GONZALO RODRÍGUEZ MEMORIAL FOUNDATION

ROAD SAFETY PLAN FOR CHILDREN EDU-CAR

Report of Studies
The critical situation of child passengers in vehicles

Observational Study on the Use of Safety Elements in Vehicles in Montevideo, Salto, and Paysandú

May, 2009

Montevideo, Uruguay

INDEX

INTRODUCTION

The following study presents the findings of an observational study of safety elements' prevalence in private motor vehicles, carried out in the cities of Montevideo, Salto and Paysandú in the period May – June, 2008.

The study is part of the research activities of the **Road Safety Plan for Children EDU-CAR**, carried out by **Gonzalo Rodríguez Memorial Foundation**.

Gonzalo Rodríguez Memorial Foundation (GRMF) is a non-profit non-governmental organization, with legal status in Uruguay since October 2000 and registered in the United States and England. Created in memoriam of the Uruguayan racer Gonzalo "Gonchi" Rodríguez (1971 - 1999) and with the motto *"More education, health, and development"*, GRMF has developed several educational programs that have helped more than 15,000 Uruguayan children and teenagers. Through its EDU-CAR Plan, GRMF has now started a project promoting road safety for those representing the most important population of a country: its children.

An observational study was carried out aiming at getting to know the general conditions in which passengers of private vehicles aged 0–14 years old travel in the cities of Montevideo, Salto and Paysandú. The information collected refers to the level of use of safety elements among these children.

Although samples provided data that cannot be generalized for the whole population of each of these cities, findings present important information on children road safety.

I. METHODOLOGICAL FRAMEWORK

This chapter will describe the methodology followed in this study.

I.1. Scope of the study

Due to the fact that no similar studies have been carried out in Uruguay, this investigation on safety elements' prevalence in vehicles has an exploratory nature, trying to describe the reality on the matter.

I.2. Objectives of the study

- *General objectives*

i) To study general travel conditions of children aged 0–14 years old in private motor vehicles (cars, vans, SUVs and motorcycles[1]) in the cities of Montevideo, Salto and Paysandú.

ii) To observe to what extent safety elements are used by children aged 0-14 years old traveling in private motor vehicles in the cities of Montevideo, Salto and Paysandú

- *Specific objectives*

i) To study the prevalence of use of safety elements (on the one hand passive safety systems such as seatbelts and helmets, and on the other, child restraint systems) by passengers aged 0–14 years old in private motor vehicles in the cities of Montevideo, Salto and Paysandú.

[1] Motorcycles were not included in Montevideo. At the beginning of the study 2-wheel vehicles were not included in the cities of Salto and Paysandú, but since there is a very large number of them circulating, it was decided to incorporate them in the survey.

ii) To check compliance with the new Traffic and Road Safety Act in the National Territory (Law Nº 18191, 30/Oct/2007), regarding the use of safety systems by children aged 0–14 years old.

I.3. Type of study

This is a non-participant observation study.

All data collected for each vehicle (case) was recorded in a structured and pre-defined form designed by Gonzalo Rodriguez Memorial Foundation.

To carry out this study, vehicles were observed when passing through certain *monitored crossings* in the cities of Montevideo, Salto and Paysandú. Said crossings were randomly selected, and observations made at times when children were coming in/out of educational centers (7:30 - 9:30 AM; 12:00 - 2:00 PM; 3:00 - 6:00 PM).

I.4. Universe of the study

Passengers (of all ages) of all those motor vehicles (cars, vans, SUVs, motorcycles and others) circulating in Montevideo, Salto and Paysandú, fulfilling the following conditions: i) the vehicles were private, ii) they were circulating at the moment of the observation and iii) they had, at least, one child passenger aged 0–14 years old.

I.5. Date of the field work

Field work was carried out on the following dates:
Montevideo: 20, 21 and 22, May 2008.

Salto and Paysandú: 25, 26 and 27 June, 2008

I.6. Technical Team

The Technical Team responsible for field work was composed by staff members and volunteers from the Gonzalo Rodriguez Memorial Foundation, as well as students from **Course on Woman's Health, Pregnancy, Childhood and Adolescence** given by the School of Medicine, University of the Republic, at different venues (Casa Universitaria, Paysandú; Regional Norte, Salto; School of Medicine, Montevideo), who worked voluntarily.

I.7. Number of cases

City	Total of children aged 0 -14	Total of individuals aged 15 and older	Total of individuals
Montevideo	737	806	1543
Salto	366	418	784
Paysandú	309	353	662

I.8. Limitations of the study

This reports aims at showing results exclusively related to the sample studied, it does not intend to make any inferences on a larger population (total number of children aged 0-14 in each city, for example). Since this study is focused on time (only one moment –day and time- was considered in the three cities); it does not intend to take the place of a representative study in terms of sample, associated framework and level of ancillary information. Nevertheless, we believe that this study can be used as an approximation to the general situation that prevails in these countries today. Particularly, in Uruguay, given the absence of legislation that makes mandatory that children must use adequate safety elements when traveling in 4-wheeled motor vehicles; it is very difficult that the population's behavior changes in a short period of time. Even more, taking into account the four seasons of the year (autumn, winter, spring and summer), in other countries, the level of use of safety elements for children do not vary significantly ([3, 4]).

A way of controlling the sample's size is to assign a fixed number of observations to each place, being fundamental to cover a minimum required number ([8]).

Complementing the previous information, it is necessary to improve auxiliary information, using for example, a sample with its same characteristics but in different days and times in order to calculate the total flow of vehicles, and how many of these were traveling with children. Another technique for the collection of information is to keep manual count of vehicles, as well as asking questions related to the number of kilometers traveled by vehicle (KRV) as part of a survey relating household expenses with means of transport used ([11]). To a lesser extent, by calculating fuel used by regions and areas, it is possible to obtain reasonable estimators to improve the quality of information collected in the sampling framework ([13]).

I.9. Medicine School students' feedback and additional comments

For the final stage of field work, "feedback workshops" were carried out in the cities of Montevideo and Salto where Medicine students shared experiences learned during the survey. Following, some of their comments:

- The lane closest to the observers (on the right from the vehicle's point of view) is rarely used, especially in Montevideo.
- Carelessness was a very important factor especially at rush hour.
- Obstacles at observation posts (especially buses, if crossings were at bus stops) made vision difficulty in some cases.
- Crossing defined close to educational centers (especially private centers) proved to be efficient for a larger number of observations in a shorter period.

II. GENERAL CHARACTERISTICS OF THE UNIVERSE OF STUDY

This section describes general characteristics of all those observed and also those belonging to vehicles in which they were traveling, in each of the three cities where the survey was carried out.

II. 1. MONTEVIDEO

II.1. i. Distribution by *gender*

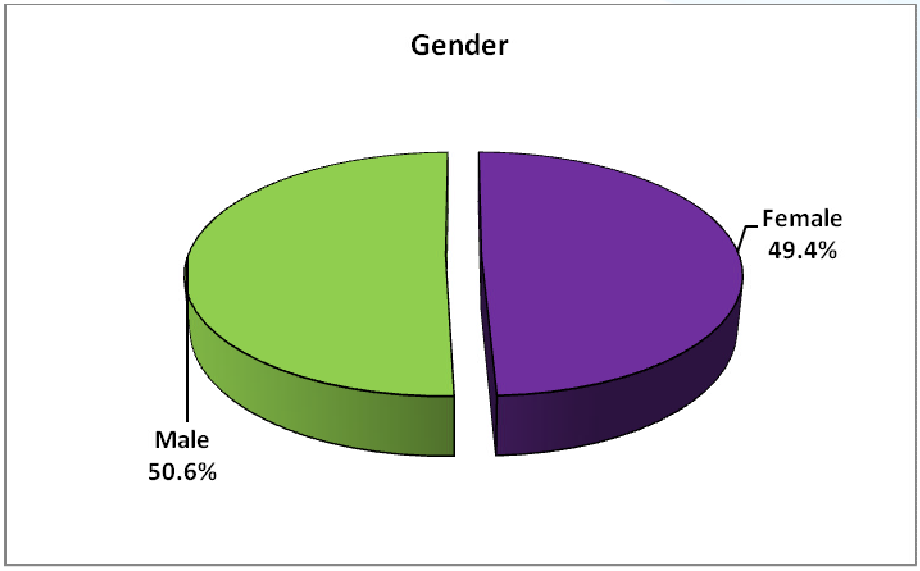
As shown in Table II.1, distribution by gender in the city of Montevideo is very similar for men and women, 50.6% and 49.4% respectively.

Table II.1.1.

Gender

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Male	742	48.1	49.4	49.4
	Female	760	49.3	50.6	100.0
	Total	1502	97.3	100.0	
	System missing values	41	2.7		
Total		1543	100.0		

Graph II.1.1.



II.1. ii. *Distribution by age*

Regarding age, 52.2% of individuals were older than 15 years old, while 47.8% were aged 0–14 years old. The largest population is among those aged 24 – 69 years old, 48.2% of passengers observed. The second age group is represented by children aged 5–14 years old, 33.2%. At the same time, 11.4% of individuals are children aged 1–4 years old; 3.2% are younger than 1 year old; 2.9% individuals aged 15–24 years old and 1.2% older than 70 years old.

Table II.1.2.

Age group

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Children (0 -14 years old)	737	47.8	47.8	47.8
	Older than 15 years old	806	52.2	52.2	100.0
	Total	1543	100.0	100.0	

Graph II.1.2.

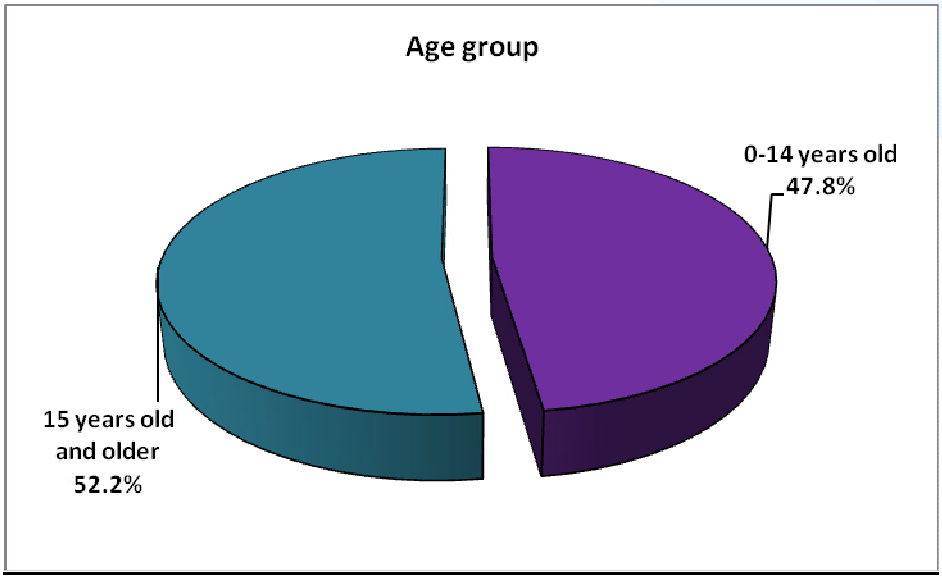
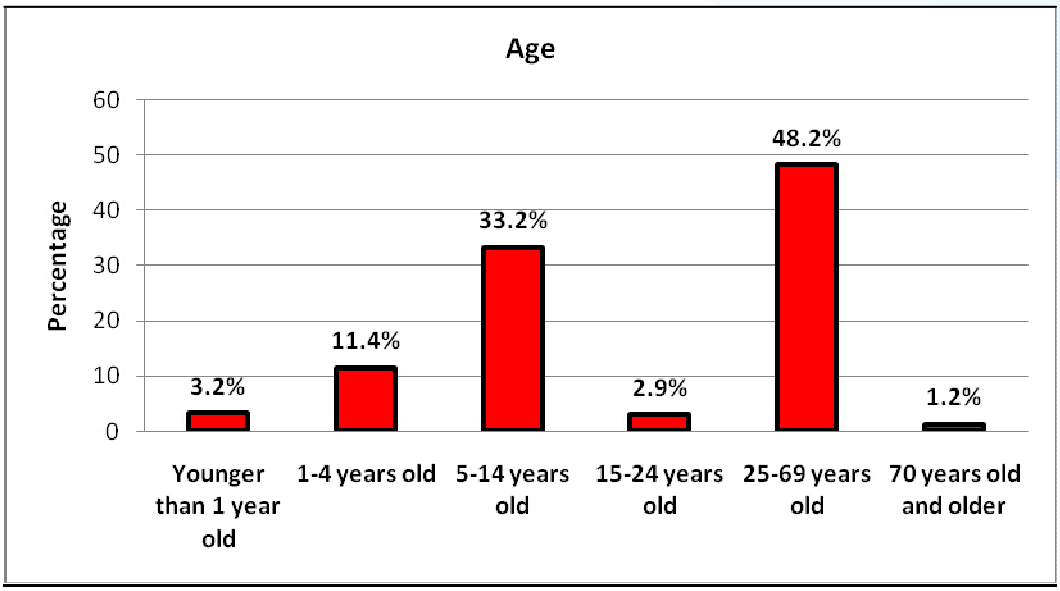


Table II.1.3.

Age

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Younger than 1 year old	49	3.2	3.2	3.2
	1 - 4 years old	176	11.4	11.4	14.6
	5 – 14 years old	512	33.2	33.2	47.8
	15 - 24 years old	45	2.9	2.9	50.7
	25 - 69 years old	743	48.2	48.2	98.8
	Older than 70 years old	18	1.2	1.2	100.0
	Total	1543	100.0	100.0	

Graph II.1.3.


Age
Percentage
60
50
40
30
20
10
0
3.2%
11.4%
33.2%
2.9%
48.2%
1.2%
Younger than 1 year old
1-4 years old
5-14 years old
15-24 years old
25-69 years old
70 years old and older

II.1. iii. Distribution by *vehicle type*

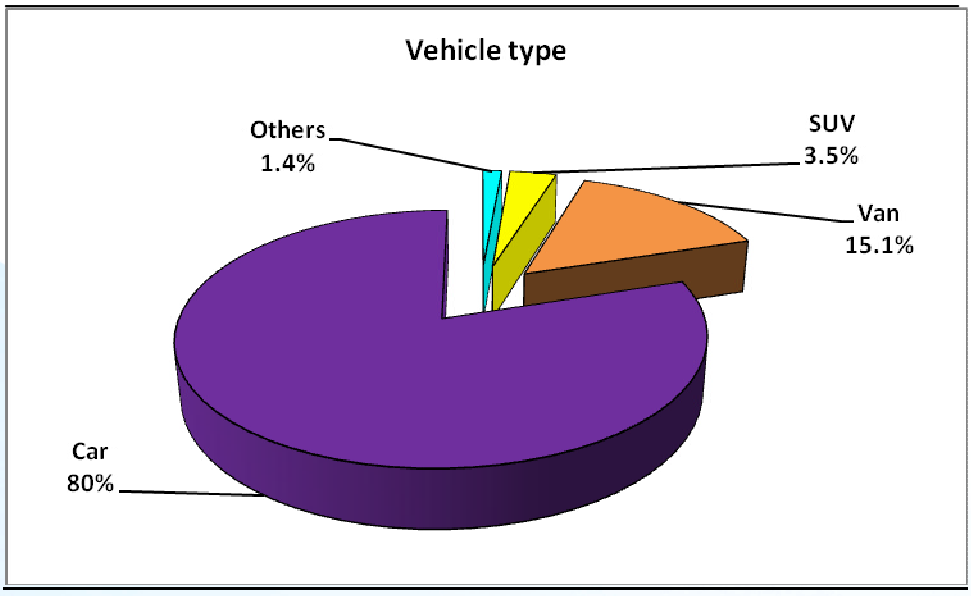
The predominant vehicle type was the car, 80% of studied passengers were traveling in this type of vehicle. Of all observed individuals, 15.1% were traveling by van and 3.5 by SUV, 1.4% of observations show residual values in the category "others".

Table II.1.4.

Vehicle Type

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Car	1229	79.7	80.0	80.0
	Van	232	15.0	15.1	95.1
	SUV	54	3.5	3.5	98.6
	Other	22	1.4	1.4	100.0
	Total	1537	99.6	100.0	
	System missing values	6	.4		
Total		1543	100.0		

Graph II.1.4.



II.1. iv. Distribution by *vehicle's age*

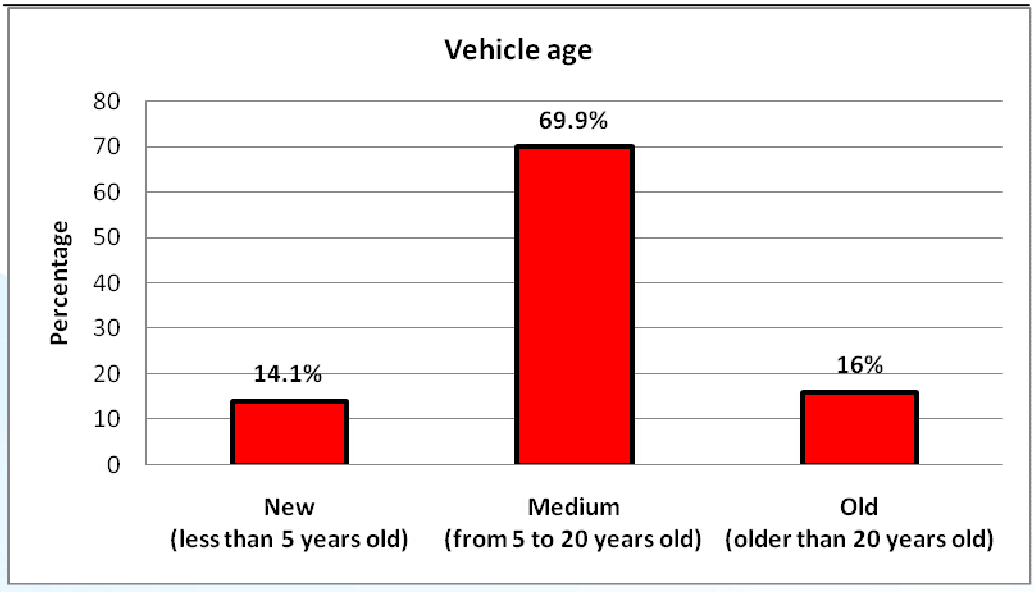
Regarding vehicle's age, 69.9% of individuals observed were traveling in 5–20 year-old vehicles, on the other hand, percentage of passengers in new vehicles (less than 5 years old) and old vehicles (older than 20 years old), was 14.1% and 16% respectively.

