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Prevalence and evolution of helmet use in motorcycle riders in an Argentine city (Mar del Plata, 2006-2014)

Prevalencia y evolución del uso de casco en ocupantes de motocicletas en una ciudad argentina (Mar del Plata, 2006-2014)

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ABSTRACT Traffic collisions involving motorcyclists are a growing problem in low and middle income countries. Helmet use is the foremost protective measure for this group of road users, however many riders do not wear them. The objective of the present study is to report the changes in helmet use during the period 2006-2014 in an Argentine city and discover associated factors for the year 2014. The sample includes more than 6,900 observations of motorcyclists carried out during the years 2006 (n = 962), 2008 (n = 977), 2012 (n = 2,542), and 2014 (n = 2,466). The data indicates a progressive increase in helmet use over time, but differences due to gender and type of rider remain. Factors associated to helmet use in motorcycle drivers during 2014 were: passenger helmet use, motorcycle type, license plate use and gender. Although the results are positive, it is necessary to be attentive to the negative consequences of the growing fleet of motorcycles.
KEY WORDS Accidents, Traffic; Motorcycles; Accident Prevention; Argentina.

RESUMEN Los siniestros viales que involucran a motociclistas conforman un problema creciente en los países de ingresos bajos y medios. La medida de protección por excelencia en estos usuarios viales es el casco. Sin embargo, una proporción considerable de motociclistas no lo usa. El objetivo de este trabajo es informar la evolución del uso de casco durante el periodo 2006-2014 en una ciudad de Argentina, y conocer los factores asociados durante el año 2014. La muestra incluye más de 6.900 observaciones de motociclistas, registradas en los años 2006 (n = 962), 2008 (n = 977), 2012 (n = 2.542) y 2014 (n = 2.466). Los datos indican un aumento progresivo del uso de casco a través del tiempo, aunque se sostienen las diferencias por género y función. Los factores asociados al uso de casco en conductores durante el año 2014 fueron el uso en pasajeros, el tipo de moto, la presencia de patente y el género. Aunque los resultados son positivos, conviene alertar sobre las consecuencias negativas del aumento del parque de motos.
PALABRAS CLAVES Accidentes de Tránsito; Motocicletas; Prevención de Accidentes; Argentina.

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INTRODUCTION

According to the World Health Organization (WHO), unintentional injuries caused by traffic accidents are a public health concern that affects populations worldwide; although, its prevalence changes depending on the country and type of road users.[1] In its *Global Status Report on Road Safety,* the WHO shows that more than 80% of road traffic deaths occur in low and middle-income countries. Among the most affected road users, a progressive increase in traffic accidents involving motorcyclists can be observed.[1] A key factor that impacts this situation is the clear increase in the motorcycle fleet.[1],[2]

Argentina is not immune to this situation. Motorcycles have become the second most common urban means of transport, just behind cars. Motorcycle use has had a 72.6% increase between 2008 and 2011.[2] According to the National Road Safety Agency [*Agencia Nacional de Seguridad Vial*], during such time, motorcycle crashes rose to 54%. An important fact is that among the motorcyclists who died from road traffic injuries, only 25% of them were wearing helmets when the crash occurred.[2]

A factor that increases road traffic mortality among motorcyclists is that the most common injuries affect the head.[3],[4] Within this group, these types of injuries are the leading cause of death.[5] On one hand, some research studies show that almost 80% of motorcyclists that died after a road crash had suffered from head injuries[6]; on the other hand, among motorcyclists who overcame these types of injuries, it is important to highlight that facial trauma has been reported, leading to secondary pain (such as emotional problems due to aesthetic concerns or a higher chance of suffering from post-traumatic stress).[7]

This information highlights why wearing a motorcycle helmet is the best self-protective measure among motorcyclists.[8] Studies have shown that when this safety instrument is appropriately used, the risk of serious injuries decreases to more than 70% and the risk of death to 40%.[1] Some research studies show that motorcycle helmet use is also related to a reduction in hospitalization time and medical expenses.[9] In addition, not wearing a helmet is related to more frequent and serious injuries, possible long-term consequences, longer hospitalization time, increase in mortality and significantly higher medical expenses; however, wearing a motorcycle helmet is still irregular in many countries including Argentina.[6],[11]

Low helmet use rates have led to exploring the possible individual and contextual factors related to use patterns; personal factors, sociodemographic and psychological features have been studied. For example, previous research studies show that motorcycle helmet use is less frequent in young and male drivers who do not carry their license or motorcycle plate and who have already been involved in road crashes.[6],[12],[13],[14] On the other hand, attitudes and beliefs regarding motorcycle helmet use play an important role as well.[12] Beliefs regarding helmet use as a measure to prevent injuries encourage its use, while the fact that it is considered uncomfortable sets it back.[15],[16] In a previous study,[17] it was shown that unfavorable implicit and explicit attitudes are related to a less frequent use. More specifically, the "emotional" component of the explicit attitude (feeling of discomfort, reluctance, and so on) plays a very important role in predicting helmet use, being more important than the rational-cognitive component (regarding helmet use as a safety measure).

