.1%)
None of these conditions	4,398 (70.2%)	22,455 (81.9%)	1,426,701 (79.4%)
Data not available	316 (5.0%)	647 (2.4%)	304,237 (16.9%)
All vehicles	6,274	27,410	1,796,698

⁵ The provinces of Quebec, Newfoundland and Manitoba are excluded from these tables, because they do not provide data on driver condition.

Table 8: Percentage of fatalities, serious injuries and collisions where the driver was under the influence of alcohol or drugs by vehicle age from 2000 to 2003

Vehicle age group	Fatalities	Serious injuries	Collisions
0-2	20.30% (241) + 1.52% (18)	12.68% (695) + 0.26% (14)	2.91% (10,163) + 0.10% (333)
3-5	20.40% (205) + 1.89% (19)	12.44% (587) + 0.38% (18)	3.10% (9,374) + 0.09% (258)
6-8	23.00% (227) + 1.22% (12)	13.41 (604) + 0.33% (15)	3.58% (9,269) + 0.12% (303)
9-11	23.88% (250) + 1.24% (13)	15.58% (722) + 0.15% (7)	4.41% (10,980) + 0.14% (352)
12-14	26.44% (252) + 1.99% (19)	18.66% (754) + 0.32% (13)	6.01% (11,549) + 0.17% (322)
15 and older	36.97% (288) + 2.05% (16)	25.27% (855) + 0.71% (24)	8.88% (12,491) + 0.26% (366)
15-29	36.28% (271) + 1.87% (14)	25.33% (833) + 0.67% (22)	8.83% (12,119) + 0.26% (355)
30 and older	53.13% (17) + 6.25% (2)	22.92% (22) + 2.08% (2)	10.75% (372) + 0.32% (11)
All vehicles	24.56% (1,463) + 1.63% (97)	15.76% (4,217) + 0.34% (91)	4.28% (63,826) + 0.13% (1,934)

5.2.2 Driver actions

We would now like to examine high-risk driver actions and vehicle age. Table 9 shows the distribution of fatalities, serious injuries and collisions by high-risk driver actions.

Table 9: Distribution of fatalities, serious injuries and collisions by driver actions from 2000 to 2003⁶

Driver action	Fatalities	Serious injuries	Collisions
Engaged in a high-risk action	4,163 (66.3%)	15,752 (57.5%)	953,274 (53.1%)
Did not engage in a high-risk action	1,795 (28.7%)	11,011 (40.1%)	539,187 (30.0%)
Data not available	316 (5.0%)	647 (2.4%)	304,237 (16.9%)
All vehicles	6,274	27,410	1,796,698

Table 10 shows the percentages of fatalities, serious injuries and collisions by vehicle age where the driver engaged in a high-risk action. These data are obtained from the “Contributing factors – Driver action” column of the NCDB [4].

The high-risk actions in question here are: driving too fast, distractions, driving on wrong side of road, failure to yield the right of way, disobeying traffic control device, loss of control, improper turning, backing unsafely and following too closely.

Table 10: Percentage of fatalities, serious injuries and collisions where the driver engaged in a high-risk action by vehicle age from 2000 to 2003

Vehicle age group	Fatalities	Serious injuries	Collisions
0-2	70.35% (835)	57.58% (3,156)	60.85% (212,550)
3-5	68.06% (684)	57.89% (2,732)	62.18% (188,082)
6-8	70.52% (696)	56.67% (2,553)	63.93% (165,358)
9-11	69.34% (726)	59.91% (2,776)	65.82% (163,975)
12-14	71.46% (681)	60.64% (2,450)	67.39% (129,542)
15 and older	69.45% (541)	61.61% (2,085)	66.64% (93,767)
15-29	68.81% (514)	61.41% (2,019)	66.75% (91,611)
30 and older	84.38% (27)	68.75% (66)	62.28% (2,156)
All vehicles	69.87% (4,163)	60.03% (15,752)	63.87% (953,274)

As Table 10 shows, high-risk actions are distributed almost evenly among vehicle age groups and the difference between the age groups is small. This is not surprising, given that high-risk actions are often the cause of collisions, regardless of vehicle age.