Table II.1.5.

Vehicle age

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	New (less than 5 years old)	217	14.1	14.1	14.1
	Medium (between 5 and 20 years old)	1072	69.5	69.9	84.0
	Old (more than 20 years old)	245	15.9	16.0	100.0
	Total	1534	99.4	100.0	
	System missing values	9	.6		
Total		1543	100.0		

Graph II.1.5.



II.1. v. Distribution by *seating position* in the vehicle

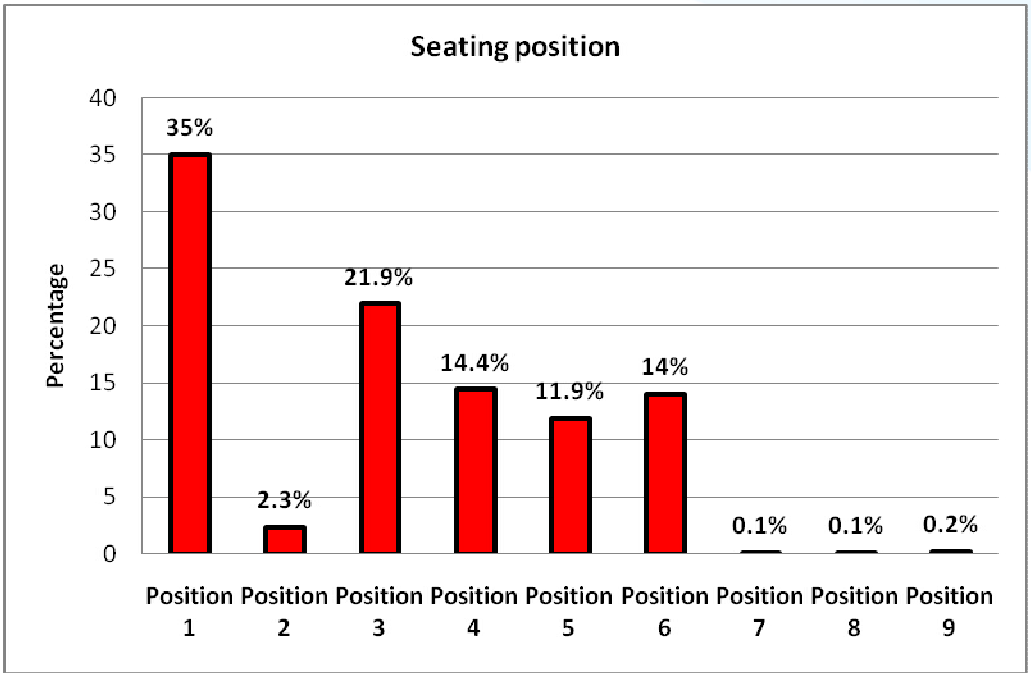
Regarding seating position in the vehicle, 35% of observations were of individuals on the driver's seat (position "1"). 21.9% of passengers were traveling in the passenger's seat (position "3"); while 2.3% were doing so in position "2", that is to say, in the front seats between the driver and the passenger. On the other hand, for rear seats, positions "4" and "6" were used by 14.4% and 14% of users respectively, while 11.9% were in position "5". At the same time, positions "7" and "8" represented 0.1% of individuals each, and position "9", 0.2%.

Table II.1.6.

Seating Position

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Position 1	539	34.9	35.0	35.0
	Position 2	36	2.3	2.3	37.3
	Position 3	338	21.9	21.9	59.3
	Position 4	222	14.4	14.4	73.7
	Position 5	184	11.9	11.9	85.6
	Position 6	215	13.9	14.0	99.6
	Position 7	1	.1	.1	99.7
	Position 8	2	.1	.1	99.8
	Position 9	3	.2	.2	100.0
	Total	1540	99.8	100.0	
	System missing values	3	.2		
Total		1543	100.0		

Graph II.1.6.


Seating position
Percentage
40
35
30
25
20
15
10
5
0
35%
2.3%
21.9%
14.4%
11.9%
14%
0.1%
0.1%
0.2%
Position 1
Position 2
Position 3
Position 4
Position 5
Position 6
Position 7
Position 8
Position 9

II.1. vi. Distribution by *type of safety system used*

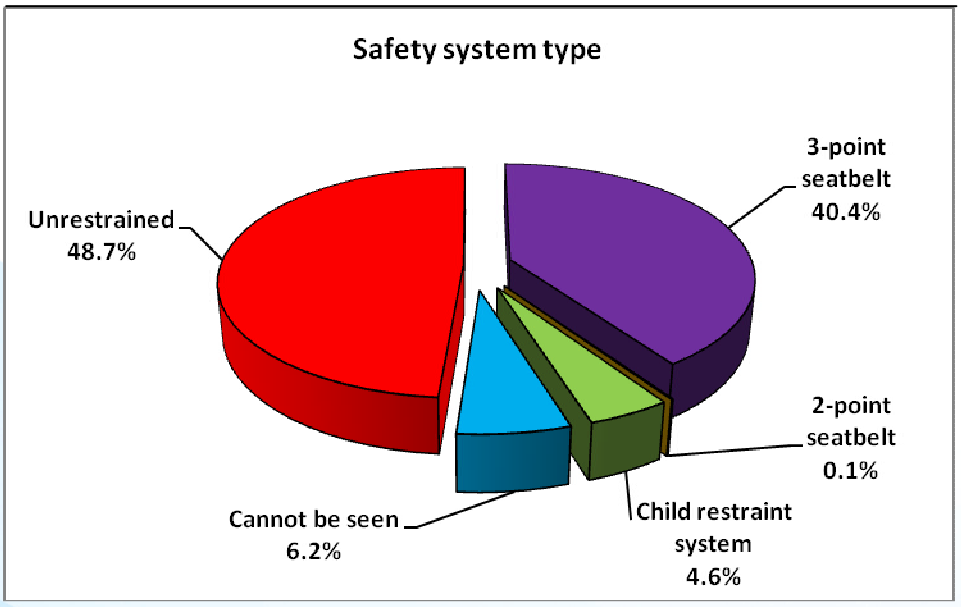
Regarding type of safety system used, 48.7% of passengers were traveling unrestrained. Of all individuals studied 40.4% were wearing 3-point seatbelts, while 0.1% were wearing 2-point seatbelts. On the other hand, 4.6% of children were traveling in CRS. For 6.2% of cases it was not possible to determine whether they were traveling in a CRS or not.

Table II.1.7.

Safety System Type

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	2 point-seatbelt	2	.1	.1	.1
	3 point-seatbelt	621	40.2	40.4	40.6
	Child Restraint System (CRS)	70	4.5	4.6	45.1
	Unrestrained	748	48.5	48.7	93.8
	Cannot be seen	95	6.2	6.2	100.0
	Total	1536	99.5	100.0	
	System missing values	7	.5		
Total		1543	100.0		

Graph II.1.7.



II.1. vii. Distribution by *correct or incorrect use* of the safety system

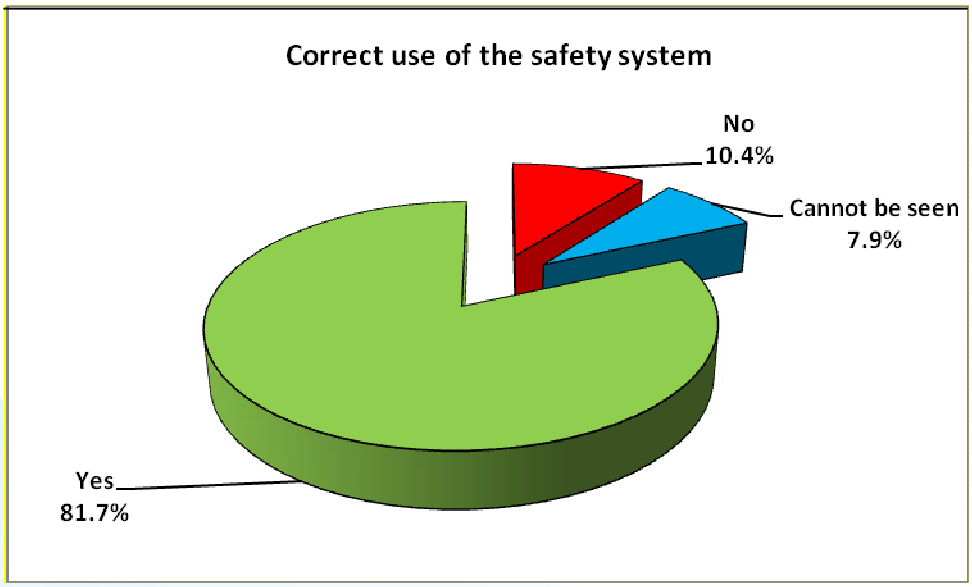
In reference to the correct or incorrect use of the safety system, 81.7% of people using some type of safety system were doing it correctly, while 10.4% were doing so incorrectly. It was impossible for 7.9% of cases to determine whether the safety system was being used correctly or incorrectly.

Table III.1.8.

Correct use of safety systems

	Frecuency	Valid Percentage	Accumulated Percentage
Yes	566	81.7	81.7
No	72	10.4	92.1
Cannot be seen	55	7.9	100.0
Total	693	100.0	

Graph II.1.8.



II. 2. SALTO

II.2. i. Distribution by *gender*

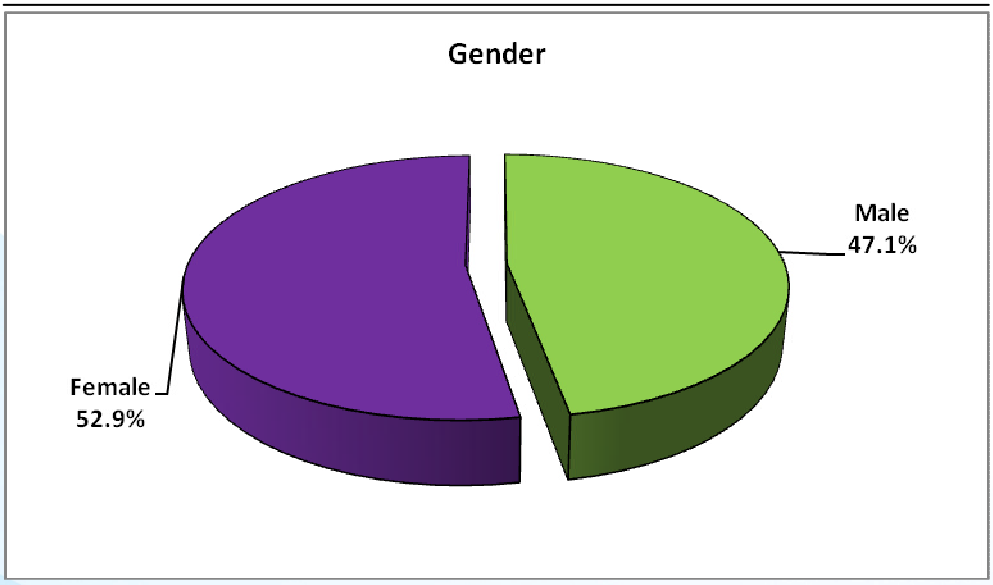
Private vehicle occupants' distribution by gender in the city of Salto shows that 52.9% are women and 47.1% are men.

Table II.2.1.

Gender

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Male	357	45.5	47.1	47.1
	Female	401	51.1	52.9	100.0
	Total	758	96.7	100.0	
	System missing values	26	3.3		
Total		784	100.0		

Graph II.2.1.



II.2. ii. Distribution by *age*

Regarding age, the percentage of people older than 15 years old reaches 52.3%, while the proportion of children aged 0–14 years old is 47.7%.

The most frequent age group was of those aged 25 – 69 years old, representing 46.6% of individuals. The second age group corresponds to children aged 5 – 14 years old, representing 31.8% of observations. In the third place, 14.3% were represented by children aged 1–4 years old. Vehicle occupants aged 15 – 24 years old represented 5.1% of observations, while children younger than 1 year old and adults older than 70 represented 1.3% and 0.6% respectively.

Table II.2.2.

Age group

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	0 - 14 years old	366	46.7	47.7	47.7
	Older than 15 years old	402	51.3	52.3	100.0
	Total	768	98.0	100.0	
	System missing values	16	2.0		
Total		784	100.0		

Graph II.2.2.

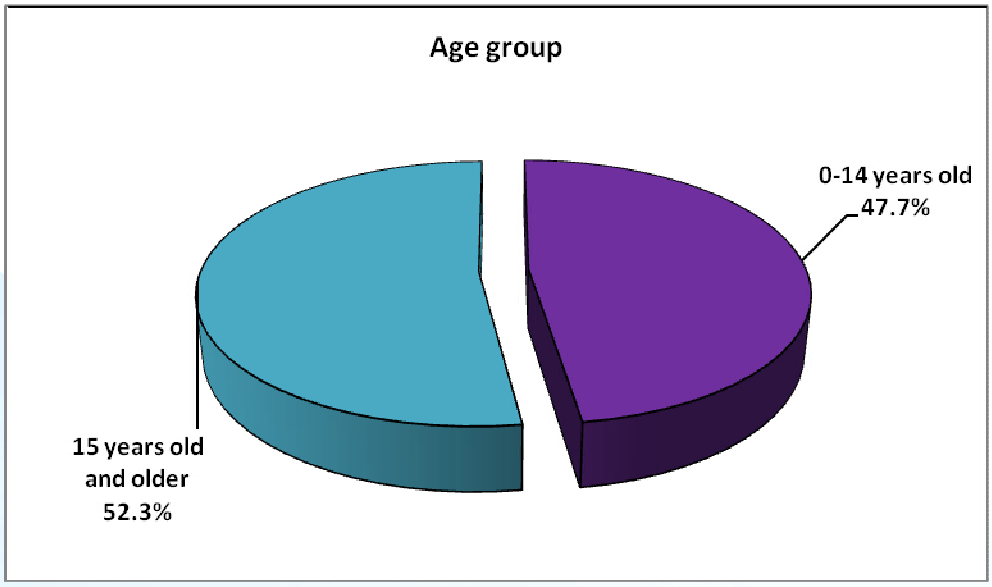
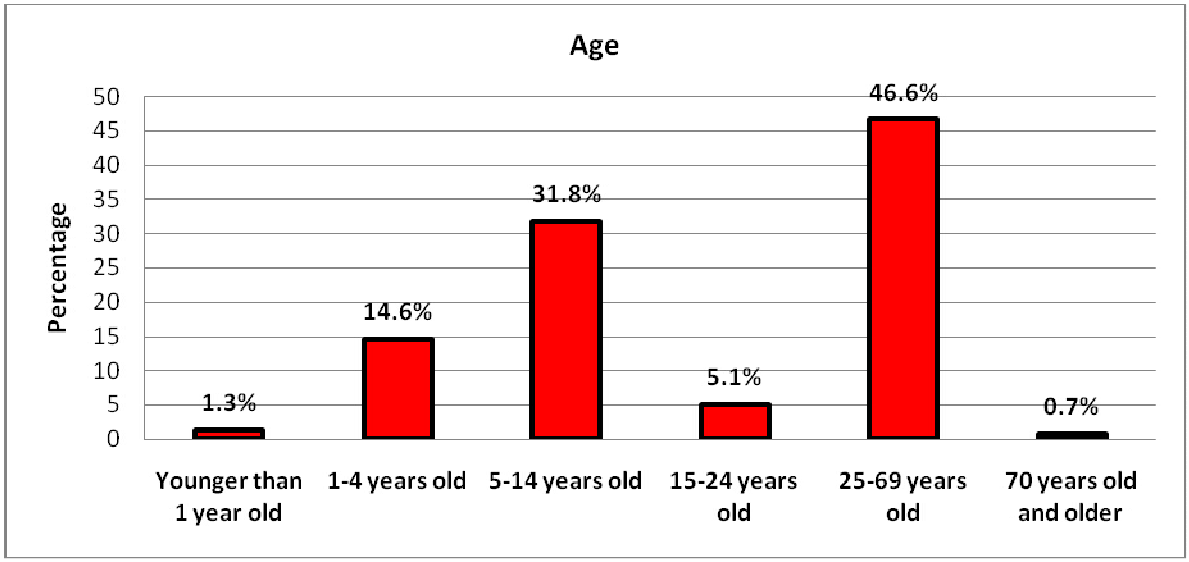


Table II.2.3.

Age

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Younger than 1 year old	10	1.3	1.3	1.3
	1 - 4 years old	112	14.3	14.6	15.9
	5 -14 years old	244	31.1	31.8	47.7
	15 -24 years old	39	5.0	5.1	52.7
	25 - 69 years old	358	45.7	46.6	99.3
	Older than 70 years old	5	.6	.7	100.0
	Total	768	98.0	100.0	
	System missing values	16	2.0		
Total		784	100.0		

Graph II.2.3.