Variables such as family and peer pressure have been considered within the previous literature.[6],[18],[19] Peer influence and the mutual subjective norms may affect helmet use both positively and negatively. For example, when the family environment or peers consider road safety an important issue, motorcyclists have a tendency to wear helmets.[6] On the contrary, when young riders associate helmet use with a weak, vulnerable or insecure personality, they are reluctant to wear it to avoid criticism from friends.[19],[20]

With regard to contextual or environmental factors, helmet use has been associated with different variables, such as city areas, time of the day or week, seasons and weather conditions.[6],[20],[21],[22] In previous studies performed in Argentina, a higher helmet use rate has been observed during weekdays, in the afternoon, in central areas and with appalling weather conditions[13],[14],[21]; however, these factors seem to be shaped by geographical and cultural contexts as findings in prior studies are not precisely consistent. For example, in a study that was conducted in China, no important differences

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were observed regarding days of the week, time of the day or weather conditions.[9] In this study, the only contextual factor associated with helmet use was road type, as a higher helmet use rate was observed in city streets compared to highways or rural roads. The results of helmet use in different seasons of the year are inconsistent as well. For example, while in some studies a decrease during the summer season has been observed,[20] other studies show the opposite pattern.[6]

Among the main factors associated with helmet use, it is important to highlight the presence of the State through enforcement strategies. The presence or absence of police controls may help understand the differences in helmet use between the city center and the outskirts, as well as the urban or country zones.[9],[13] For example, a recent study has shown that in inner-city areas where police controls have been implemented, the prevalence of helmet use is much higher than in the outskirts where control does not exist.[23] Similarly, the helmet use rates have been compared in four metropolitan areas in Mexico and results have shown that a higher helmet use rate was related to police controls and fines.[11] A different study showed that increasing the number of traffic wardens in the cities has led to lower mortality rates.[24] To sum up, enforcement seems to play an important role in understanding the changes in helmet use rates.

Considering the importance of self-protective devices, Argentina has increased the enforcement strategies, awareness campaigns and educational efforts in different areas of the country.[2] Some observational studies have shown the results of these actions, highlighting a continuous increase in the helmet use rate.[2],[21] However, these studies do not systematically analyze the changes over time and do not compare the results due to methodological differences in the way data was gathered. The importance of a study that shows the evolution of helmet use is related to the possibility of precisely knowing how the helmet use rates differ from year to year and to determine changes in the factors associated with these patterns. At the same time, it would be easier to know the effects that the different interventions regarding road safety have had and establish or, where necessary, increase, change or plan new strategies.

The goal of this study is to show the evolution of helmet use wearing among motorcycle riders between 2006 and 2014 in an Argentine city (Mar del Plata). At the same time, the study explores possible factors associated with helmet use. The advantage of this study is that data has been gathered by following the same method over time. The data collected in 2014 has never been published and is presented here for the first time. The data from early years has been published in partial works[13],[14],[21] and will be used here for comparative purposes.

METHOD

Sample

The population that was studied includes drivers and passengers in the city of Mar del Plata (Argentina). The current sample (made in 2014) is composed of 2,466 drivers and 501 passengers who were observed in 17 different spots in the city (for more details see "proceedings"). For comparative purposes, data from previous studies were used: 2006 (n = 962), 2008 (n = 977) and 2012 (n = 2,542). It is important to highlight that no studies were performed in 2010, thus, no data from such year are included.

Instruments

The methods that were used over these years were not significantly modified. Observations were registered by following a standardized coding worksheet that includes data about moments of the day (time, date, and so on) and observation spots, weather and environmental conditions (time, light, temperature, humidity, visibility, wind, weather), features of the vehicle (type of motorcycle, presence of license plate) and type of user (gender and position). Helmet use was registered for both drivers and passengers.

Procedure

In 2014 the procedure was the same as in previous studies. Observations were performed in the same 17 city spots that were used in previous studies, especially in the observations performed in 2012.