5.2.3 License status

Some drivers drive without a driver’s license or with a suspended license, which constitutes an illegal behaviour. We would like to examine whether this behaviour is more frequent with increasing vehicle age.

⁶ The provinces of Quebec, Newfoundland and Manitoba are excluded from these tables, because they do not provide data on driver actions.

Table 11 shows the distribution of fatalities, serious injuries and collisions by license status. Table 12 shows the percentages of fatalities, serious injuries and collisions by vehicle age where the driver did not have a driver's license or had a suspended license. These data are taken from the "License status" column of the NCDB [4].

Table 11: Distribution of fatalities, serious injuries and collisions by license status from 2000 to 2003⁷

License status	Fatalities	Serious injuries	Collisions
No driver's license or suspended license	125 (2.0%)	455 (1.1%)	15,543 (0.8%)
Valid driver's license	5,384 (85.0%)	39,063 (94.0%)	1,747,684 (84.9%)
Data not available	823 (13.0%)	2,043 (4.9%)	295,330 (14.3%)
All vehicles	6,332	41,561	2,058,557

Table 12: Percentage of fatalities, serious injuries and collisions by vehicle age where the driver did not have a driver's license or had a suspended license from 2000 to 2003

Vehicle age group	Fatalities	Serious injuries	Collisions
0-2	2.20% (24)	0.73% (58)	0.60% (2,527)
3-5	1.97% (19)	0.84% (59)	0.63% (2,271)
6-8	2.16% (21)	0.95% (65)	0.78% (2,411)
9-11	1.75% (19)	1.20% (89)	0.99% (2,968)
12-14	2.47% (21)	1.61% (101)	1.37% (3,029)
15 and older	3.84% (21)	2.05% (83)	1.75% (2,337)
15-29	3.80% (20)	2.09% (83)	1.77% (2,297)
30 and older	5.00% (1)	0.00% (0)	1.47% (40)
All vehicles	2.27% (125)	1.15% (455)	0.91% (15,543)

In general, fatalities involving vehicles that are 12 years or older where the driver did not have a driver's license or had a suspended license are more frequent than they are for all vehicles. The same trend can be observed for serious injuries and all collisions for vehicles that are 9 years or older. However, the difference is quite large for vehicles 15 years and older. For example, fatalities, serious injuries and collisions involving vehicles 15 years and older where the driver did not have a driver's

license are approximately twice as frequent as they are for all vehicles.

5.2.4 Seat belt non-use

Failure to wear a seat belt constitutes another high-risk behaviour. Table 13 shows the distribution of fatalities, serious injuries and collisions by seat belt use.

Table 14 shows the percentages of fatalities, serious injuries and collisions by vehicle age where the occupants were not wearing a seat belt. These data are taken from the "Safety device used" column of the NCDB [4].

Table 13: Distribution of fatalities, serious injuries and collisions by seat belt use from 2000 to 2003⁸

Seat belt use	Fatalities	Serious injuries	Collisions
Not wearing seat belt	2,554 (31.2%)	6,269 (14.2%)	25,895 (1.1%)
Wearing seat belt	4,496 (54.9%)	33,070 (75.2%)	1,455,383 (62.2%)
Data not available	1,135 (13.9%)	4,676 (10.6%)	860,611 (36.7%)
All vehicles	8,185	44,015	2,341,889

Fatalities and serious injuries involving vehicles 12 years and older where the occupants were not wearing a seat belt are more frequent than they are for all vehicles. The same trend can be observed for all collisions involving vehicles 9 years or older. However, the difference is quite noticeable for vehicles 15 years and older. For example, fatalities, serious injuries and collisions involving vehicles 15 years and older where the occupants were not wearing a seat belt are at least 40% more frequent than they are for all vehicles.

⁷ The provinces of Newfoundland, Nova Scotia, New Brunswick, Manitoba and British Columbia are excluded from these tables as they do not collect data on license status.

⁸ The provinces of Newfoundland and Manitoba are excluded from these tables as they do not collect this data.