II.2. iii. Distribution by *vehicle type*

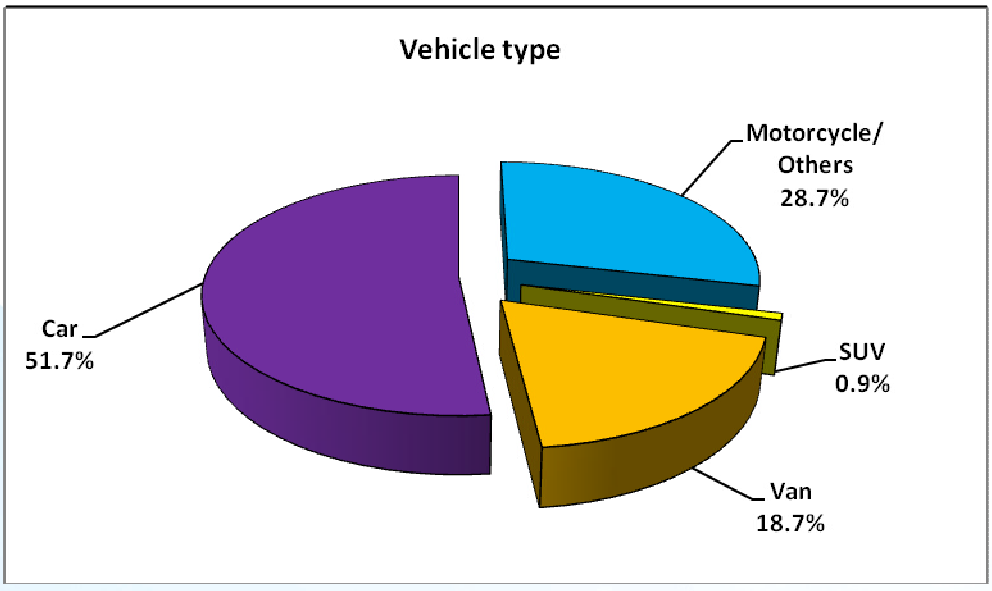
Regarding vehicle type, 51.7% of study individuals were traveling in cars, 18.7% in vans, while 0.9 were doing so in SUVs. The category "motorcycle/others", was mainly represented by motorcycles, 28.7%.

Table II.2.4.

Vehicle Type

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Car	403	51.4	51.7	51.7
	Van	146	18.6	18.7	70.4
	SUV	7	.9	.9	71.3
	Motorcycle/ other	224	28.6	28.7	100.0
	Total	780	99.5	100.0	
	System missing values	4	.5		
Total		784	100.0		

Graph II.2.4.



II.2. iv. Distribution by *vehicle's age*

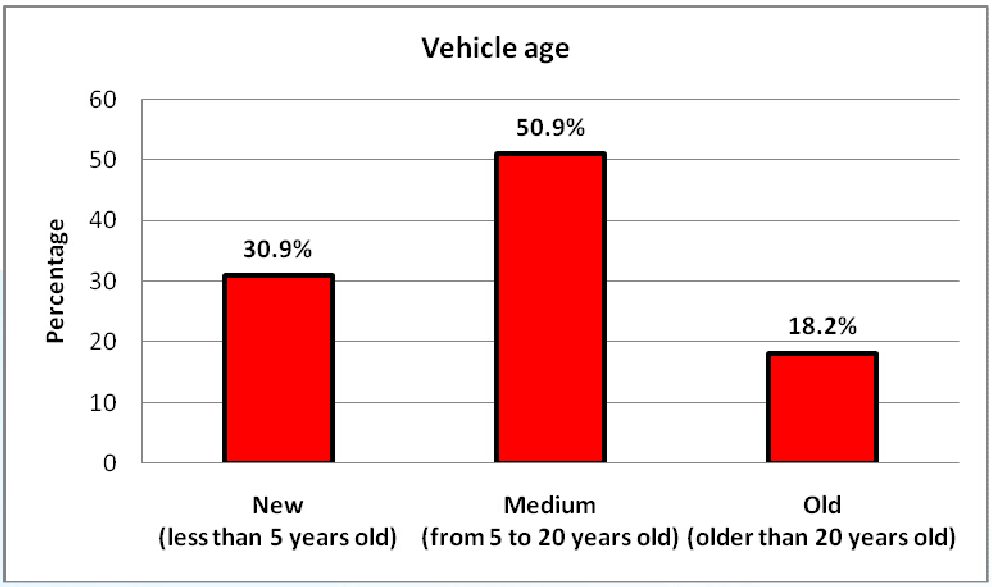
In reference to vehicle age, 50.9% were traveling in vehicles aged 5–20, at the same time 30.9% of passengers were in new vehicles. People traveling in old cars (older than twenty years old) represented 18.2% of observed cases.

Table II.2.5.

Vehicle Age

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	New (less than 5 years old)	231	29.5	30.9	30.9
	Medium (between 5 and 20 years old)	380	48.5	50.9	81.8
	Old (more than 20 years old)	136	17.3	18.2	100.0
	Total	747	95.3	100.0	
	System missing values	37	4.7		
Total		784	100.0		

Graph II.2.5.



II.2. v. Distribution by *seating position* in the vehicle

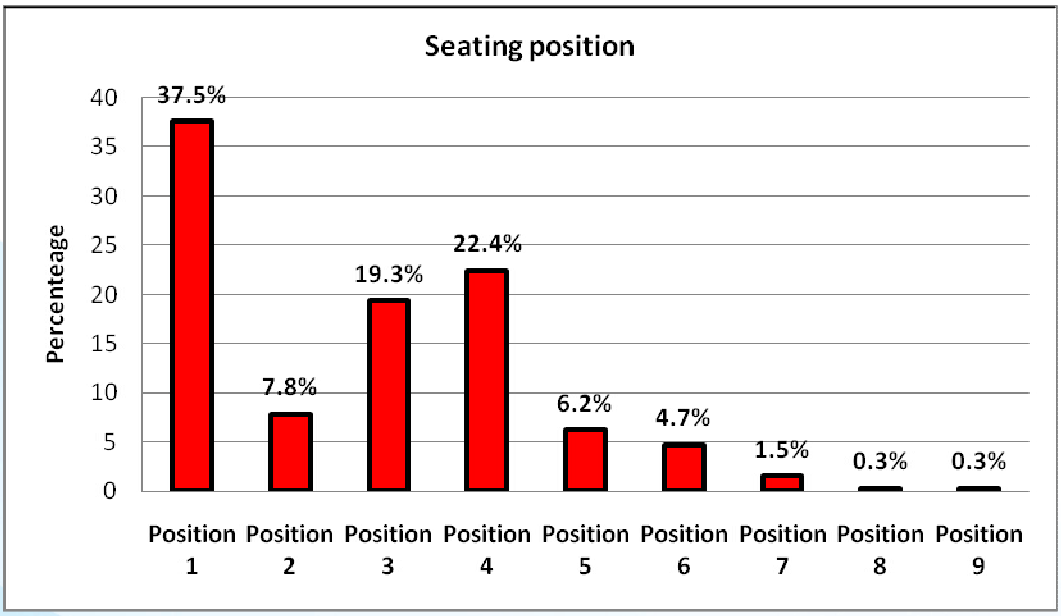
Regarding seating positions in the vehicle, position "1" is the most frequent, 37.5%. Positions "4" and "3" follow with 22.4% and 19.3% respectively. Occupants in positions "2", "5" and "6" respectively reach 7.8%, 6.3% and 4.7%. Percentages for positions "7", "8" and "9" are 1.5%, 0.3% and 0.3%.

Table II.2.6.

Seating Position

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Position 1	294	37.5	37.5	37.5
	Position 2	61	7.8	7.8	45.3
	Position 3	151	19.3	19.3	64.5
	Position 4	176	22.4	22.4	87.0
	Position 5	49	6.3	6.3	93.2
	Position 6	37	4.7	4.7	98.0
	Position 7	12	1.5	1.5	99.5
	Position 8	2	.3	.3	99.7
	Position 9	2	.3	.3	100.0
	Total	784	100.0	100.0	

Graph II.2.6.



II.2. vi. Distribution by *type of safety system used*

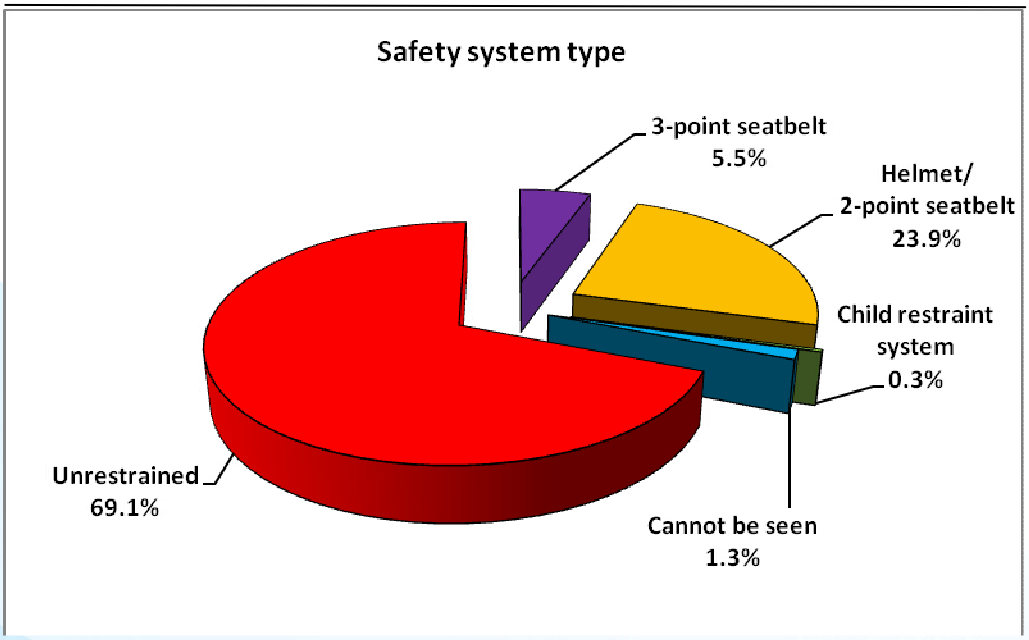
Regarding the type of safety system used, the number of passengers that travel unrestrained reaches 69.1%. Of those individuals observed, 23.9% were wearing 2-point seatbelts (for four-wheeled vehicles) or helmets (for motorcycles), while 5.5% were wearing 3-point seatbelts. Children in CRS were 0.3%. For 1.3% of cases it was not possible to determine whether they were wearing safety elements or not.

Table II.2.7.

Safety System Type

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	2-point seatbelt/ helmet	187	23.9	23.9	23.9
	3-point seatbelt	43	5.5	5.5	29.4
	Child Restraint System (CRS)	2	.3	.3	29.6
	Unrestrained	541	69.0	69.1	98.7
	Cannot be seen	10	1.3	1.3	100.0
	Total	783	99.9	100.0	
	System missing values	1	.1		
Total		784	100.0		

Graph II.2.7.



II.2. vii. Distribution by *correct or incorrect* use of the safety system

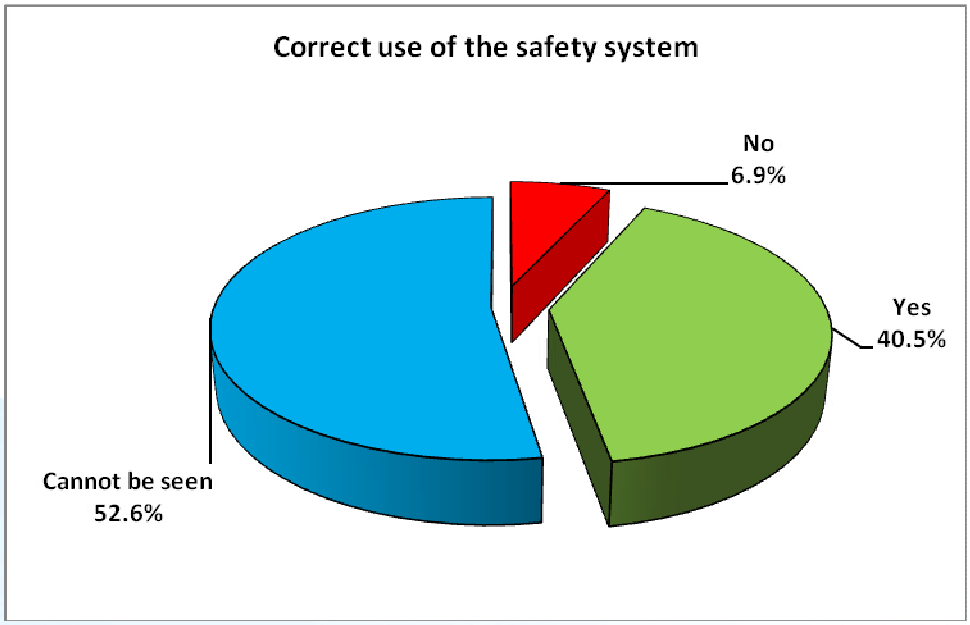
Data collected shows that 40.5% of passengers were using safety systems correctly, while 6.9% were doing so incorrectly. For 52.6% of individuals it was impossible to determine whether they were using them correctly or incorrectly.

Table II.2.8.

Correct use of safety systems

	Frecuency	Valid Percentage	Accumulated Percentage
Yes	94	40.5	40.5
No	16	6.9	47.5
Cannot be seen	122	52.6	100.0
Total	232	100.0	

Graph II.2.8.



II. 3. PAYSANDÚ

II.3. i. Distribution by *gender*

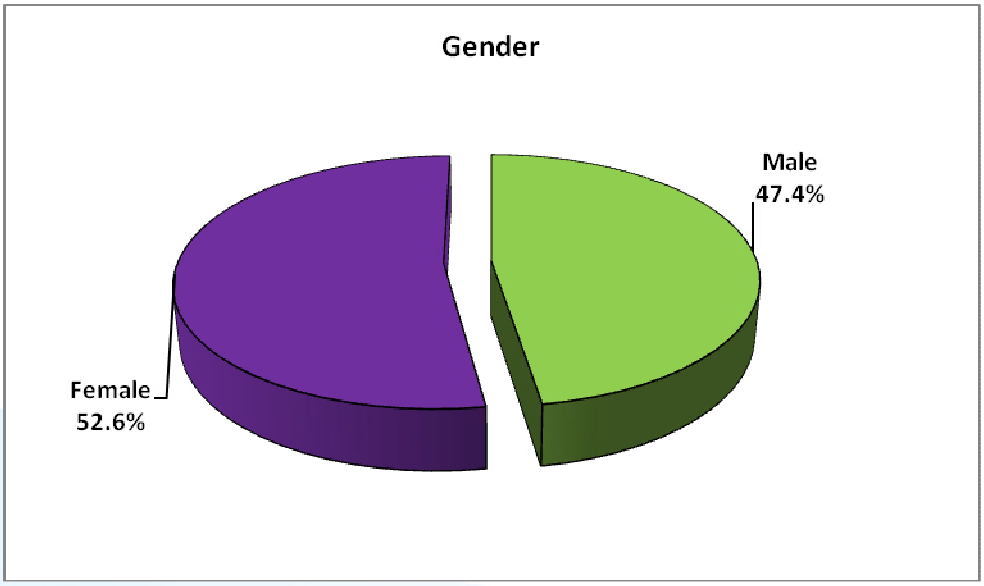
Distribution of private vehicle occupants by gender in the city of Paysandú, shows there are more women (52.6%) than men (47.4%).

Table III.3.1.

Gender

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Male	303	45.8	47.4	47.4
	Female	336	50.8	52.6	100.0
	Total	639	96.5	100.0	
	System missing values	23	3.5		
Total		662	100.0		

Graph III.3.1.



II.3. ii. Distribution by *age*

Regarding occupants' age, the percentage of individuals older than 15 years old reaches 52.9%, while the proportion of children aged 0–14 years old is 47.1%.

The most frequent age group observed was represented by those aged 25–69 years old, 49.1% of individuals. Following this category, children aged 5–14%, represented 30.3% of observations. After these, children aged 1-4 years old represented 14.5%. Passengers aged 15–24 years old reached 2.9% while children younger than 1 year old were 2.1% of the sample and adults older than 70 represented 0.9% of cases.

Table III.3.2.

Age Group

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	0 - 14 years old	309	46.7	47.1	47.1
	Older than 15 years old	347	52.4	52.9	100.0
	Total	656	99.1	100.0	
	System missing values	6	.9		
Total		662	100.0		

Graph III.3.2.