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These spots were located mainly in the urban area, including the city center and its surroundings (n = 12), although some places in the outskirts were considered as well (n = 5). In each of these spots, observations were made in four different conditions: during day and night (with artificial light) and on weekdays or at the weekend (either Saturday or Sunday). In each of these conditions, the minimum number of observations was completed (n = 35) and they took approximately an hour each. All of these cases were observed in intersecting roads. Observations were made from July to November in two seasons of the year: winter (56%) and spring (44%).

Observations were coded in accordance with the previously mentioned worksheet and were analyzed using the SPSS software. For the purposes of this study, the helmet use rates for the year 2014 were analyzed. To figure out the factors that are associated with helmet use in drivers and passengers over such year, two logistic regression analyses were performed using the "use/non use" variable as the dependent variable. The predictor variables were the following: gender, helmet use in passengers and drivers (depending on the sample that was analyzed), weather conditions, type of vehicle, moment of the day, day of the week, presence of license plate, season of the year and relationship between moment of the day and day of the week. Later, the helmet use percentage was studied over some years, excluding data regarding gender and position (driver or passenger of the vehicle). As in the year 2010 when no observations were made, the percentage was calculated by averaging previous and later periods of time.

RESULTS

Prevalence of helmet use and other related factors in 2014

Results show that 81.3% of drivers wear a helmet, while in passengers, this number decreases to 57.7%. Table 1 shows the prevalence of helmet use in different conditions.

As shown in Table 2 and Table 3, the logistic regression analysis shows that gender is significantly associated with helmet use in both, drivers and passengers: its use decreases when the occupant is male. Helmet use by one of the occupants was also associated with the use by the other occupant; in other words, when one of the occupants does not wear a helmet, tendency shows that the other does not wear it either.

In relation to the variables of the vehicle, both the type of motorcycle and the presence of a license plate were associated with helmet use, although only in the drivers' sample. This use decreases when Cross, Enduro or Trail motorcycle models are involved, in comparison with the most usual motorcycle model ("Biz" type). On the other hand, motorcyclists without license plates tend to avoid using helmets, in comparison with those who drive motorcycles with license plates.

Finally, within contextual variables, the season of the year was associated with differences in helmet use (only in the passengers' sample), with an increase during winter. Both drivers and passengers did not show relations between helmet use and weather conditions, time of the day, or time of the week. No relations between helmet use and interaction between time of the day and time of the week were found either.

Evolution of helmet use

Results show a progressive growth in helmet use percentages. Figure 1 shows the results broken down by gender and position (drivers and passengers). As the period from 2008-2012 was longer than the rest, estimations for 2010 are included to facilitate biannual comparison. These estimations were made by averaging the percentages of the previous and later periods. Overall, an increase in helmet use in all the subgroups can be seen, although this use is always less frequent between passengers, in comparison with other drivers, and in males in comparison with females. The group that is most reluctant to wear helmets is the male passengers group.

DISCUSSION

Information on risk patterns by road users is the key to assess road safety policies. Moreover, if data helps discover behavior patterns in time, the value in terms of prevention and monitoring is greater.

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Table 1. Percentage of helmet use in motorcycle drivers and passengers, based on selected variables. City of Mar del Plata, Argentina, 2014.

Variables	Drivers		Passengers	
	Frequency (n=2,466)	Helmet use (%)	Frequency (n=501)	Helmet use (%)
Gender				
Males	2,235	78.7	180	42.8
Females	224	92.9	318	66.4
Unidentified	7	100.0	3	33.3
Weather conditions				
Sunny	1,129	80.2	239	64.0
Cloudy	984	80.1	193	55.4
Rainy	353	79.6	69	42.0
Type of vehicle				
Biz-like	1,057	81.5	202	55.4
Moped/Scooter	132	89.4	22	63.6
Street standard	668	79.2	155	60.6
Custom/Touring/Sport	175	85.1	33	72.7
Off-road (Cross, Enduro, Trail, etc.)	397	72.0	84	48.8
Other	22	81.8	2	50.0
Unidentified	15	93.3	3	100.0
Time of the day				
Day	1,259	81.7	237	56.1
Night	1,207	78.4	264	59.1
Time of the week				
Weekdays	1,254	79.7	246	53.7
Weekends	1,212	80.5	255	61.6
License plate				
Yes	2,234	81.5	437	59.0
No	172	64.0	43	37.2
Unidentified	60	75.0	21	71.4
Season of the year				
Winter	1,380	81.3	251	51.0
Spring	1,086	78.5	250	64.4

Source: Own elaboration.