Table 14: Percentage of fatalities, serious injuries and collisions by vehicle age where the occupants were not wearing a seat belt from 2000 to 2003

Vehicle age group	Fatalities	Serious injuries	Collisions
0-2	33.48% (462)	13.68% (1,104)	1.22% (4,304)
3-5	32.52% (399)	12.80% (899)	1.30% (3,922)
6-8	33.31% (392)	13.50% (930)	1.40% (3,634)
9-11	34.39% (466)	15.19% (1,127)	1.77% (4,429)
12-14	38.10% (421)	18.94% (1,155)	2.37% (4,489)
15 and older	51.36% (414)	27.48% (1,054)	4.08% (5,117)
15-29	51.03% (398)	27.13% (1,014)	3.99% (4,898)
30 and older	55.17% (16)	40.40% (40)	7.47% (219)
All vehicles	36.23% (2,554)	15.94% (6,269)	1.75% (25,895)

6. Who drives vehicles 15 years and older?

The Canadian Motor Vehicle Traffic Collision Statistics brochure [5] contains the number of drivers by age group, from which was calculated Table 15. The distribution of vehicle by age (Table 16) is also obtained from the CVS [2].

The number of vehicle-kilometers driven by driver age and vehicle age (Table 17) is obtained from Statistics Canada [6]. The distribution of the number of vehicle-kilometers driven by driver age and vehicle age (Table 18) is obtained from Table 17.

Vehicles 14 years old and over contribute only 7.9% of the vehicle-kilometers driven in Canada and only 0.6% of those vehicle-kilometers are

driven by drivers under 25 years of age. Is this because there are few vehicles over 14 years and few drivers under 25?

From the data in Tables 15 and 16, the product of the distribution of drivers by age and of the distribution of vehicles by age is calculated (Table 19). That is, the expected distribution of vehicle-kilometers, if the total number of vehicle-kilometers was uniformly divided between all vehicles and drivers. For each vehicle age group and driver age group, the ratio between the distribution of the number of vehicle-kilometers by driver age and vehicle age and the product of the distribution of drivers by age and of the distribution of vehicles by age (Table 20) is obtained.

The ratios show not only that vehicles 14 years and older are driven less than expected, but that young drivers drive those vehicles less than expected. The increased risk for vehicles 15 years and older is therefore not the result of an increased exposure to risk.

Table 15: Driver distribution by age from 2000 to 2003

Driver age group	Proportion (in %)
0-24	13.4
25-54	61.4
55-64	12.8
65 and older	12.4
Total	100.0

Table 16 : Distribution of vehicles by age from 2000 to 2003

Vehicle age group	Proportion (in %)
0-2	20.8
3-5	19.0
6-9	23.0
10-13	21.0
14 and older	16.2
Total	100.0

Table 17 : Number of vehicle-kilometers driven by driver age and vehicle age from 2000 to 2003

Vehicle age group	Driver age group				
	0-24	25-54	55-64	65 and older	Total
0-2	27,227.32	355,282.71	77,806.77	40,695.43	501,012.22
3-5	24,344.71	321,781.05	58,753.43	42,423.92	447,303.10
6-9	32,425.67	318,169.23	61,109.30	46,851.03	458,555.24
10-13	29,305.05	206,322.02	46,692.87	30,546.99	312,866.94
14 and older	11,471.79	98,458.05	21,419.22	17,081.88	148,430.94
Total	124,774.53	1,300,013.06	265,781.59	177,599.26	1,868,168.44

Table 18 : Distribution of vehicle-kilometers driven by driver age and vehicle age from 2000 to 2003 (in %) from Table 16

Vehicle age group	Driver age group				
	0-24	25-54	55-64	65 and older	Total
0-2	1.5	19.0	4.2	2.2	26.8
3-5	1.3	17.2	3.1	2.3	23.9
6-9	1.7	17.1	3.3	2.5	24.6
10-13	1.6	11.0	2.5	1.6	16.8
14 and older	0.6	5.3	1.1	0.9	7.9
Total	6.7	69.6	14.2	9.5	100.0

Table 19 : Product of the distribution of drivers by age and of vehicles by age from 2000 to 2003

Vehicle age group	Driver age group				
	0-24	25-54	55-64	65 and older	Total
0-2	2.8	12.7	2.7	2.6	20.8
3-5	2.6	11.7	2.4	2.4	19.0
6-9	3.1	14.2	2.9	2.9	23.0
10-13	2.8	12.9	2.7	2.6	21.0
14 and older	2.2	9.9	2.1	2.0	16.2
Total	13.4	61.4	12.8	12.4	100.0