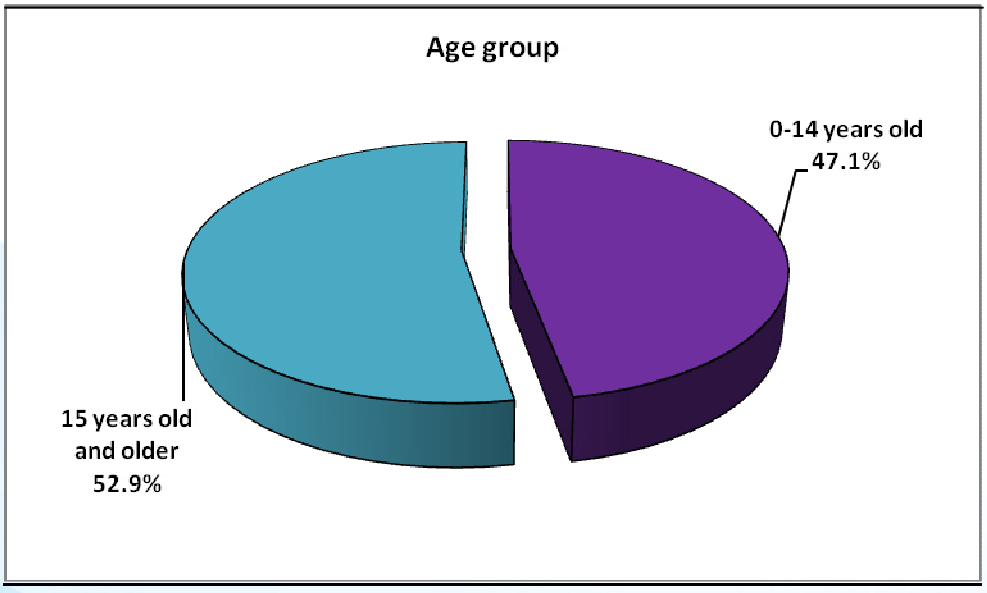
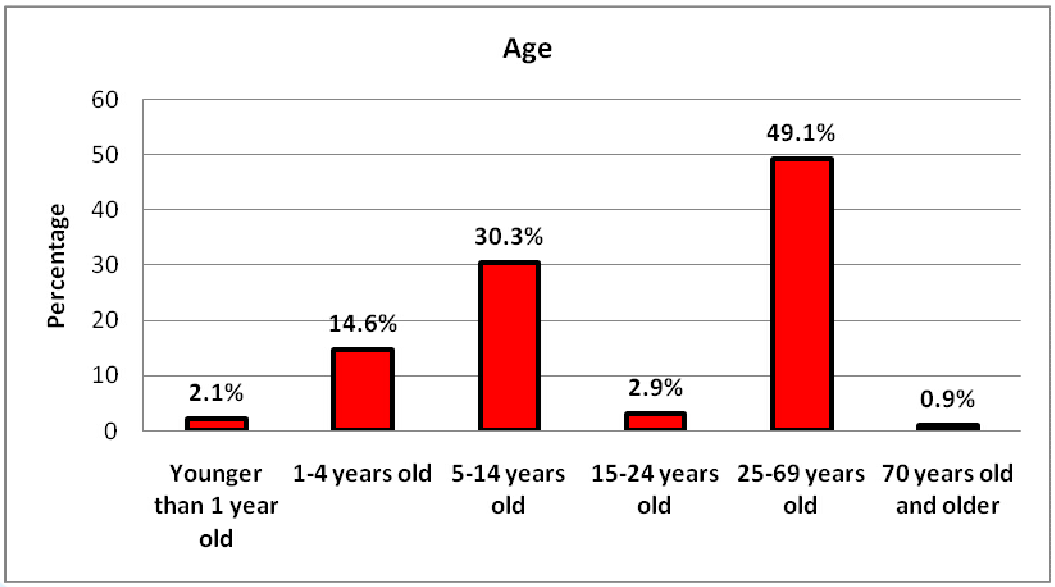


Table III.3.3.

Age

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Younger than 1 year old	14	2.1	2.1	2.1
	1 - 4 years old	96	14.5	14.6	16.8
	5 - 14 years old	199	30.1	30.3	47.1
	15 - 24 years old	19	2.9	2.9	50.0
	25 - 69 years old	322	48.6	49.1	99.1
	Older than 70 years old	6	.9	.9	100.0
	Total	656	99.1	100.0	
	System missing values	6	.9		
Total		662	100.0		

Graph III.3.3.



II.3. iii. Distribution by *vehicle type*

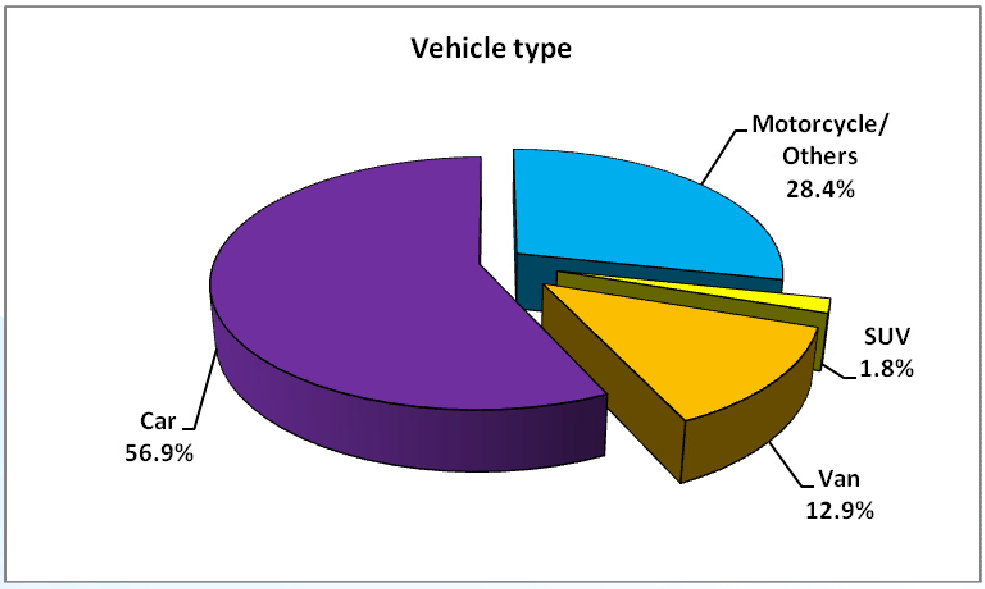
Data related to vehicle type show that 56.6% of people surveyed were traveling in cars, 12.9% in vans, and 1.8% in SUVs. For the category "motorcycles/others", basically composed by motorcycles, observations reached 28.4%.

Table III.3.4.

Vehicle Type

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Car	375	56.6	56.9	56.9
	Van	85	12.8	12.9	69.8
	SUV	12	1.8	1.8	71.6
	Motorcycle/ others	187	28.2	28.4	100.0
	Total	659	99.5	100.0	
	System missing values	3	.5		
Total		662	100.0		

Graph III.3.4.



II.3. iv. Distribution by *vehicle's age*

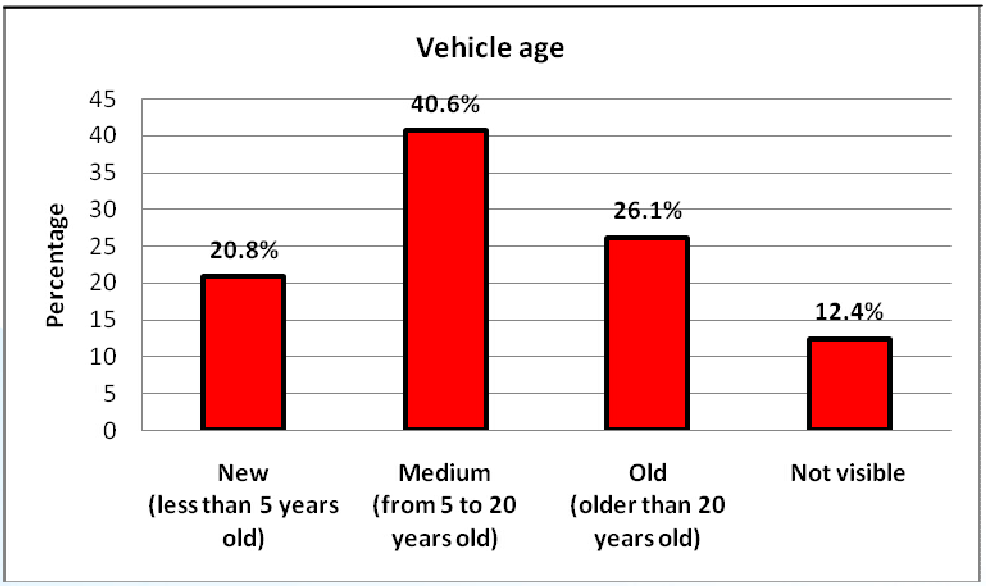
Regarding vehicle's age, 40.6% of individuals observed were traveling in 5–20 year old vehicles, while 20.8% were traveling in new vehicles and 26.1% in vehicles older than 20 years old. In 12.4% of cases it was impossible to determine the vehicle's age.

Table III.3.5.

Vehicle Age

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	New (less than 5 years old)	138	20.8	20.8	20.8
	Medium (from 5 to 20 years old)	269	40.6	40.6	61.5
	Old (more than 20 years old)	173	26.1	26.1	87.6
	Age cannot be determined	82	12.4	12.4	100.0
	Total	662	100.0	100.0	

Graph III.3.5.



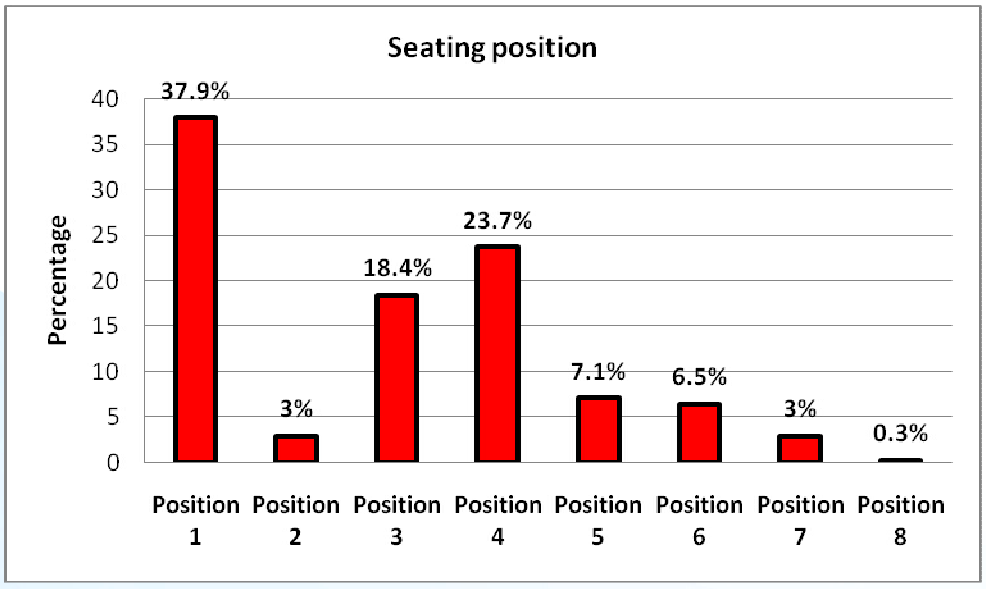
II.3. v. Distribution by *seating position* in the vehicle

Regarding seating position in the vehicle, the most frequent position is the driver's (position "1"), reaching 37.9%. Position "4" and "3" follow, respectively representing 23.7% and 18.4% of cases. Occupants in positions "5" and "6" were 7.1% and 6.5%. Position "8", on the other hand, represented 0.3%, there were no observations for position "9".

Table III.3.6.
Seating Position

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Position 1	251	37.9	37.9	37.9
	Position 2	20	3.0	3.0	40.9
	Position 3	122	18.4	18.4	59.4
	Position 4	157	23.7	23.7	83.1
	Position 5	47	7.1	7.1	90.2
	Position 6	43	6.5	6.5	96.7
	Position 7	20	3.0	3.0	99.7
	Position 8	2	.3	.3	100.0
	Total	662	100.0	100.0	

Graph III.3.6.



II.3. vi. Distribution by *type of safety system* used

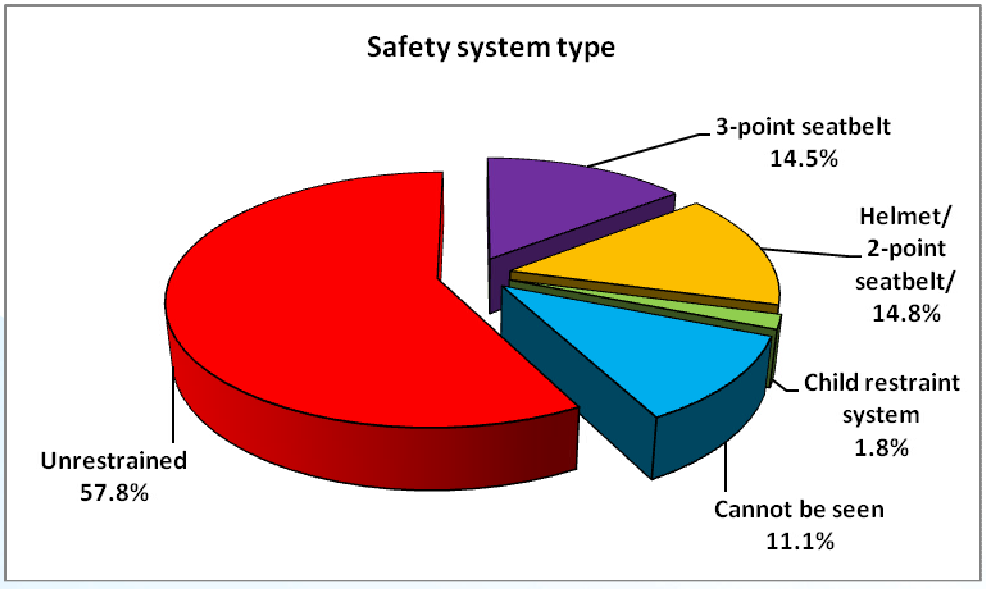
In reference to *type of safety system* used, 57.8% of occupants were unrestrained; 14.7% were wearing 3-point seatbelts, while almost the same number were doing so wearing 2-point seatbelts (for 4-wheeled vehicles) or helmets (for motorcycles). At the same time 1.8% of children were traveling in a CRS.

Table III.3.7

Safety System Type

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	2-point seatbelt/ helmet	97	14.7	14.8	14.8
	3-point seatbelt	95	14.4	14.5	29.2
	Child Restraint System (CRS)	12	1.8	1.8	31.1
	Unrestrained	380	57.4	57.8	88.9
	Cannot be seen	73	11.0	11.1	100.0
	Total	657	99.2	100.0	
	System missing values	5	.8		
Total		662	100.0		

Graph III.3.7.



II.3. vii. Distribution by *correct or incorrect* use of the safety system

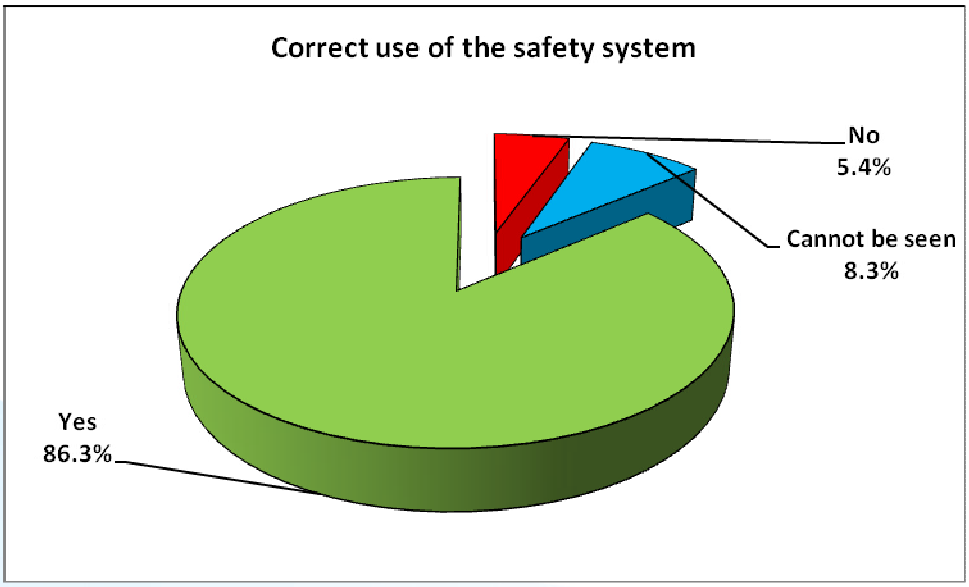
Data collected shows that 86.3% of passengers were using safety systems correctly, while 5.4% were doing so incorrectly. For 8.3% of individuals it was impossible to determine whether they were using them correctly or incorrectly.

Table III.3.8.

Correct use of safety systems

	Frecuency	Valid Percentage	Accumulated Percentage
Yes	176	86.3	86.3
No	11	5.4	91.7
Cannot be seen	17	8.3	100.0
Total	204	100.0	

Graph III.3.8.



III. CHARACTERISTICS OF CHILDREN AGED 0-14 YEARS OLD

This section will describe characteristics of children aged 0-14 years old as well as characteristics of the vehicles they were traveling in each one of the cities studied.

III. 1. MONTEVIDEO

III.1. i. Distribution by *gender*

Regarding gender, from the total children observed in Montevideo, 49.3% are boys and 45.9% are girls. It was not possible to determine children's gender in 4.9% of the cases.

Table III.1.1.

Gender

			Gender			Total
			Male	Female	Cannot be seen	Nuevo
Children	Younger than 1 year old	Count	17	14	18	49
		% of children	34.7%	28.6%	36.7%	100.0%
	1 - 4 years old	Count	98	70	8	176
		% of children	55.7%	39.8%	4.5%	100.0%
	5 - 14 years old	Count	248	254	10	512
		% of children	48.4%	49.6%	2.0%	100.0%
Total		Count	363	338	36	737
		% of children	49.3%	45.9%	4.9%	100.0%

III.1. ii. Distribution by a*ge*

Regarding these children's age, 69.5% belong to the group aged 5-14 years old and 23.9% are 1-4 years old while 6.6% of these children are younger than 1 year old.

Table III.1.2.