One of the strengths of this research study is that it helped describe the evolution of a preventive behavior (helmet use in motorcyclists) during a long period of time (8 years).

Factors associated with helmet use

Results showed that women wear helmets more than men, both as drivers and passengers, which coincides with the evidence in previous studies carried out in our city[13],[14] and in other spots,[6],[9],[22] and in line with the general idea that men tend to show more risky behaviors. On the other hand, the role of motorcycle occupants is also related to helmet use: lower helmet use rate is observed in passengers in comparison with drivers. This result is similar to other studies,[11],[21] and is mainly related to the lack of a second helmet in passengers that, in many cases, are casual.

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Table 2. Factors associated with helmet use in motorcycle drivers. Multiple logistic regression analysis. City of Mar del Plata, Argentina, 2014.

Variables	OR	CI95%
Gender		
Female[1]	-	-
Male	0.309	0.172; 0.555
Helmet use in passengers		
No passengers[1]	-	-
Passengers not wearing helmets	0.117	0.075; 0.182
Passengers wearing helmets	1.193	0.836; 1.703
Weather conditions		
Sunny[1]	-	-
Cloudy	0.954	0.680; 1.340
Rainy	0.815	0.524; 1.268
Type of vehicle		
Biz-like[1]	-	-
Moped/Scooter	1.914	0.990; 3.701
Street standard	0.923	0.698; 1.220
Custom/Touring/Sport	1.538	0.902; 2.622
Off-road (Cross, Enduro, Trail, etc.)	0.631	0.465; 0.856
Time of the day		
During day light[1]	-	-
In the dark	0.779	0.561; 1.081
Time of the week		
Weekends[1]	-	-
Weekdays	1.337	0.884; 2.021
License plate		
Yes[1]	-	-
No	0.404	0.278; 0.587
Season of the year		
Spring[1]	-	-
Winter	1.794	1.243; 2.589

Source: Own elaboration.
[1]Reference value.
OR=odds ratio; CI95%=confidence interval of 95%.

Regarding vehicle variables, there are still differences in terms of the type of motorcycle, which is probably associated with different motorcyclist profiles.[13),(14),(21] Furthermore, there is still an association between helmet use and the presence of a motorcycle license plate.[13),(14),(21] This result is also consistent with studies from other countries.[9] We believe that this relationship could be partly explained by a common factor: drivers' predisposition to comply with traffic rules.[13),(14]

In terms of contextual variables, they are now less important than in previous studies.[13),(14),(21] The only differences were found in the time of the year (more helmet use in winter), in accordance with studies from other sources.[6] Overall, these results suggest that helmet use has come to be more consistent or less dependent on factors such as time of the day, time of the week, or weather conditions.

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Table 3.Factors associated with helmet use in motorcycle passengers. Multiple logistic regression analysis. City of Mar del Plata, Argentina, 2014.

Variables	OR	CI95%
Gender		
Female[1]	-	-
Male	0.391	0.249; 0.614
Helmet use in passengers		
Wearing helmets[1]	-	-
Not wearing helmets	0.123	0.077; 0.195
Weather conditions		
Sunny[1]	-	-
Cloudy	0.864	0.442; 1.693
Rainy	0.392	0.164; 0.939
Type of vehicle		
Biz-like[1]	-	-
Moped/Scooter	1.193	0.414; 3.436
Street standard	1.163	0.691; 1.957
Custom/Touring/Sport	1.930	0.719; 5.181
Off-road (Cross, Enduro, Trail, etc.)	0.841	0.449; 1.574
Time of the day		
During day light[1]	-	-
In the dark	1.216	0.650; 2.273
Time of the week		
Weekends[1]	-	-
Weekdays	0.941	0.437; 2.029
License plate		
Yes[1]	-	-
No	0.913	0.412; 2.021
Season of the year		
Spring[1]	-	-
Winter	0.832	0.407; 1.699

Source: Own elaboration.
[1]Reference value.
OR=odds ratio; CI95%=confidence interval of 95%.