Table 20 : Ratio between the distribution of vehicle-kilometers by driver age and vehicle age and the product of the distribution of drivers by age and of vehicles by age from 2000 to 2003

Vehicle age group	Driver age group				
	0-24	25-54	55-64	65 and older	Total
0-2	0.52	1.50	1.57	0.84	1.29
3-5	0.51	1.47	1.29	0.96	1.26
6-9	0.56	1.20	1.11	0.88	1.07
10-13	0.56	0.86	0.93	0.63	0.80
14 and older	0.28	0.53	0.55	0.45	0.49
All vehicles	0.50	1.13	1.11	0.77	1.00

7. Imported vehicles

unlike 2002, 2003 and 2004, where all vehicles were included.

7.1 Number of imported vehicles 15 years and older

The number of vehicles 15 years and older imported from 2000 to 2004 was obtained from the Registrar of Imported Vehicles (RIV) [1]. Table 21 summarizes the numbers imported each year.

The 2000 and 2001 data are partial, as the method that was used did not take all vehicles into account,

Table 21: Number of vehicles 15 years and older imported from 2000 to 2004

Year	Imported Vehicle
2000	1,155
2001	2,311
2002	10,072
2003	12,012
2004	14,594
Total	40,144

According to the RIV, most vehicles 15 years and older imported into Canada are passenger vehicles. Some trucks and a very small number of motorcycles are also imported. [1]

7.2 Imported vehicles involved in collisions

Between 2000 and 2004, some vehicles 15 years and older imported into Canada were involved in collisions. To identify these vehicles, we cross-referenced the RIV database with the NCDB using the vehicle identification number (VIN), which enabled us to identify the vehicles that were in both databases.

Table 22: Number of fatalities, serious injuries and collisions involving imported vehicles 15 years and older from 2000 to 2004

Year	Collisions	Fatalities	Serious injuries
2000	0	0	0
2001	4	0	1
2002	23	0	0
2003	20	1	0
2004	33	0	0
Total	80	1	1

Table 22 shows the number of fatalities, serious injuries and collisions involving imported vehicles 15 years and older that were identified for these years.

7.3 Vehicle Condition

Data on vehicle condition were available for only 64 of the 80 vehicles. Of the imported vehicles 15 years and older involved in collisions from 2000 to 2004, 4.69% (3 collisions) had mechanical problems at the time of the collision, while only 1.04% of all vehicles 15 years and older had mechanical problems.

7.4 Alcohol and drugs

The data on alcohol or drug use were available for only 64 of the 80 collisions. The data indicate that no driver of an imported vehicle 15 years and older was under the influence of alcohol or drugs.

7.5 License status

Data on license status were available for only 64 of the 80 collisions. Of the imported vehicles 15 years and older involved in a collision between 2000 and 2004, all of the drivers had a driver's license (and none had a suspended license) at the time of the collision.

7.6 Seat belt non-use

Data on seat belt use were available for only 30 of the 80 collisions. Of the imported vehicles 15 years and older involved in a collision between 2000 and 2004, 6.67% (2 collisions) of the vehicles had occupants who were not wearing a seat belt; this is consistent with all vehicles 15 years and older involved in a collision during the same period, where 6.06% had occupants who were not wearing a seat belt.

7.7 Driver age

Data on driver age were available for 71 of the 80 collisions. Table 23 shows the distribution of collisions by driver age for collisions involving imported vehicles 15 years and older.

Table 23: Distribution of collisions by driver age for vehicles 15 years and older from 2000 to 2004

Driver age group	Imported vehicles	All vehicles
Under 20	23.9	11.3
20-24	11.3	13.7
25-34	9.9	20.8
35-44	21.1	21.6
45-54	14.1	15.9
55-64	16.9	8.7
65 and older	2.8	8.0
Total	100.0	100.0

The proportion of collisions involving drivers under 20 is higher for imported vehicles than it is for all the vehicles 15 years and older.

8. Discussion

8.1 Missing data

A significant amount of data for the different variables that we examined was not available, either because vehicle age was not available or because the value of the variable in question was not available in the NCDB.