Age

	Frecuency	Valid percentage	Accumulated percentage
Younger than 1 year old	49	6.6	6.6
1-4 years old	176	23.9	30.5
5-14 years	512	69.5	100
	737	100	

III.1. iii. Distribution by *vehicle type*

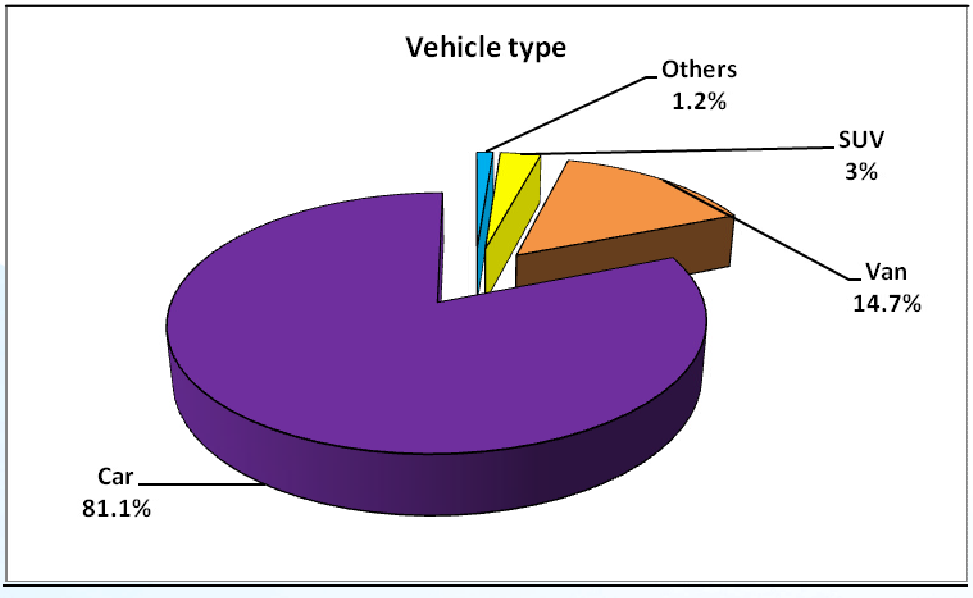
Regarding vehicle type, 81.1% were cars, 14.7% vans, 3% SUVs and 1.2% "other" Vehicle Type. These numbers agree with the data related to the whole population (see Chapter II.1) and they keep a similar proportion in the age group in which children were observed.

Table III.1.3.

Vehicle Type

			Type of vehicle.				
			Car	Van	SUV	Other	Total
Children	Younger than 1 year old	Count	38	7	3	1	49
		% of children	77.6%	14.3%	6.1%	2.0%	100.0%
	1-a 4 years old	Count	149	21	4	1	175
		% of children	85.1%	12.0%	2.3%	.6%	100.0%
	5 - 14 years old	Count	409	80	15	7	511
		% of children	80.0%	15.7%	2.9%	1.4%	100.0%
Total		Count	596	108	22	9	735
		% of children	81.1%	14.7%	3.0%	1.2%	100.0%

Graph III.1.



III.1. iv. Distribution by *vehicle age*

Concerning vehicle age, percentages related to children younger than 14 years old are very similar to the total of the observed population; half of the children 70.6% traveled in vehicles 5-20 years old, while 14.4% did so in vehicles manufactured less than 5 years ago and 15% traveled in vehicles manufactured more than two decades ago. At the same time, there is a similar proportion among the different children's age groups.

Table III.1.4.

Vehicle Age

			Vehicle Age			Total
			New	Medium	Old	Nuevo
Children	Younger than 1 year old	Count	5	37	7	49
		% of children	10.2%	75.5%	14.3%	100.0%
	1 - 4 years old	Count	30	120	25	175
		% of children	17.1%	68.6%	14.3%	100.0%
	5 - 14 years old	Count	71	361	78	510
		% of children	13.9%	70.8%	15.3%	100.0%
Total		Count	106	518	110	734
		% of children	14.4%	70.6%	15.0%	100.0%

III.1. v. Distribution by *seating position* in vehicle

In order to study the seating position in which children were traveling in the vehicle, the nine possible seating positions were grouped in two positions: one corresponding to the front seats (positions "1", "2" and "3") and the other related to back seats (positions "4", "5", "6", "7", "8" and "9"). Of those children studied, 78.1% were in the back seats, while 21.9% were traveling in the front seats. Data analysis suggests that according to age groups, the largest percentage of child passengers in the back seats was among those aged 1-4 years old: almost 89.9%. Figures for those younger than 1 year old traveling in the back seats, reached 79.6%. Regarding children aged 5-14 years old, 73.9% were traveling in the back seats.

Table III.1.5.

Seating position

			Seating position		
			Front seats	Back seats	Total
Children	Younger than 1 year old	Count	10	39	49
		% of children	20.4%	79.6%	100.0%
	1 - 4 years old	Count	18	158	176
		% of children	10.2%	89.8%	100.0%
	5 - 14 years old	Count	133	376	509
		% of children	26.1%	73.9%	100.0%
Total		Count	161	573	734
		% of children	21.9%	78.1%	100.0%

Table III.1.6.

Seating Position

			Position								
			Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Total
Children	Younger than 1 year old	Count	7	3	13	16	10	0	0	0	49
		% of children	14.3%	6.1%	26.5%	32.7%	20.4%	.0%	.0%	.0%	100.0%
	1 – 4 years old	Count	10	8	57	47	52	1	1	0	176
		% of children	5.7%	4.5%	32.4%	26.7%	29.5%	.6%	.6%	.0%	100.0%
	5-14 years old	Count	10	123	132	113	127	0	1	3	509
		% of children	20.0%	24.2%	25.9%	22.2%	25.0%	.0%	.2%	.6%	100.0%
Total		Count	27	134	202	176	189	1	2	3	734
		% of children	37.0%	18.3%	27.5%	24.0%	25.7%	.1%	.3%	.4%	100.0%

III.1. vi. Distribution by *seating position in the vehicle* according to *vehicle type*

When analyzing seating position according to vehicle type, results show that for vans and SUVs the percentage of children traveling in the front seats significantly increases reaching 36.2% and 40.9% respectively. At the same time, child passengers in cars' front seats represented 18.8% and in "other" Vehicle Type, 22.2%.

Table III.1.7.

Seating position * Vehicle Type Crosstabulation

Type of vehicle				Seating position		Total
				Front seats	Back seats	
Car		Younger than 1 year old	Count	5	33	38
			% of children	13.2%	86.8%	100.0%
		1 - 4 years old	Count	8	141	149
			% of children	5.4%	94.6%	100.0%
		5 - 14 years old	Count	99	310	409
			% of children	24.2%	75.8%	100.0%
	Total		Count	112	484	596
			% of children	18.8%	81.2%	100.0%
Van	Children	Younger than 1 year old	Count	3	4	7
			% of children	42.9%	57.1%	100.0%
		1 - 4 years old	Count	7	14	21
			% of children	33.3%	66.7%	100.0%
		5 - 14 years old	Count	28	49	77
			% of children	36.4%	63.6%	100.0%
	Total		Count	38	67	105
			% of children	36.2%	63.8%	100.0%
SUV	children	Younger than 1 year old	Count	2	1	3
			% of children	66.7%	33.3%	100.0%
		1 - 4 years old	Count	2	2	4
			% of children	50.0%	50.0%	100.0%
		5 - 14 years old	Count	5	10	15
			% of children	33.3%	66.7%	100.0%
	Total		Count	9	13	22
			% of children	40.9%	59.1%	100.0%
Other	children	Younger than 1 year old	Count	0	1	1
			% of children	.0%	100.0%	100.0%
		1 - 4 years old	Count	1	0	1
			% of children	100.0%	.0%	100.0%
		5 - 14 years old	Count	1	6	7
			% of children	14.3%	85.7%	100.0%
	Total		Count	2	7	9
			% of children	22.2%	77.8%	100.0%

III.1. vii. Distribution by *safety system type* used

Regarding safety system type used, the proportion of children traveling wearing 2-point seatbelts was practically non-existent, 0.3%. At the same time 14% of the total of children studied were wearing 3-point seatbelts and 9.8% were traveling in some kind of Child Restraint System (CRS). The percentage of children traveling unrestrained reached 75.8% of observations.

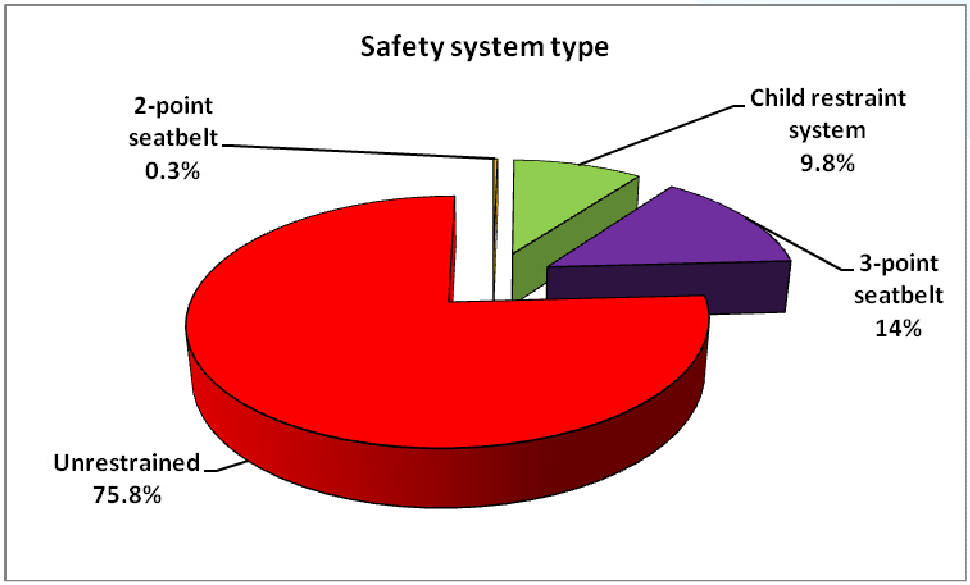
For children younger than 1 year old, figures for those traveling unrestrained decreased to 38.8%. This is mainly because one out of six children in said age group (61.2%) was observed traveling in some kind of CRS. It is important to highlight that the number of observations for children in this age group was particularly small (6.6% of the total of children aged 0 - 14 years old in the sample), this is the reason why, as mentioned in the previous paragraph and shown in Table III.1.8, when considering the total of the children population studied in Montevideo, figures for CRS use decrease to 9.8% and the proportion of children traveling unrestrained reaches 75.8%.

Table III.1.8.

Safety System Type

			Safety System Type				
			2-point seatbelt	3-point seatbelt	Child Restraint System (CRS)	Unrestrained	Total
Children	Younger than 1 year old	Count	0	0	30	19	49
		% of children	.0%	.0%	61.2%	38.8%	100.0%
	1 - 4 years old	Count	0	6	34	133	173
		% of children	.0%	3.5%	19.7%	76.9%	100.0%
	5 - 14 years old	Count	2	94	6	388	490
		% of children	.4%	19.2%	1.2%	79.2%	100.0%
Total		Count	2	100	70	540	712
		% of children	.3%	14.0%	9.8%	75.8%	100.0%

Graph III.1.2.


Safety system type
2-point seatbelt 0.3%
Child restraint system 9.8%
3-point seatbelt 14%
Unrestrained 75.8%

III.1. viii. Distribution by *correct or incorrect use of the safety system*

Data collected related to the correct use of safety systems shows that 75.4% of child passengers were using safety systems correctly, while 15.8% were doing so incorrectly. For 8.9% of individuals it was impossible to determine whether they were using them correctly or incorrectly.

Table III.1.3.

Correct Safety* System use Crosstabulation

			Correct Safety System use			
			Yes	No	Cannot be seen	Total
Children	Younger than 1 year old	Count	17	0	0	17
		% of children	100.0%	.0%	.0%	100.0%
	1 - 4 years old	Count	76	7	13	96
		% of children	79.2%	7.3%	13.5%	100.0%
	5 - 14 years old	Count	170	48	18	236
		% of children	72.0%	20.3%	7.6%	100.0%
Total		Count	263	55	31	349
		% of children	75.4%	15.8%	8.9%	100.0%

III. 2. SALTO

III.2. i. Distribution by *gender*

Regarding gender, from the total children observed in the city of Salto, 51.4% were girls and 43.4% were boys. It was not possible to determine children's gender in 5.2% of the cases.

Table III.2.1.

			Gender			
			Male	Female	Cannot be seen	Total
Children	Younger than 1 year old	Count	6	1	3	10
		% of children	60.0%	10.0%	30.0%	100.0%
	1 - 4 years old	Count	45	57	10	112
		% of children	40.2%	50.9%	8.9%	100.0%
	5 - 14 years old	Count	108	130	6	244
		% of children	44.3%	53.3%	2.5%	100.0%
Total		Count	159	188	19	366
		% of children	43.4%	51.4%	5.2%	100.0%

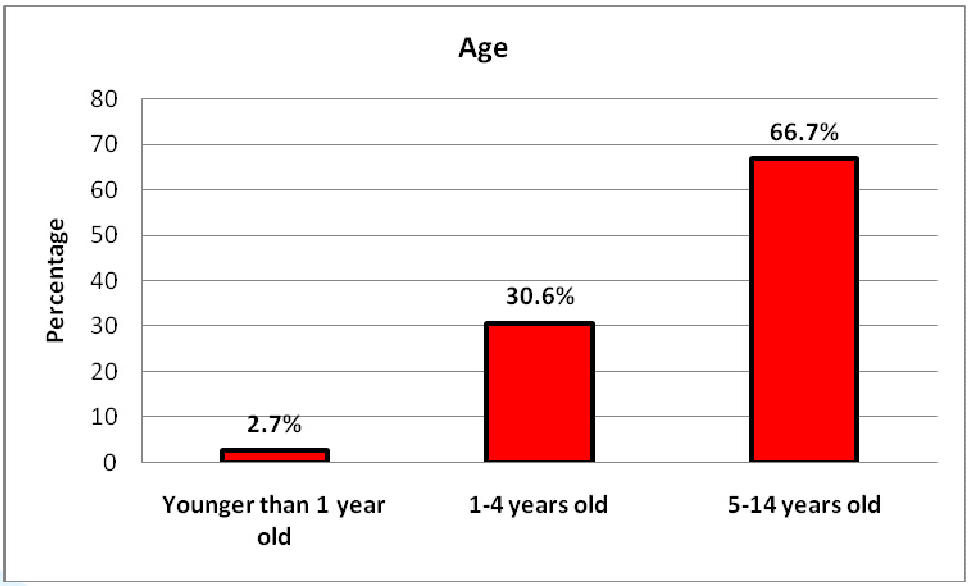
III.2. ii. Distribution by *age*

Regarding these children's age, 66.7% belong to the group aged 5-14 years old and 30.6% are 1-4 years old while 2.7% of these children are younger than 1.

Table III.2.2.

	Frequency	Valid percentage	Accumulated percentage
Younger than 1 year old	10	2.7	2.7
1 - 4 years old	112	30.6	33.3
5 - 14 years old	244	66.7	100
Total	366	100	

Graph III.2.1.



III.2. iii. Distribution by *vehicle type*

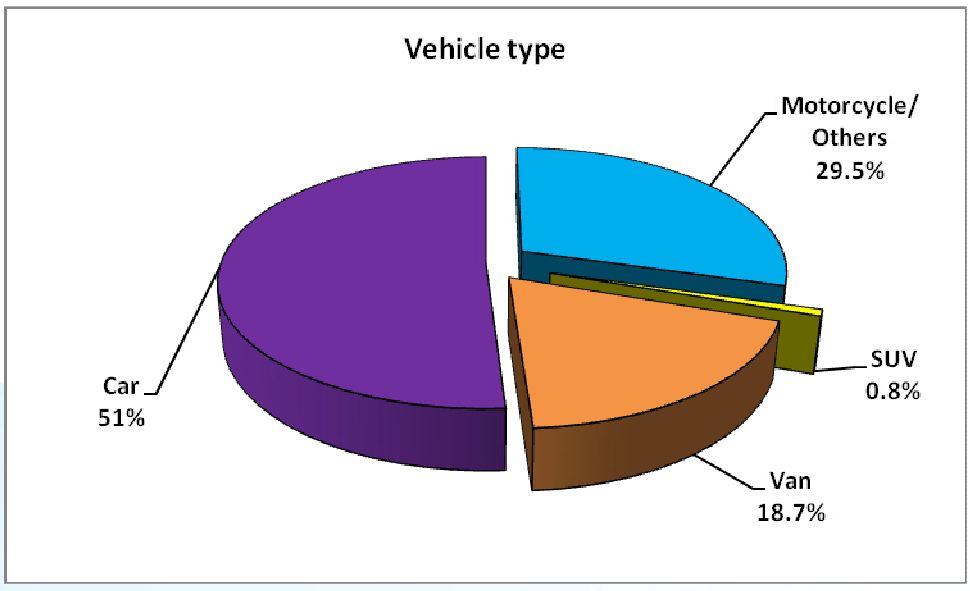
Regarding vehicle type, half of the vehicles studied (51%) were cars, 18.7% vans, 0.8% SUVs and 29.5% "motorcycle / other" Vehicle Type (mainly motorcycles).

Table III.2.3.

Type of vehicle

			Type of vehicle				
			Car	Van	SUV	Motorcycle /other	Total
Children	Younger than 1 year old	Count	6	2	0	2	10
		% of children	60.0%	20.0%	.0%	20.0%	100.0%
	1 - 4 years old	Count	53	26	1	32	112
		% of children	47.3%	23.2%	.9%	28.6%	100.0%
	5 - 14 years old	Count	126	40	2	73	241
		% of children	52.3%	16.6%	.8%	30.3%	100.0%
Total		Count	185	68	3	107	363
		% of children	51.0%	18.7%	.8%	29.5%	100.0%

Graph III.2.2.



III.2. iv. Distribution by *vehicle's age*

Concerning vehicle's age, the percentages related to children younger than 14 years old are very similar to the total of the observed population; half of the children 50.3% traveled in vehicles 5 - 20 years old, while 31.1% did so in vehicles manufactured less than 5 years ago and 18.6% traveled in vehicles manufactured more than two decades ago.

Table III.2.4.