Evolution of helmet use

A helmet is a basic element for the protection of motorcyclists, so any road safety strategy in this group contemplates initiatives that tend to control and promote its use. In Argentina, these initiatives have been extended and intensified in recent times, both at national and local levels. In the context of the Strategic Road Safety Plan [*Plan Estratégico de Seguridad Vial*] promoted by the National Road Safety Agency,[2] different activities were proposed to stress the importance of helmets as a key element of motorcyclists' life protection. One of the highlights is the development of an online classroom that offers a free course with relevant information for them. At the same time, police controls and imposition of fines due to non-use of helmets have been further implemented in the city of Mar del Plata.[26] In addition to these control actions, some campaigns to make motorcyclists aware of self-protective measures have been launched. An important action associated with control strategies has been the free distribution of

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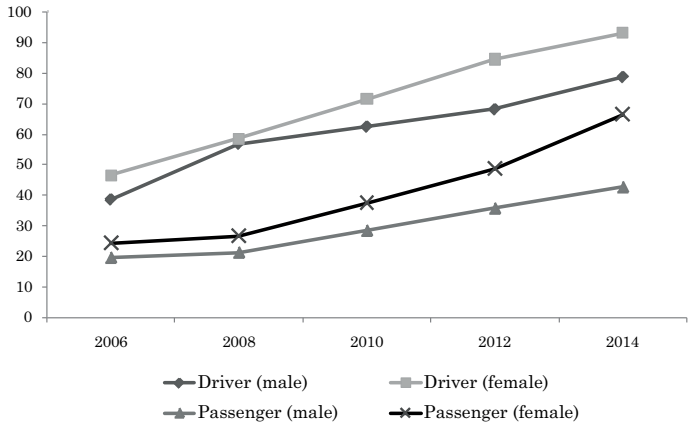

Figure 1. Evolution of helmet use percentage in drivers and passengers by gender. City of Mar del Plata, Argentina, 2014.

Source: Own elaboration.

helmets for those who drive without them and do not own any.[27] Another initiative in the same vein has been the compulsory delivery of an authorized helmet when a motorcycle is sold, plus, checking for a driver's license and motorcycle insurance.[28]

The results of this study show that, when education and enforcement are maintained in time, helmet use rate within a community can be progressively increased. However, there is still the challenge of developing communication, awareness and education strategies that reach the portion of users who are more reluctant to wear helmets, e.g., motorcycle passengers. On the other hand, although data shows a favorable evolution in time, results should be placed within a context and considered a less promising indicator such as the increase in the motorcycle fleet. As evidenced by the National Road Safety Agency,[2] while in 2008 the motorcycle fleet was 2,500,000, in 2011, approximately 4,200,000 motorcycles were registered. Curiously, in the period from 2008-2011, the increase in the motorcycle fleet was 5 times greater in comparison with the cars fleet.

In this context, it seems essential to begin to implement policies that contemplate more structural changes in urban mobility, and help discourage the purchase and use of motorcycles. We understand that more effort oriented towards the promotion and development of public transport is required to constitute a real alternative to individual and motorized transport modes. Furthermore, it would be equally important to encourage active means of transport (for example, the use of bicycles), as healthier, more economic and environmentally sustainable alternatives. In our view, the future challenge will be the integration of road safety policies to more ambitious plans in terms of urban transportation.

Limitations of the study

Finally, it is important to point out some limitations of this study. First, it is worth mentioning that no observations during summer were carried out, which could affect the estimation of prevalence of helmet use. Previous studies show a decrease in helmet use during this time of the year,[20] although evidence is not conclusive.[6] Especially, the city of Mar del Plata is a touristic spot that during summer welcomes a considerable amount of visitors. This situation significantly changes the traffic characteristics, which can be evidenced in the increase in the motorcycle fleets and crashes involving this type of vehicle. In this sense, due to the idiosyncrasy of this city, summer observations could be expected to show more differences between the seasons of the year.

Secondly, there could be some problems in the samples used. As mentioned above,

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observation sites mainly covered the city center and its surrounding area, with much fewer observation spots in peripheral neighborhoods. Suburban and rural areas were also excluded. This could create an overestimate of the prevalence of helmet use, as previous studies showed a decrease in both peripheral and rural areas.[9],[13] Finally, another bias could be associated with the times of the day in which the observations were carried out. The lack of differences between day and night, as in other studies,[22] could be due to our observations not covering the whole night but only the period between 8:00 pm and 10:00 pm, approximately. It is possible that a decrease in helmet use could be evidenced during late night hours, which has not been detected.

Finally, it is necessary to point out that although the results of this study are useful to know the factors associated with helmet use, the progression of use in an extended period of time and the identification of groups that require more attention do not provide knowledge about the individuals' motivations to implement this self-protective measure. While there are previous studies that highlight the role of attitudes, especially the emotional component and the implicit evaluations,[16],[17] it is still necessary to study the psychological and behavioral aspects that influence helmet use.

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