However, even though a number of data were not available, the trends obtained are consistent for fatalities, serious injuries, and collisions.

8.2 Fleet crashworthiness

Lund states: “While vehicle age effects have pushed the US death rate upward, vehicle design improvements have tended to push the rate downward”. [8]

According to Elvik and Vaa [9], poor vehicle crashworthiness ranks at the top of the list according to the size of their contribution to fatalities and injuries (p.76).

Hence, the high volume importation of older vehicles will likely “push the casualty rates upward”. Older vehicles should be subjected to the rules of the registrar of imported vehicles, just as newer vehicles are.

8.3 Vehicle deterioration

Our paper has shown that the proportion of fatalities, serious injuries and collisions for the occupants of vehicles 15 years and older involving vehicles with mechanical problems, increases and is approximately two and a half times higher than the average for occupants of all vehicles.

Instances of mechanical failure are very infrequent (in the order of 0.3%) as contributing factors for collisions; it might indicate vehicle deterioration, or a lower level of maintenance of older vehicles.

A literature review of annual vehicle inspections of older vehicles should be conducted to assess whether or not such a measure would be beneficial in the Canadian context.

8.4 Who drives older vehicles and how they drive them.

Our results show that there is an issue regarding how older vehicles are driven. We have shown that:

- The proportion of fatalities, serious injuries and collisions for the occupants of vehicles 15 years and older, where the driver was under the influence of alcohol or drugs, increases and is approximately 50% higher than the average for the occupants of all vehicles;
- The proportion of fatalities, serious injuries and collisions for the occupants of vehicles 15 years and older, where the occupants were not wearing their seat belt, increases and is at least 40% higher than the average for the occupants of all vehicles;
- The proportion of fatalities, serious injuries and collisions for the occupants of vehicles 15 years and older, where the driver did not have a driver’s license or whose driver’s license was suspended, increases and is approximately twice as high as the average for the occupants of all vehicles;

These findings point to an enforcement issue; while there is nothing illegal about driving an older vehicle, illegal behaviors appear to be more frequent for drivers of older vehicles.

There could also be psychological or social factors at play.

- Perhaps, are drivers more cautious when driving newer vehicles.
- The age of vehicles is perhaps an indirect measure of socio-economic status; where less privileged individuals are more at risk of injury as is the case in several manifestations of ill-health [12].

8.5 Imported vehicles

Vehicles that were imported will only appear in the collision database after their date of importation if they were in a collision. For example, the vehicles imported in 2004 can only be found in the collision database after their importation date in 2004. The database of imported vehicle is comprehensive since only 2002.

Despite that fact, 80 collisions were found where a 15 year old imported vehicle was involved, including one fatality and one severe injury.

With mechanical failure being a very infrequent contributing factor, it is particularly astonishing that three of these collisions involved mechanical failure.

9. Conclusion

An association was found between older vehicles and mechanical failure as a contributing factor in crashes. It could be an indication of vehicle deterioration with age, or poor maintenance of older vehicles. A literature review of annual vehicle inspections of older vehicles should be conducted to assess whether or not such a measure would be beneficial in the Canadian context.

Collision-involved older vehicles were also associated with alcohol and drug use, unbelted occupants and suspended or unlicensed drivers.

This indicates that the way the older vehicles are driven contributes to the high casualty rates that are associated with them. These findings point to an enforcement issue; while there is nothing illegal about driving an older vehicle, illegal behaviors appear to be more frequent for drivers of older vehicles.

Older vehicles are driven less than other vehicles and are not driven by a disproportionate number of drivers under 25 years old. The increased risk for vehicles 15 years and older is therefore not the result of increased exposure to risk.

Between 2000 and 2004, 25,550 imported vehicles 15 years and older accounted for 80 collisions, including one fatality and one severe injury. With mechanical failure being a very infrequent contributing factor; it is astonishing that three of these collisions involved mechanical failure.

A market for imported vehicles more than 15 years old has been growing in Canada by 24% per year over the last few years. The literature shows that vehicle crashworthiness affects casualty rates. The high volume importation of older vehicles will likely "push the casualty rates upward". Older vehicles should be subject to the rules of the registrar of imported vehicles, just as newer vehicles are.

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