Vehicle Age

			Vehicle Age			
			New	Medium	Old	Total
Children	Younger than 1 year old	Count	2	5	2	9
		% of children	22.2%	55.6%	22.2%	100.0%
	1 - 4 years old	Count	35	51	12	98
		% of children	35.7%	52.0%	12.2%	100.0%
	5 - 14 years old	Count	70	117	50	237
		% of children	29.5%	49.4%	21.1%	100.0%
Total		Count	107	173	64	344
		% of children	31.1%	50.3%	18.6%	100.0%

III.2. v. Distribution by *seating position* in the vehicle

Regarding seating position in the Vehicle, 68% were traveling in the back seats, while 32% were doing so in the front seats.

These figures vary according to children's age. It is important to highlight that results for children younger than 1 change dramatically, 70% of them were traveling in the front seats, while 30% were doing so in the back seats. It is important to mention, however, that the number of children in said age group is particularly small (they represent 2.7% of children studied in the city of Salto). On the other hand, 40.2% of children aged 1 - 4 years old were traveling in the front seats, and 59.8% were traveling in the back seats. Thirdly, the largest percentage of child passengers in back seats was registered among those aged 5 - 14 years old, more than 73.4%.

Table III.2.5.

Seating position

			Seating position		
			Front seats	Back seats	Total
Children	Younger than 1 year old	Count	7	3	10
		% of children	70.0%	30.0%	100.0%
	1 - 4 years old	Count	45	67	112
		% of children	40.2%	59.8%	100.0%
	5 - 14 years old	Count	65	179	244
		% of children	26.6%	73.4%	100.0%
Total		Count	117	249	366
		% of children	32.0%	68.0%	100.0%

Table III.2.6.

			Position								
			Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Total
children	Younger than 1 year old	Count	7	0	3	0	0	0	0	0	10
		% of children	70.0%	.0%	30.0%	.0%	.0%	.0%	.0%	.0%	100.0%
	1 – 4 years old	Count	33	12	43	11	7	4	1	1	112
		% of children	29.5%	10.7%	38.4%	9.8%	6.3%	3.6%	.9%	.9%	100.0%
	5-14 years old	Count	17	48	118	35	23	1	1	1	244
		% of children	7.0%	19.7%	48.4%	14.3%	9.4%	.4%	.4%	.4%	100.0%
Total		Count	57	60	164	46	30	5	2	2	366
		% of children	15.6%	16.4%	44.8%	12.6%	8.2%	1.4%	.5%	.5%	100.0%

III.2. vi. *Distribution by seating position in the vehicle according to vehicle type*

When analyzing seating position according to vehicle type, results show that in the case of vans the same proportion of children was traveling in the front seats and in the back seats, 50%. Regarding cars, 42.7% were traveling in the front seats while 57.3% were doing so in the back seats. For SUVs, 66.7% of child passengers were traveling in the back while 33.3% were traveling in the front seats. At the same time, child passengers in "motorcycle/other" category (mainly motorcycles), reached 97.2% for the back seats.

Table III.2.7.

Seating position * Type of vehicle Crosstabulation

Type of vehicle				Seating position: Front seats	Seating position: Back seats	Total
Car	children	Younger than 1 year old	Count	4	2	6
			% of children	66.7%	33.3%	100.0%
		1 - 4 years old	Count	30	23	53
			% of children	56.6%	43.4%	100.0%
		5 - 14 years old	Count	45	81	126
			% of children	35.7%	64.3%	100.0%
	Total		Count	79	106	185
			% of children	42.7%	57.3%	100.0%
Van	children	Younger than 1 year old	Count	2	0	2
			% of children	100.0%	.0%	100.0%
		1 - 4 years old	Count	12	14	26
			% of children	46.2%	53.8%	100.0%
		5 - 14 years old	Count	20	20	40
			% of children	50.0%	50.0%	100.0%
	Total		Count	34	34	68
			% of children	50.0%	50.0%	100.0%
SUV	Children	1 - 4 years old	Count	1	0	1
			% of children	100.0%	.0%	100.0%
		5 - 14 years old	Count	0	2	2
			% of children	.0%	100.0%	100.0%
	Total		Count	1	2	3
			% of children	33.3%	66.7%	100.0%
Motorcycle/Other	children	Younger than 1 year old	Count	1	1	2
			% of children	50.0%	50.0%	100.0%
		1 - 4 years old	Count	2	30	32
			% of children	6.3%	93.8%	100.0%
		5 - 14 years old	Count	0	73	73
			% of children	.0%	100.0%	100.0%
	Total		Count	3	104	107
			% of children	2.8%	97.2%	100.0%

III.2. vii. Distribution by *safety system* used

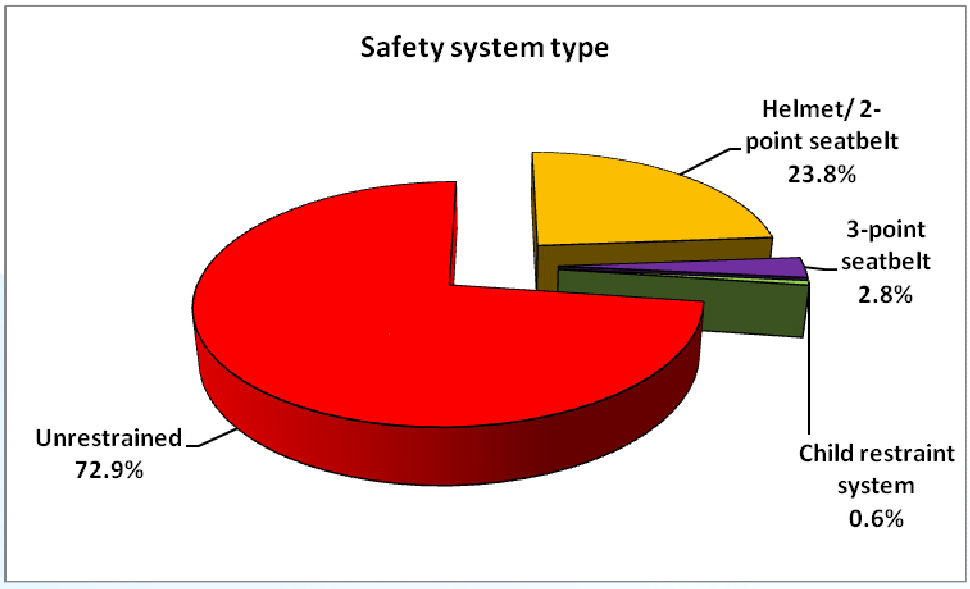
Regarding safety system type used, 23.8% of children studied were wearing a helmet (for those traveling on a motorcycle) or were wearing 2-point seatbelts (for 4-wheel vehicles), while 2.8% were wearing 3-point seatbelts. Also, the number of children traveling in some kind of Child Restraint System (CRS) reached 0.6%. The percentage of children traveling unrestrained was 72.9% of observations.

Table III.2.8.

Safety System Type

			Safety System Type				
			2-point seatbelt/helmet	3-point seatbelt	Child Restraint System (CRS)	Unrestrained	Total
children	Younger than 1 year old	Count	0	0	1	8	9
		% of children	.0%	.0%	11.1%	88.9%	100.0%
	1 - 4 years old	Count	22	0	1	89	112
		% of children	19.6%	.0%	.9%	79.5%	100.0%
	5 - 14 years old	Count	64	10	0	166	240
		% of children	26.7%	4.2%	.0%	69.2%	100.0%
Total		Count	86	10	2	263	361
		% of children	23.8%	2.8%	.6%	72.9%	100.0%

Graph III.2.3.



III.2. viii. Distribution by *correct or incorrect use* of the safety system

Data collected on the correct use of safety systems shows that 38.8% of children were using safety systems correctly, while 6.1% were doing so incorrectly. For 54.1% of individuals it was impossible to determine whether they were using them correctly or incorrectly.

Table III.2.9.

			Correct use of safety systems			
			Yes	No	Cannot be seen	Total
Children	Younger than 1 year old	Count	1	0	0	1
		% of children	100.0%	.0%	.0%	100.0%
	1 - 4 years old	Count	8	3	12	23
		% of children	34.8%	13.0%	52.2%	100.0%
	5 - 14 years old	Count	30	3	41	74
		% of children	40.5%	4.1%	55.4%	100.0%
Total		Count	39	6	53	98
		% of children	39.8%	6.1%	54.1%	100.0%

III. 3. PAYSANDÚ

III.3. i. Distribution by *gender*

Concerning distribution by gender in Paysandú, there is a 48.9% of boys and a 45.3% of girls. There were 5.8% of children whose gender could not be identified.

Table III.3.1.
Gender

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	Male	151	48.9	48.9	48.9
	Female	140	45.3	45.3	94.2
	Cannot be identified	18	5.8	5.8	100.0
	Total	309	100.0	100.0	

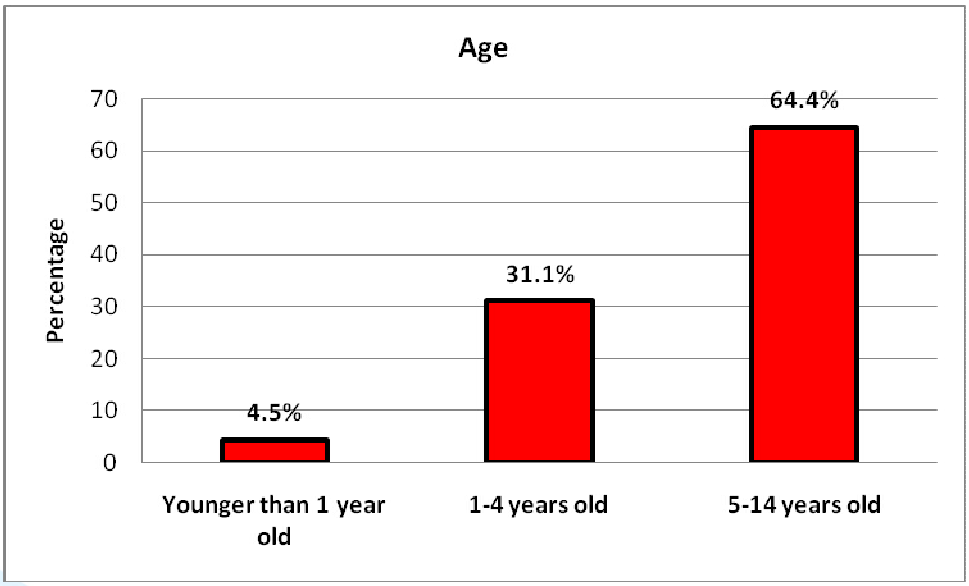
III.3. ii. Distribution by *age*

A 4.5% of these children were younger than 1 year old, 31.1% were between 1 and 4 years old and 64.5% belonged to the group of children aged 5-14 years old.

Table III.3.2.

	Frequency	Valid percentage	Accumulated percentage
Younger than 1 year old	14	4.5	4.5
1-4 years old	96	31.1	35.6
5 - 14 years old	199	64.4	100
Total	309	100	

Graph III.3.1.



III.3. iii. Distribution by *vehicle type*

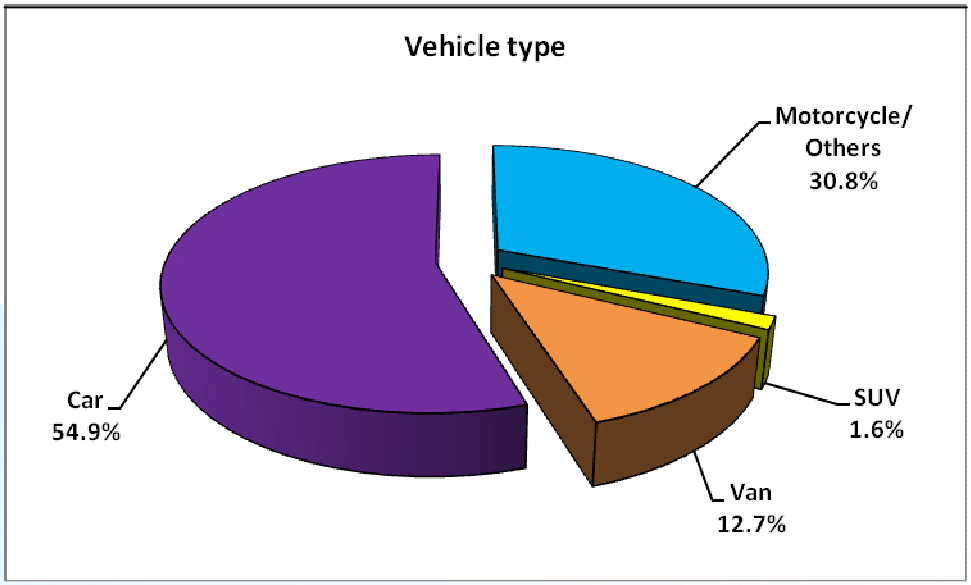
Regarding vehicle type, 54.9% traveled by car, 12.7% traveled by van and 1.6% traveled in SUVs and 30.8% did so in "motorcycle/others" (mainly motorcycles).

Table III.3.3.

Vehicle Type

			Vehicle Type				
			Car	Van	SUV	Motorcycle /Other	Total
Children	Younger than 1 year old	Count	6	2	1	5	14
		% of children	42.9%	14.3%	7.1%	35.7%	100.0%
	1 - 4 years old	Count	54	8	1	33	96
		% of children	56.3%	8.3%	1.0%	34.4%	100.0%
	5 - 14 years old	Count	109	29	3	57	198
		% of children	55.1%	14.6%	1.5%	28.8%	100.0%
Total		Count	169	39	5	95	308
		% of children	54.9%	12.7%	1.6%	30.8%	100.0%

Graph III.3.2.



III.3. iv. Distribution by *vehicle's age*

Regarding vehicle's age, 38.8% traveled in vehicles manufactured between 5 and 20 years ago, 21.7% traveled in new vehicles and 26.5% traveled in vehicles manufactured more than 20 years ago. It was not possible to distinguish the vehicle's age of those in which 12.9% of observed children traveled.

Table III.3.4.

Vehicle Age

			Vehicle Age				
			New(less than 5 years old)	Medium (from 5 to 20 years old)	Old (more than 20 years old)	Age cannot be determined	Total
children	Younger than 1 year old	Count	2	8	3	1	14
		% of children	14.3%	57.1%	21.4%	7.1%	100.0%
	1 - 4 years old	Count	29	32	26	9	96
		% of children	30.2%	33.3%	27.1%	9.4%	100.0%
	5 - 14 years old	Count	36	80	53	30	199
		% of children	18.1%	40.2%	26.6%	15.1%	100.0%
Total		Count	67	120	82	40	309
		% of children	21.7%	38.8%	26.5%	12.9%	100.0%

III.3. v. Distribution by *seating position* in the vehicle

Regarding seating position in the vehicle, 78.3% of children were traveling in the back seats of the Vehicle, while 21.7% were doing so in the front seats.

When classifying data by age groups, it is observed that children aged 1 – 4 years old represent the largest proportion of individuals traveling in the back seats. Following passengers aged 5 – 14 years old represented 74.9% of the total. On the other hand children younger than 1 year old represent the largest proportion, 35.7%, on the front seats

Table III.3.5.

Seating position

			Seating position		
			Front seats	Back seats	Total
Children	Younger than 1 year old	Count	5	9	14
		% of children	35.7%	64.3%	100.0%
	1 - 4 years old	Count	12	84	96
		% of children	12.5%	87.5%	100.0%
	5 - 14 years old	Count	50	149	199
		% of children	25.1%	74.9%	100.0%
Total		Count	67	242	309
		% of children	21.7%	78.3%	100.0%

Table III.3.6.

			Position							
			Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Total
children	Younger than 1 year old	Count	5	0	7	2	0	0	0	14
		% of children	35.7%	.0%	50.0%	14.3%	.0%	.0%	.0%	100.0%
	1 – 4 years old	Count	7	5	58	14	11	0	1	96
		% of children	7.3%	5.2%	60.4%	14.6%	11.5%	.0%	1.0%	100.0%
	5-14 years old	Count	7	43	79	30	227	12	1	199
		% of children	3.5%	21.6%	39.7%	15.1%	13.6%	6.0%	.5%	100.0%
Total		Count	19	48	144	46	38	12	2	309
		% of children	6.1%	15.5%	46.6%	14.9%	12.3%	3.9%	.6%	100.0%

III.3. vi. Distribution by *seating position* in the vehicle according to *vehicle type*

When differentiating by seating position in the vehicle according to Vehicle Type, a similar proportion of children traveling in the front seats and in the back seats was observed: 48.7% and 51.3% respectively. Regarding children traveling in cars, 25.4% were traveling in the front seats; while 74.6% were doing so in the rear seats. Regarding SUVs, 80% of child passengers were traveling in the front seat, while 20% were traveling in the rear seats. At the same time child passengers in the category "motorcycle/other" (mainly motorcycles), 98.9% of them were traveling in the back seats.

Table III.3.7.

Seating position* Vehicle Type Crosstabulation

Type of vehicle				Seating position: Front seats	Seating position: Back seats	Total
Car	children	Younger than 1 year old	Count	3	3	6
			% of children	50.0%	50.0%	100.0%
		1 - 4 years old	Count	6	48	54
			% of children	11.1%	88.9%	100.0%
		5 - 14 years old	Count	34	75	109
			% of children	31.2%	68.8%	100.0%
	Total		Count	43	126	169
			% of children	25.4%	74.6%	100.0%
Vans	children	Younger than 1 year old	Count	1	1	2
			% of children	50.0%	50.0%	100.0%
		1 - 4 years old	Count	5	3	8
			% of children	62.5%	37.5%	100.0%
		5 - 14 years old	Count	13	16	29
			% of children	44.8%	55.2%	100.0%
	Total		Count	19	20	39
			% of children	48.7	51.3%	100.0%
SUV	children	Younger than 1 year old	Count	1	0	1
			% of children	100.0%	.0%	100.0%
		1 - 4 years old	Count	1	0	1
			% of children	100.0%	.0%	100.0%
		5 - 14 years old	Count	2	1	3
			% of children	66.7%	33.3%	100.0%
	Total		Count	4	1	5
			% of children	80.0%	20.0%	100.0%
Motorcycle /Others	children	Younger than 1 year old	Count	0	5	5
			% of children	.0%	100.0%	100.0%
		1 - 4 years old	Count	0	33	33
			% of children	.0%	100.0%	100.0%
		5 - 14 years old	Count	1	56	57
			% of children	1.8%	98.2%	100.0%
	Total		Count	1	94	95
			% of children	1.1%	98.9%	100.0%

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III.3. vii. Distribution by *type of safety system* used

Regarding the type of safety system used, 15.9% of children studied were wearing a Helmet (for those traveling on motorcycles) or 2-point seatbelts for 4-wheeled vehicles, while 4.9% were wearing 3-point seatbelts.

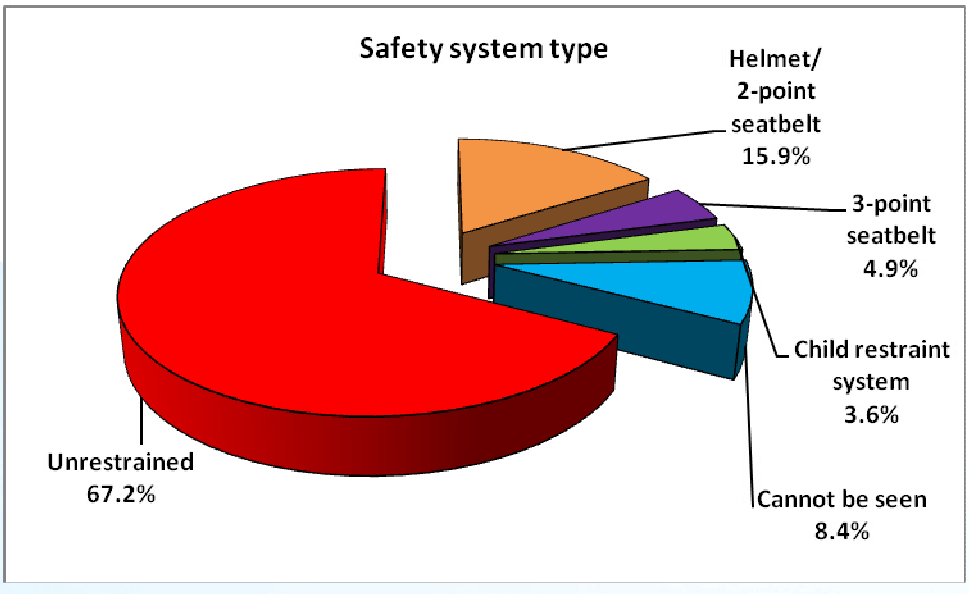
At the same time, 3.6% of children were doing so in a CRS, while 67.2% were traveling unrestrained. In 8.4% of cases it was impossible to identify if they were traveling in a CRS.

Table III.3.8.

Type of safety system

			Type of safety system					
			2-point seatbelt/helmet	3-point seatbelt	Child Restraint System (CRS)	Unrestrained	Cannot be seen	Total
Children	Younger than 1 year old	Count	0	0	2	10	2	14
		%	.0%	.0%	14.3%	71.4%	14.3%	100.0%
	1-4 years old	Count	19	1	9	60	7	96
		%	19.8%	1.0%	9.4%	62.5%	7.3%	100.0%
	5-14 years old	Count	30	14	0	137	17	198
		%	15.2%	7.1%	.0%	69.2%	8.6%	100.0%
Total		Count	49	15	11	207	26	308
		%	15.9%	4.9%	3.6%	67.2%	8.4%	100.0%

Graph III.3.8.



III.3. viii. Distribution by *correct or incorrect use* of the safety system

Data collected on the correct use of safety systems shows that 82.7% of passengers aged 0 - 14 years old were using safety systems correctly, while 9.3% were doing so incorrectly. For 8% of individuals it was impossible to determine whether they were using them correctly or incorrectly.

Table III.2.8.

			Correct use of safety system			Total
			Yes	No	Cannot be seen	
Children	Younger than 1 year old	Count	0	2	0	2
		% of children	0.0%	100.0%	0.0%	100.0%
	1-4 years old	Count	22	4	3	29
		% of children	75.9%	13.8%	10.3%	100.0%
	5-14 years old	Count	40	1	3	44
		% of children	90.9%	2.3%	6.8%	100.0%
Total		Count	62	7	6	75
		% of children	82.7%	9.3%	8.0%	100.0%

IV. CONCLUSIONS

As from the information presented in this report the following conclusions can be drawn:

In the city of Montevideo the study only included 4-wheeled vehicles, not motorcycles. Although eight out of ten children In Montevideo (78.1%) aged 0 – 14 years old were traveling in the back seats, almost the same proportion of children (75.8%) were traveling unrestrained, without wearing seatbelts or without a CRS. At the same time 9.8% of children observed were traveling in CRS, what means that the remaining 90.5% were not using said systems.

Based on comments and remarks made by Medicine students who took part in the study, it is important to mention the difference between "central" areas and "peripheral" areas (these areas showed other means of transport used to transport children such as buses, motorcycles, and horse-drawn carriages). In the same way there were obvious differences between observations in the cities of Salto and Paysandú, where motorcycles were included in the study and Montevideo where this means of transport was not considered. In Salto, 70.5% of children observed were traveling in cars, vans and SUVs, while the remaining 29.5% were doing so in "other" vehicles, mainly on motorcycles. Of children included in the study, 99.2% were not traveling in any CRS.

In Paysandú, 68.8% of children observed were traveling in 4-wheeled motor vehicles, cars, vans and SUVs, while 30.8% were traveling on motorcycle. The percentage of children traveling unrestrained reached 94.8%.

As a conclusion, in the three cities studied the most frequent situation among children aged 0- 14 years old, was the absence of safety systems us among children aged 0 – 14 years old. In addition to this, a large percentage of incorrect age-height usage of child restraint systems was observed. Students highlighted the fact that even when children traveling in the observed vehicles were doing so in the back seats, they were unrestrained and going as "packages". In order to change this reality, it is important to raise awareness of those directly involved (children and adults) and at the same time take into account the high costs of purchasing elements for children safety.

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VI. GLOSSARY

Top Tether: An anchor point in the vehicle to which the CRS is secured, used as a frontal anti-rotation device. It dramatically improves protection performance of CRS in the event of a crash, even when incorrectly attached or installed.

Booster: A firm seating platform that improves belt fit in order to avoid injuries. Seatbelts and other safety systems are designed for occupants of at least 1.40m tall.

2-point seatbelt: Seatbelt with 2 anchorage points secured to the vehicle's structure. It only restrains the occupant's pelvis.

3-point seatbelt: Seatbelt with 3 anchorage points secured to the vehicle's structure. It restrains the occupant's pelvis and trunk. One of its sections is held flat across the passenger's shoulders, and across the pelvis.

Technical Standard: Document that establishes requirements to be met by a device or element to maximize possibilities of best performance under specific circumstances. In the case of seatbelts, a Technical Standard indicates that a seatbelt shows high probabilities (within specific safety levels) of keeping the occupant safe. The standard contains test protocols to be used and a minimum expected result for the element to be accepted.

CRS: Child Restraint System. Devices designed to safely restrain children to the vehicle, aiming at reducing injuries. The seatbelt is not a CRS; examples of CRS are child seats, boosters and related systems.

VII. METHODOLOGICAL ANNEXE

I. DEFINITION OF SAMPLING FRAME

I.1. Sampling Units

For Montevideo: Primary Units – valid quadrants of the city map[2], monitored street corners within these quadrants.

Secondary Units – circulating vehicles mentioned.

For Salto and Paysandú: Primary Units – valid quadrants for the maps of each of these cities. *Secondary Units* – circulating vehicles mentioned.

I.2. Analysis Units

For Montevideo: vehicles and their occupants

For Salto and Paysandú: vehicles and their occupants

I.3. Observation Units

For Montevideo: valid quadrants of the city map, monitored street corners within these quadrants, circulating vehicles mentioned.

For Salto and Paysandú: valid quadrants for the maps of each of these cities, circulating vehicles mentioned.

I.4. Steps for the definition of the sampling frame

For Montevideo

i) Map of the city of Montevideo Province, with quadrants

ii) List of urban areas in Montevideo, previous pre-selection of quadrants in the province map. An aleatory selection of abscissas and ordinates for those quadrants was attempted, which resulted in a

[2] Map of the province of Montevideo, published by ANCAP (2007).

complex and inefficient method that would have proved to be expensive in terms of transport to check which places effectively had monitored crossings.

iii) List of monitored crossings in the selected quadrants.

iv) Visual inspection of crossings that may not be useful in the selected quadrants.

v) List of population data on Area Centers (CCZ) in Montevideo according to Census Phase I 2004 carried out by the National Statistics Institute (INE) (latest available data). It was decided to include the largest population proportion according to population density in each CCZ (those with the smallest density were excluded, mainly due to the difficulty of assigning observers to areas with a very small vehicle flow, especially taking into account the number of children that travel in each vehicle subject to study). Because of this, CCZ 18 was excluded from the selection and so were CCZ 12 and 17 (partially).

For Salto and Paysandú

1. Map of the capital cities of Salto and Paysandú, with quadrants designed a posteriori, scale 1:10000
2. Aleatory selection of abscissas and ordinates of quadrants from maps mentioned. For these two cities the procedure worked all right.
3. Visual inspection of crossing that may not be useful in selected quadrants.
4. Population data: data was collected from Census Phase I 2004 for each city. Only valid quadrants in the census areas were considered.

I.5. Variables

It is important to mention that estimated values were based on observations carried out at a certain distance, observing vehicles parked or traveling at a slow speed in the corresponding crossing. In order to determine age and gender variables, medical students made a difference, because of their studies on pediatrics at the University, it was much easier for them to identify characteristics like gender and age.

- Data on vehicle: type and estimated age
- Data on occupants
  - Estimated Age
  - Gender
  - Safety System Type (SS) used at the moment of the survey
  - Correct use of SS: this variable was studied taking into account principles exposed in the Observational Study Manuals ([14]).

II. FACTOR ANALYSIS TECHNIQUES APPLIED TO SAMPLES OBSERVED

II.1. Short introduction to data Factor Analysis

Descriptive technique of the multivariate analysis of data whose principles are:

1. to eliminate redundant information, obtaining new variables (factors) that describe the information provided by the scatter diagram without being redundant, or in other words that are uncorrelated
2. to simplify the information of the scatter diagram, especially from the graphic point of view. This simplification needs to be made taking into account the smallest possible loss of information.
3. to differentiate observed individuals in the best possible way

In all cases, there is a change from qualitative variables with correlations different from zero among their categories, to numerical variables that are a linear combination of the previous and independent among them that will help to find hidden relations among data.

As an example, we can consider three variables shared by all people, such as age, weight and height. These last two can be merged into one, called Body Mass Index (BMI), showed in the formula:

IMC = Weight in Kgs/(Height in mts)2

This provides a figure that combines the other two, with a minimal loss of information. The concept in the factor analysis is similar, but numerical variables (factors) are obtained through tools provided by matrix algebra, and will be linear combinations of the original variables, that will minimize the amount of information lost through maximization of the inertia of the scatter diagram[3].

[3] Inertia is, broadly speaking, the dispersion of the elements in the diagram in the hyperspace, or in other words, the information contained in the scattered diagram. Maximizing this value when projecting the different diagrams on the new axes is the same as trying to minimize deformation of said diagram in order not to alter the quality and quantity of the information contained.

On the other hand, it is important to mention that this technique is not inferential: data used represents itself, thus it is important to take into account that the analysis should be done individually, to be later compared and to establish similarities or differences between them.

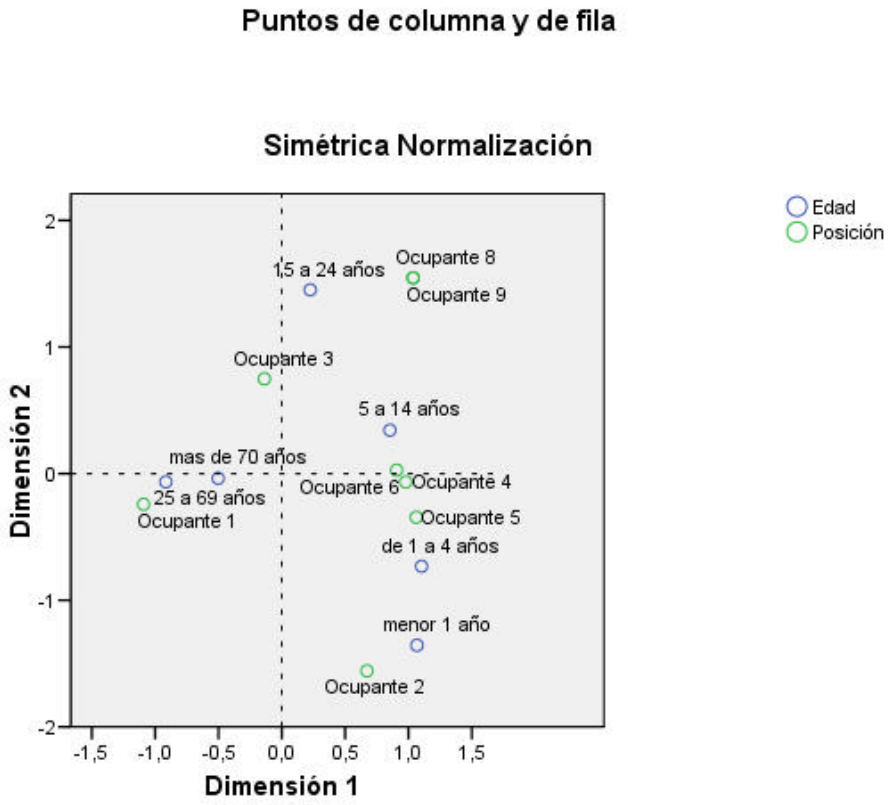
For a more in depth study of the multivariate technique, please see the Methodological Annexe, at the end of this paper.

II. 2. Simple Correspondence Analysis (ACS)

Montevideo: the significant negative correlation between Age and Seating Position in the Vehicle (-,713) is clearly shown in the Simple Correspondence ; the driver is older than 25 years old, while children aged 1 – 14 years old tend to be in rear positions (4,5 and 6). Passengers 2, 8 and 9 are not well represented in this first factor plane as well as passengers 15 -24 years old, and to a lesser point, younger children.

The association between position 2 and children younger than 1 year old may be due to the fact that from all the children between these ages (49) almost 37% were not only traveling unrestrained but in the passenger's arms in the front seat, this position was entered as number two.

Adults follow rules that determine that children should travel in the back seats, but for the youngest, it is still common for them to travel in the passenger's arms in the front seat, something extremely dangerous in case of a sudden impact. On the other hand, relationship between Age and Vehicle Type, categories Van and New are very close to each other with good levels of representation especially of axis 1, which can be clearly considered as the Age axis, measured in increasing order from right to left. At the same time, categories Car, Old and Medium are close to each other, showing the prevalence of cars older than 5 years old.



Montevideo - ACS Seating position vs. Age 1

Paysandú and Salto: in both cases relations among variables are not very clear, although the graphic representation may provide some information, the correlation among values in the different dimensions is rather high, which does not specify whether the situation illustrated in the graph happened by chance or due to underlying relations among modalities of the variables studied.

II. 3. Multiple Correspondence Analysis (ACM)

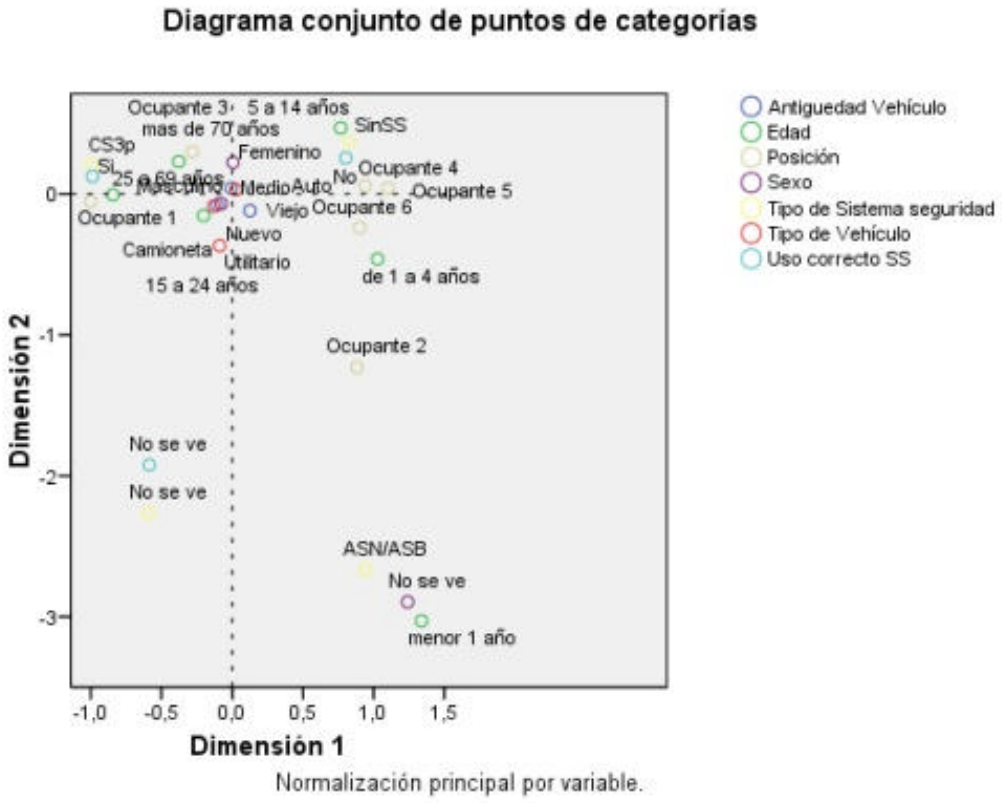
Montevideo: since rare modalities considerably influence results, it is advisable to remove those observations falling into one of these modalities. These are for Montevideo: Vehicle Type: other and missing data; Age: missing data, Seating Position: 8 and 9; SS Type: 2-point seatbelt (CS2p) and 99.

→ *Results - Plane (1,2):* axis one separated passengers in the front seats from passengers in the rear seating positions. The graph shows on its left side an overlapping of categories 3-point seatbelt (CS3p), correct use yes, occupant 1 and 25 – 69 years old, very similar to cases in Salto and Paysandú, categories 3 and older than 70 years old are closer those previously mentioned.

This clearly opposes the grouping of categories with barycenters for categories 1 - 4 and 5 - 14 years old, without SS, Correct Use No and Occupants 4, 5 and 6. Again, there is an important association between positions and ages, something that, although insufficient, is important to know since those traveling with children in 4-wheeled vehicles are aware of the importance of them doing so in the back seats. On the other hand, it is important to highlight the association in the lower part of the graph of ASN/ASB (child restraint system) with children younger than 1 old and Gender Not visible, recurrent value when observing very young children.

→ *Results - Plane (1,3):* discrimination by variable is almost the same as in the first factor plane, the difference is in the clusters, especially for younger children and use associated to CRS: these are at the top of the graph, unlike the previous case.

As a conclusion, differentiation by axes 1 and 2 on the one hand and 1 and 3 on the other seem to reinforce interpretation for each case: adults in the front seats in CS3p clearly differentiate from children aged 14 years old and younger in the back seats “unrestrained”. The exception is represented by babies younger than one year old that were traveling in CRS at the moment of study; this seems to reinforce the idea that although the situation of younger children is not the most appropriate, within the 0 – 14 year old group they are in a better position regarding passive safety systems in the vehicle. At the same time this reinforces what was observed in ACS of variables Seating Position and Age, where there is a clear difference between drivers and those older than 25 years old, and people younger than 15 years old traveling in the rear seats.



Montevideo - ACM 1

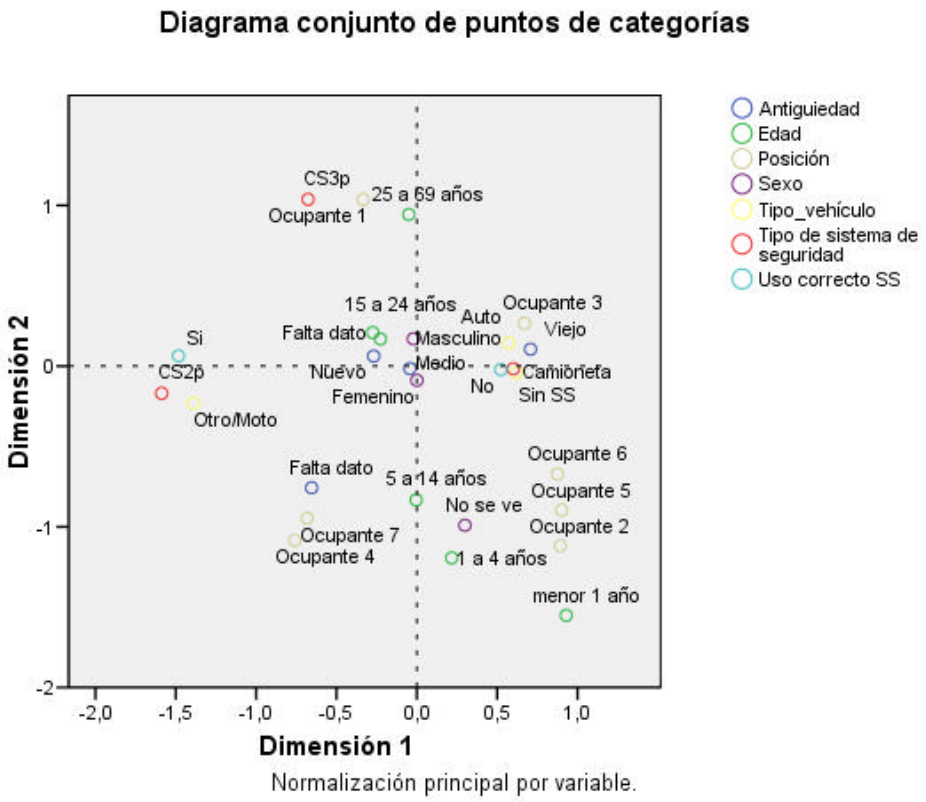
Salto: removed rare modalities were: Vehicle Type: 3-SUV and 99- Missing Data hardly represent 0.9% and 0.5% respectively; Seating Position: occupants 8 and 9 only represent 0.3% of the variable; Age: those older than 70 years old can be excluded since they represent 0.6% [age=younger than 1 year old will remain in the study for being an important modality for this particular case, although it only represents 1.3% of the total cases]; SS Type modality and Correct Use: modality missing data was removed in both cases.

→ *Results - Plane (1,2):* axis 2 clearly differentiates by ages in increasing order, while axis 1 identifies vehicle type, type of safety system used and its correct use. In the first case, unlike 25 – 69 year-old adults, using CS3p and traveling in position 1, children younger than 14 years old are close to positions 2, 4, 5, 6 and 7. For the second case (that is axis 1) there seems to be an

association between the correct use of the helmet for those riding motorcycles and the non-use or even incorrect use of other safety elements by those traveling in cars and vans.

To sum up, the seating position and the passenger's age determine the level of safety observed. Another aspect observed is the better use of safety elements by those riding motorcycles (helmet) than those traveling in 4-wheel motor vehicles. This may be related to possible enforcement policies from the part of the Municipality of Salto prioritizing the use of helmets over seatbelts. Only two CRS were found in this sample, the correct use of these elements is thus in doubt. However, children tend to be on the opposite side of the correct use area in the graph, on the upper part of the graph.

Results - Plane (1,3): discrimination is similar to the plane formed by axes 1 and 2, but interpretation of this plane is a little bit more vague.



Salto - ACM 1

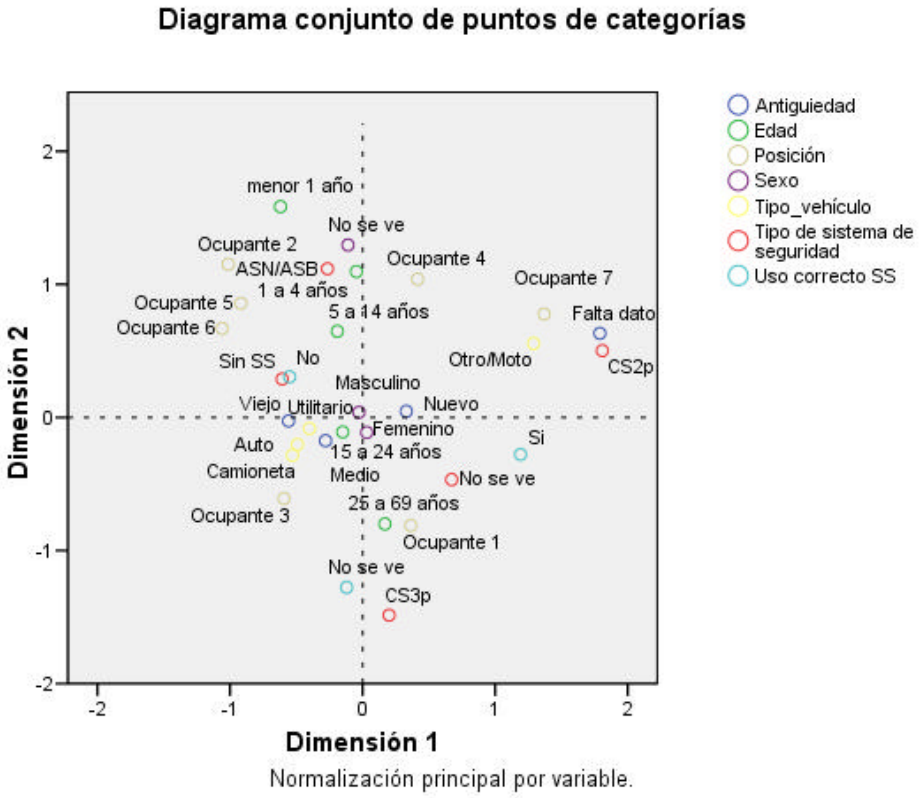
Paysandú: modalities removed were: Vehicle Type: Data missing; Age: +70 years old and Missing data; Seating Position: 8; SS Type: 55 and 99; Gender: Missing data

→ *Results - Plane (1,2):* Age variable separates in descending order values in axis 2, while Vehicle Type and Vehicle Age are represented in axis 1. The centroid for ASN/ASB modality is close to ages 0 – 14 years old, together with the modality Not visible in the Gender variable, a rather common problem when trying to identify gender of the youngest ones under study conditions.

As in Salto, there is a clear difference in the position of 4-wheeled vehicles observed associated to the non-use of safety elements (seatbelt) on motorcycles, close to modality Helmet and unknown age, common value for 2-wheeled vehicles in Paysandú. This difference may not be as evident as in Salto, since coordinates of said modalities are closer to the graph center. Besides, CS3p is associated to drivers of 4-wheeled vehicles, aged 25 - 69 years old, and without being able to determine its correct use, while the non-use of this element appears associated to the passenger's seating position in the front seat. Regarding those younger than 14 years old, they are not close to any key modality, may be because these relations exist in greater proportions than those obtained.

→ *Results - Plane (1,3):* separation of one set of modalities from the rest results curious, being ASN/ASB the prominent one, surrounded by Younger than 1 year old, Correct use Not visible and Gender Not visible. Relation of the rest of modalities seems a little confusing, however, the situation is the same as in the first vector plane: association among 4-wheeled vehicles with Occupant 3, Without SS and Correct Use No and, separated from all these, modality Helmet, Motorcycle, Age data missing and Correct Use Yes.

Apparently, as in Salto, it is more probable to find people traveling without the appropriate elements in 4-wheeled vehicles (being the driver the exception) than in 2-wheeled vehicles. A closeness between the different modalities 5 – 14 years old, Without SS and Incorrect Use of SS, something that suggests lack of use of safety elements in this sub-population.



Paysandú - ACM 1

ACM general conclusions: the last 3 cases have apparently shown a clear dichotomy: for those traveling in 4-wheeled vehicles, adults travel safely and in front seats (in particular drivers), while those younger than 14 years old travel unrestrained in the back seats.

Those younger than 1 year old, traveling in CRS, represent the difference in Paysandú as well as in Montevideo, in both cities separated from the rest of the children. These results may be interpreted in different ways, from the legal standpoint (since 1989 seatbelts are compulsory for the front positions, and also for the back seats since the coming into effect of the new Traffic Act, although the population seems not to have got the message) to parents' unawareness (also extensive to all passengers) of the existence of passive safety elements for young children, especially for those older than 5 years old.

This argument also reinforces the previous one: ongoing legislation does not specify any special passive safety element for children for a specific height and weight, which evidences two

responsible parts for this lack of protection; adults and also competent authorities. It is our obligation then to work on these issues in order to raise population's awareness and by doing so to revert behavior observed.

Salto y Paysandú: in the extreme vertical position of the graph we have, on the one hand CS3p, aged 25 – 69 years old, Driver and on the other hand, those younger than 14 years old, that in the case of Paysandú children aged 1 - 4 years old seem to show a correspondence with the use of some CRS without making reference to the position in which they travel and in Salto they are clearly associated to back seat positions, the exception, however, seems to be represented by the age group of those younger than 1 year old, associated to position 2. An horizontal interpretation of the graphs shows a clear separation of passengers of 2-wheel vehicles wearing helmets from 4-wheel vehicles, especially front seat passengers next to the driver, doing so unrestrained.

Montevideo: in the horizontal axis there is a clear association between passengers older than 25 years old in the front seats, correctly using CS3p, and children up to 14 years old in the back seat positions, unrestrained. Further on the ordinate axis, although on the same side of the rest of children, correspondence between CRS categories, those younger than 1 year old and Gender not identified.

III. Matrix algebra

Definitions following only make sense when working in "vector space", with certain properties both mathematical and operational, such as product and sum. From here on it is assumed that we are working in a vector space with an inner product (see definition below).

1. Vector

Different characteristics of a person such as age, height, academic performance, intelligence, etc. that cannot be defined by only one numerical value. These different measures collected about an individual can be can be formalized in a row or column of real numbers $(a_1, a_2, \ldots, a_n)$, called vector, arbitrarily defining its size by n (columns or rows).

If data collected are grouped in m rows and only one column (m x 1), it is said that this data table is a column vector, if on the contrary, data are grouped in a table with only one row and n columns (1 x n), it is said that it is a row vector.

2. Inner Product

It is the product component to component between two vectors of the same dimension:

$$< a, b > = a_1 b_1 + a_2 b_2 + \cdots + a_n b_n$$

3. Norm

Operation that determines the length of a vector, which is defined by the square root of a vector's inner product and its own value.

$$||a|| = \sqrt{a_1 a_1 + a_2 a_2 + \cdots + a_n a_n} = \sqrt{a_1^2 + a_2^2 + \cdots + a_n^2}$$

4. Matrix

A matrix is a Collection of real numbers arranged into a fixed number of m rows and n columns. It can also be considered as a group of vectors of identical dimensions in only one table. Example: dimension identity matrix 3 (used as neutral operator in multiplication, among other things):

$$I_3 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

5. Matrix transposition

Transposition of a matrix (X^{tr}) changes columns for rows of an initial matrix X.

For example, if

$$X = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} \Rightarrow X^{tr} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}^{tr} = \begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 6 \end{bmatrix}$$

6. Orthogonal vectors set

A set of vectors is said to be orthogonal when the inner product between a vector and any other vector belonging to that set is zero.

7. Orthonormal vectors set

A set of vectors is orthonormal when it is an orthogonal set and at the same time the norm of each of its vectors equals 1.

IV. Basic statistics definitions

8. Sample median or average: of a finite quantity of numbers, equals the sum of them all divided by the number of addends.

$$\bar{x} = \frac{x_1 + x_2 + \cdots + x_n}{n} = \frac{\sum_{i=1}^{n} x_i}{n}$$

9. Sample variance: measure of dispersion of all the values of a sample; it is the mean squared deviation of a set of values from the mean and it is expressed in

$$s^2 = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

10. Sample Quasi variance: another measure of dispersion, more frequently used than the previous one for being unbiased, that is to say, in average, it equals the value of the population's covariance

$$s_{n-1}^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

In both cases, standard or typical deviation is the square root of the variance or quasi variance.

11. Covariance: measure of the dependence between two variables. This can be positive (high values of x corresponds to high values of y) negative (high values of x corresponds to low values of y) or null (there is no *lineal* relationship between x and y)

$$s_{xy} = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2 (y_i - \bar{y})^2$$

12. Correlation: quotient between covariance and standard deviations of variables x and y, that measures the noisiness and direction of a linear relation between two variables. It varies between -1 y +1, showing for each case a positive and negative linear correlation, respectively.

$$r_{xy} = \frac{s_{xy}}{s_x s_y}$$

13. Matrix of correlations: a table or numerical array made up of correlations between different variables. In the specific case of a correlation matrix between 3 variables $\{1,2,3\}$:

$$\boldsymbol{R} = \begin{bmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \end{bmatrix}$$

V. Factor Analysis

As previously mentioned, the aim of these descriptive and exploratory techniques is to analyze possible associations between: a) individuals, variables and categories of variable studied for ACM and b) modalities or categories of two variables for the case of ACS. Besides, these techniques provide a lot of information to the study of non-linear relationships among the different variables that cannot be captured using other analytical methods.

Principles used are unique for any analysis of this type: from rectangular tables of individuals by variables, two scatter diagrams are generated (row and column) and these are, in turn, projected on new spaces formed by the factors, in these spaces rows and columns are closely related. Inputs for the different factorial methods are: the space, points, masses assigned to weights and metric; products are: inertia axes, point coordinates on the axes, called factors and different indicators that will allow interpretation of results.

Metric: it could be defined as the weight of variables in the space considered. Unit metric is generally used; it is defined by the identity matrix (a matrix presenting ones in the main diagonal and zeros elsewhere).

Weights: since all individuals observed play the same role in the analysis, each of them is given the same weight. In this way, the weights matrix of the rows, will be formed by the inverse of the total of individuals in each element of the main diagonal and will be zero outside the main diagonal.

Taking into account the information above, when we say:

"Given a scatter diagram of I points, N_I, we will look for a set of orthonormal axes according to the metric of the space in a way that then projecting said diagram on these axis, N_I inertia is maximum." [10] (For the diagram of J points N_J this procedure is analog)

That is to say:

"Given a scatter diagram of I points, N_I, we will look for an orthogonal set of axes $U = \{\{u_s\}\}$ and with an inner product zero between each of its vectors, such that it maximizes

$$Inercia = u_s^{tr} M X^{tr} X M u_s$$

according to metric M (in our example, the metric will be the identity matrix), being

$$F_s = XMu_s$$

A vector of dimension I, formed by coordinates of the projections of the scattered diagrams N_I on u_s, being u_s, a direction vector of an axis R_J, solution to the problem of maximizing the projected inertia. For the cloud of columns N_J the reasoning is very similar.

For a more detailed analysis of this and other techniques of the multivariate analysis, see [10].